

Abstracts and Highlight Papers of the 31st Annual European Society of Regional Anaesthesia (ESRA) Congress 2012

Invited Speaker Highlight Papers

1 REFRESHER COURSE: MANAGING LOCAL ANESTHETIC SYSTEMIC TOXICITY. CHECKLIST AND OTHER IMPORTANT PRACTICAL ISSUES

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Introduction: Several elements contribute to preparedness in managing severe local anesthetic systemic toxicity (LAST). In addition to having awareness of the **risk**, there should be a **system** in place to address an event should it occur. Such a system should include familiarity with methods of **prevention** and **diagnosis**, availability of the necessary equipment and instructions and practice or simulated experience in **treatment** and resuscitation specific for LAST. The following approach reflects the importance of these components.

Recognizing risk: Reports of successful resuscitation from severe local anesthetic systemic toxicity (LAST) over the past several years and the advent of ultrasound guidance have reduced the overall anxiety among our profession about this potentially fatal complication of regional anesthesia. This change in attitude is reasonable in some respects since such saves validate experimental evidence that lipid emulsion infusion is an effective antidote for LAST and reports that ultrasound can facilitate detection of intravascular injection suggest this risk is reduced as well. However, nonchalance is not acceptable. There are many factors affecting both the incidence and outcomes of LAST that remain elusive or poorly understood. We can predict that until non-toxic alternatives to standard local anesthetics are available LAST will continue to occur even in the context of optimal clinical practice when standards of care are strictly followed and outside direct intravascular injection. For instance, clinicians cannot predict or prevent absorption of local anesthetic from the tissue depot created at the site of injection. This is presumably accelerated when the advancing needle passes through vascular structures while transiting various tissue planes, thereby creating rents in high and low pressure vessels. Delayed absorption is a common feature among cases of LAST a delay of > 5 minutes delay between injection and symptoms of LAST is often reported in published cases of LAST. Moreover, there are subpopulations of patients more susceptible to LAST than the general population. Two groups of patients, at least, have a lower-than-normal threshold for exhibiting LAST. The larger group includes patients with underlying cardiac disease, particularly ischemia, but reduced cardiac output and delayed conduction also confer greater susceptibility to LAST than normal. The precise incidence of frank LAST is not known but falls in between extremes; that is, it is neither so common that we expect to see it every day, nor so rare that it becomes clinically irrelevant. Occupying this 'middle ground' carries an implicit increased susceptibility since clinicians are easily lulled into forgetting about an event that, while rare, is not vanishingly so. The point is that patient safety demands we remain prepared to diagnose and treat such events, even if we expect never to see one in our career.

Establishing a System: No methods of **preventing** LAST are 100% effective; however, the likelihood of an adverse event is likely to be reduced by adhering to standards of care during regional anesthesia that include: use of standard monitoring, careful selection of drug and dose, frequent aspiration and small, incremental doses with reasonable intervals between them. **Diagnosis** requires awareness that a substantial proportion of events present with atypical symptoms and signs of LAST. The most commonly reported evidence of CNS toxicity is seizure, but any form of altered mental status can occur, including the entire spectrum from coma and obtundation to agitation. Although cardiovascular collapse is generally considered to occur late in the sequence of LAST, a surprising percentage of reports indicate LAST can occur with no CNS symptoms and only evidence of cardiovascular toxicity. The latter typically include bradycardia, progressive hypotension, conduction block, arrhythmias and even cardiovascular collapse. Finally, it is important to recognize that a significant percent of patients present with LAST only a considerable delay following injection of drug. This implies that LAST should be in the differential diagnosis of any patient exhibiting altered mental

status or cardiovascular instability in the setting of regional anesthesia even if the symptoms occur much later. Because there is an effective antidote, just placing LAST in the differential could save a life. Once diagnosed, **treatment** of LAST requires rapid intervention so it is important to have ready access to the necessary components of resuscitation. At a minimum, these include a bag valve mask resuscitator, oxygen source, intravenous access, suction, a crash cart and large syringes with needles for delivering lipid emulsion. It is also important to have instructions for appropriate steps in resuscitation from LAST, since this differs from the usual advanced cardiac life support. Specifically, it is recommended that after attention to airway, oxygenation and ventilation that infusing 20% lipid emulsion be considered. The standard recommendations include a bolus injection (~1.5mL/kg ideal body weight) plus infusion (~0.25mL/kg/min) to be continued up to 10 minutes after restoration of normal vital signs. The bolus can be repeated and the infusion increased if the patient fails to respond or the blood pressure sags. However, lipid dosing should be limited to ~10-12mL/kg over the first 30 minutes. Other specific differences with standard resuscitation include avoiding local anesthetic, beta blockers, calcium channel blockers, and vasopressin and limiting epinephrine to small doses (~1mcg/kg). Importantly, Neal et al showed recently that use of a checklist improved considerably the performance of residents in **simulated** instances of LAST. The newest iteration of ASRA recommendations for managing LAST include the checklist format and can be downloaded for free from the ASRA website (<http://www.asra.com/checklist-for-local-anesthetic-toxicity-treatment-1-18-12.pdf>). The study of Neal et al also brings attention to the benefits of using simulation to educate anesthesiologists in proper management of LAST. Smith et al reported a successful resuscitation from severe LAST shortly after the treating physicians had completed a course that included a simulated LAST scenario. Whether in formal simulation settings or just a drill of 'what-to-do' in case of an event, either form of practice will improve physician response and possibly patient outcome in such events.

Future: Laboratory studies of LAST currently focus on improving methods of resuscitation and understanding the mechanisms of benefit derived from lipid infusion. However, helping educate our non-anesthesia colleagues is one very important method of improving LAST-related treatment where every physician (especially clinicians) can contribute. Many specialties other than anesthesiology use local anesthetics. Unfortunately use implies risk and most non-anesthesiology specialists are woefully lacking in knowledge of these risks, and their proper management. I recommend we take advantage of our position as experts on the use of local anesthetics to inform and educate our colleagues whenever possible about the current state-of-the-art in understanding LAST. We can improve patient safety through this indirect but very important action.

2 'THE BLOCK DOESN'T WORK' - ANALYSIS, REASONS, AVOIDANCE AND STRATEGIES

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"It is not a failure to fail, it is a failure to not have a plan in case you fail"

No clinician or technique can sustain a 100% success rate due to the many variables that exist between the patient, clinician and the environment. Success in regional anaesthesia is itself a variable, do you measure operative anaesthesia, operative analgesia or just post-operative analgesia? In clinical terms most anaesthetists would accept success of a regional technique as: 'that which avoids the need for a general anaesthesia'. Whatever your end point is, regional anaesthesia has an inherent failure rate, what's important is whether your failure rate is acceptable and what strategies you should employ to minimise failure and how to deal with it.

Regional anaesthesia is a practical skill that has to be learnt and as such has a definite learning curve; the main determining factors of this learning

curve are then clinician himself, the teaching available and the number of cases that they are exposed to. A common failure is the exposure to multiply technique, which confuses the trainee and then they fail to become competent in any one technique.

To learn a procedure adequate exposure to sufficient numbers is important and the learning curve for techniques can to an extent be expressed as minimum numbers need reach a certain level / consistency. Early work done by Kopacz et al showed that 90% success rate for spinal / epidural was not reach till 45/60 procedures were performed although significant improvement over baseline was shown at 20/25(1). This can also be shown in other techniques and the numbers needed vary considerable with each technique. Schuepfer et al showed that in children, a 91% success rate for penile blocks can be achieved after 10 procedures, this will increase to 96% after 20, but will not significantly change then with increasing numbers (2). However, for lumbar plexus blocks (children) the institutional learning curve to achieve only a 70% success was 55 procedures (3). These learning curves will vary between individuals and institutions and a better way of tracking individual learning curves is the use of cumulative summation analysis (CUSUM) (4). Even with all these methods, we need to know what is an acceptable failure rate and is this different for trainees or specialists. Grau et al surveyed German speaking anaesthetists showing success rates for residents performing supraclavicular blocks -SPB (69.7 +/- 11%) & spinal anaesthesia -SAB (85.5 +/- 9%) compared to specialist s SPB (79.2 +/-11.3%) & SAB (91.0 +/-6.8%) (5). Failure is inevitable even in the best-trained hands and may be as high as 20% for certain techniques.

Although the promise of improved success rates with the use of ultrasound has not specifically materialised in peripheral nerve blocks (6,7) a benefits has been shown when using ultrasound as a pre-procedural scan prior to lumbar epidural in obstetrics. Grau et al demonstrated an improvement in the learning curve with ultrasound (US) compared to control (normal landmark technique- CG), US 84% success after first ten attempt vs. 60% CG, improving to 94% vs. 84% after 50 procedures (7).

Regional anaesthesia is just applied anatomy and as such a comprehensive knowledge of the anatomy is essential. Anatomical variation is common and the path and area of innervation of peripheral nerves may be variable. It is important to know the innervation of the structures being operated on and the proposed surgical approach & incision.

Patient factors may well affect success, choice of the patient and the choice of the technique are most important, as anxious patients patients do not make ideal regional candidates. Co-morbidities such as obesity, arthritides and diabetes will affect positioning, access, nerve location and identification.

The techniques and the method of nerve location and identification (loss of resistance - LOR, peripheral nerve stimulation -PNS, ultrasound -UGRA) will also effect success. Most LOR techniques have an inherent failure rate, thoracic paravertebral blocks 10%, rectus sheath blocks & ilioinguinal 45-60% (9,10); this can be improved in some cases by the use of ultrasound. When using PNS, knowledge of the motor response of the innervating nerve is crucial to maintain acceptable success rates, acceptance of non-ideal motor responses will increase failure rates (11,12).

The environment in which regional anaesthesia is performed may influence the success as when hurried or pressurised your performance will suffer and failure rates will increase.

When presented with a failed or inadequate block:

- Allow adequate time for the block to work, not all nerves block at the same rate - the sciatic nerve taking up to 30mins to show effect. Consider anaesthetic / analgesic effect of the tourniquet for brachial plexus blocks.
- Repeating the block (UGRA)/use top-up blocks to selectively anaesthetise the area or nerve/nerves missed with the initial technique.
- Infiltration by anaesthetist or surgeon
- Analgesia with opioids or adjuvants e.g. ketamine
- Sedation is only effective for anxiety and minor positional or tourniquet discomfort. Never use sedation to overcome pain of an inadequate block.
- General anaesthesia - to convert to a GA is not a failure, as almost always the effect of your regional technique will have a reduction in post-operative pain and morphine consumption. To struggle with an inadequate regional technique will cause anxiety / trauma to the patient.

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3

EPIDURAL TECHNIQUE FOR POSTOPERATIVE PAIN- GOLD STANDARD NO MORE?

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Epidural analgesia is a well-recognised technique for treating postoperative pain since decades and has been generally considered the "gold standard" for pain management after major surgery. Studies have shown that the technique has several additional benefits such as reduced cardiovascular, pulmonary and gastrointestinal morbidity (1,2,3) and also reduced mortality (4). However, more rigorous evaluation of previous data and newer meta-analyses show less optimistic results.

Epidural analgesia and postoperative morbidity

Cardiovascular morbidity: By decreasing sympathetic outflow, thoracic epidural analgesia can improve coronary blood flow. Current evidence suggests that thoracic epidural analgesia may reduce the risks of cardiovascular complications such as myocardial infarction in high-risk patients undergoing major vascular surgery. However, there is little evidence that epidural analgesia reduces cardiovascular morbidity in the relatively healthy "low-risk" surgical population (5). The authors of a recent meta-analysis of more than 2700 cardiac surgery patients concluded that the potential benefits of TEA in cardiac surgery may not be worth the potential risks such as neuraxial haematoma.(6).

Pulmonary morbidity: There is good evidence that epidural analgesia is associated with reduced risk of postoperative pulmonary complications particularly in high-risk patients undergoing open abdominal aortic surgery or

coronary artery bypass(7). However, as with cardiovascular and gastrointestinal advantages, these benefits are seen only when the epidural catheter is sited at the thoracic level and only when local anaesthetics (not opioids) are used. In clinical practice the epidural solution is typically a combination of low-dose local anaesthetic with an opioid such as fentanyl. In general, the protective effect of epidural analgesia against pneumonia after abdominal or thoracic surgery has lessened over the last 35 years because of decrease in baseline risk (8). The debate about the pulmonary benefits of epidural analgesia is becoming increasingly irrelevant as surgical techniques become less invasive.

Gastrointestinal morbidity: Current evidence supports the use of epidural local anaesthetics (but not opioids) to reduce the risk of postoperative ileus (POI). A metaanalysis showed that epidural analgesia with local anaesthetics reduced time to return of gastrointestinal function by 24–36h compared to systemic or epidural opioids (3). However, another metaanalysis of epidural analgesia after colorectal surgery showed that improved analgesia and decrease in POI did not lead to shorter duration of hospital stay (9). There are 3 meta-analyses showing that a continuous infusion of i.v. lidocaine during and after abdominal surgery was associated with several benefits such as reduced duration of ileus, decreased pain scores, decreased risk of PONV and shorter hospital stay (10,11,12). A much simpler and safer evidence-based method to prevent or ameliorate POI is gum chewing (13). Currently, there are no comparative studies to show that epidural is superior to either i.v. lidocaine infusion or to gum chewing in reducing the risk of POI. In a recent editorial the authors stated “There is a significant lack of evidence supporting the use of epidural analgesia and we question the routine use of this mode of analgesia in the postoperative period for patients having abdominal surgery” (14).

Coagulation morbidity: The influence of postoperative epidural analgesia on coagulation-related outcomes is not clear. Recent procedure-specific metaanalyses for open aortic surgery, abdominal surgery, THA and TKA failed to show any benefits of epidural analgesia for reduction of coagulation-related morbidity (15,16). A recent literature review concluded “in unselected patients undergoing gastrointestinal surgery, epidural analgesia does not seem to reduce anastomotic leakage, intraoperative blood loss, transfusion requirement, risk of thromboembolism, cardiac morbidity, or hospital stay compared to conventional analgesia” (17).

Length of hospital stay and the role of epidural technique in enhanced recovery (ER) protocols: It has been claimed that postoperative accelerated “multimodal” recovery programmes, in which epidural analgesia is a key component, decrease perioperative morbidity and reduce length of hospital stay without compromising patient safety (18,19,20). Such protocols have been proposed for a variety of surgical procedures, the programme for colorectal surgery is one of the most studied and evaluated in the last decade (21). The use of thoracic epidural analgesia using a mixture of low-dose local anaesthetics and opioids for 48h has been recommended as one of the key elements of ER pathways (21,22). ER strategies which include early ambulation, early feeding, reduced use of opioid analgesia and TEA have been shown by some investigators to lead to considerable reduction in duration of hospital stay (27,29,31) but the results have not been widely reproduced (23).

There are a large number of ER protocols for colorectal surgery. The number of “evidence-based” components for such protocols can range from 4(24) to 20 (25,26), all claim enhanced recovery and shorter stay when compared with “traditional care”. A Cochrane review concluded “the quality of the trials and lack of sufficient other outcome parameters do not justify implementation of fast-track surgery as standard of care” (27). The debate about the role of epidural is becoming irrelevant due to change in the surgical technique. The PROSPECT group does not recommend epidural technique for laparoscopic colonic surgery (28).

There is a need for good quality comparative studies to establish the critical components and independent predictors of faster postoperative recovery in a FT programme.

In conclusion, in spite of confusion about the optimal number of components, the implementation of ER protocols has shown impressive reduction in hospital stays without increasing morbidity. This appears most likely due to protocolized perioperative care rather than the combination and number of applied ER components. Currently, there is no convincing evidence that epidural technique as a component of such protocols provides any further benefits, this applies to open as well as laparoscopic colorectal surgery.

Alternatives to epidural analgesia: It is emphasised that the benefits of epidural analgesia on cardiovascular, pulmonary and gastrointestinal morbidity have been reported in patients undergoing open and more invasive

surgery. The recommendations for laparoscopic procedures such as cholecystectomy and colonic surgery no longer include epidural technique (28,29). Furthermore, the above mentioned benefits of epidural analgesia were noted when compared to systemic opioids.

There is increasing evidence from several metaanalyses and systematic reviews that good alternatives to epidural are now available for thoracic, abdominal and major orthopaedic surgery. These analgesic alternatives include paravertebral block (PVB) for thoracotomy (30,31) peripheral nerve blocks for hip (32) and knee (33,34) replacement, iv lidocaine for colorectal surgery (10,11,12), wound catheter infusions (WCI) for a large variety of surgical procedures including abdominal, cardiothoracic, vascular and major abdominal (35), Local Infiltration Analgesia (LIA) technique for hip and knee joint replacement surgery (36,37,38) and transversus abdominis plane (TAP) block for surgery involving abdominal wall (39).

Are there no indications left for epidural technique? There is robust data that pain relief with epidural technique is excellent. In patients undergoing major vascular open surgery and in high-risk patients undergoing major surgery, epidural with local anesthetic reduces postoperative cardiovascular and pulmonary complications. Current evidence suggests that regional anesthesia techniques are superior to opioid analgesia. In centers where it is a well-established routine, epidural would remain a good choice in the transitional period while alternative evidence-based regional methods (perineural, paravertebral, LIA, WCI, TAP blocks) are introduced into clinical practice.

In future, there might be new indications for the use of epidural technique. There is some weak evidence that the use of epidural technique may reduce the risk of cancer recurrence (40) and surgical site infections (41).

In conclusion, recent evidence suggests that the benefits of epidural technique are not as impressive as believed in the past. Although the efficacy of pain relief is outstanding and there might be some benefits in reduced cardiovascular and pulmonary morbidity in high-risk patients undergoing open major vascular or cardiac surgery, in general, the indications for use of epidural technique are decreasing. The reasons for the decline of this invasive, high-cost, labour intensive technique are many: a) no evidence of decreased postoperative mortality b) no convincing evidence of reduced risk of morbidity in the low- to- medium-risk surgical population, c) advances in surgical techniques such that many previous in-patient procedures are now day case or overnight stay surgical procedures, d) use of fast-track, epidural-free, early mobilisation postoperative rehabilitation routines, e) widespread implementation of prophylactic anticoagulant routines, f) increasing evidence that many less- invasive regional techniques are as good or better than epidural after several major surgical procedures, g) no convincing evidence of cost-effectiveness of epidural technique in spite of use for decades, h) litigation concerns due to risk of severe neurological complications. Thus, it is no exaggeration to say that the diminishing role of epidural technique can be expected to continue. Epidural technique is the gold standard for labour analgesia because there are no good alternatives. That cannot be said for the use of the technique after surgery. For routine postoperative analgesia epidural technique can no longer be considered the gold standard.

The continued use of epidural technique at your institution should be based on an evaluation of its risks and benefits from your own audit data rather than outdated traditions.

(Adapted from Carl Koller lecture: Rawal N. Epidural technique for postoperative pain. Gold standard no more? Reg Anesth Pain Med 2012; 37:301-317)

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4

ULTRASOUND PRACTICE: BASIC PHYSICS, ARTEFACTS, PITFALLS

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Introduction: This refresher course will provide the ultrasound user with the necessary basic knowledge of physics, artefacts and avoidable pitfalls in order to maximize the image quality in individual cases of everyday practical applications for ultrasound-guided nerve blocks in regional anesthesia and

pain medicine. The lecture concentrates on practical examples and stories to facilitate learning the laws of (ultra-)sound physics in an easy way. As an addition, this abstract offers a glossary of expressions, definitions and explanations important in the field. Delegates may use this as an additional resource to improve their physical knowledge.

Basic physics:

- **Characteristics of ultrasound waves:** A sound wave is a mechanical energy that needs a medium to be propagated and cannot be transmitted through vacuum. All sound waves are longitudinal waves, as opposed to transversal water- or electromagnetic waves, which means that the direction of the “swinging” axis corresponds to the direction of wave propagation. Dependent on the medium they are travelling in, sound waves differ in speed with an increase of speed the denser the medium is. While audible sound is in the frequency range of 16 Hz to 20 kHz, ultrasound waves are oscillating at a higher rate than twenty thousand times a second. Ultrasound machines are typically operating in MHz frequencies.
- **Frequency:** The frequency is the number of cycles of the wave during one second. The unity of the frequency is Hertz (Hz).
- **Wavelength:** The higher the frequency of a wave the shorter the wavelength is. In fact, they are inversely proportional at any given constant speed. The wavelength is a measure of the distance of two adjacent points of the wave that are in the same condition, for example the “mountains”. As a rule of thumb in body tissue the wavelength in mm can be calculated as 1,54 divided by the frequency in MHz; this can be important for calculations of the axial resolution that cannot be higher than 1 or 2 times the wavelength.
- **Amplitude:** The amplitude of the ultrasound wave can be regarded as its “volume” or the amount of acoustic pressure.
- **Speed of sound:** Mathematically, this is the product of wavelength and frequency. In air the speed of sound waves is 331, in blood 1540 and in bone 4080 meters per second.
- **Piezoelectric effect:** This effect was discovered in 1880 by the Curie brothers. It describes the conversion of mechanical- to electrical energy and vice versa (which is called the reverse piezoelectric effect) by means of special crystals. Ultrasound transducers are equipped with many piezoelectric elements that emit and listen to sound waves.
- **Transducer frequency:** The transducer frequency determines the resolution of the image and the penetration of the tissue. Generally, the higher the frequency- the higher the resolution but the lower the tissue penetration. This is why we use high frequency transducers (e.g. 15 MHz) for small nerves close to the skin and lower frequencies (e.g. 5 MHz) for deeper targets.
- **Transducer type:** There are linear and curvilinear transducers. The latter give a better overview but generally operate at lower frequencies than the first.
- **Refraction and reflection:** They occur when the sound beam hits a border between two media with different acoustic resistances. Reflection of sound is the fundamental principle image generation is based at. Bad news is: Both can lead to artefacts.
- **Time gain compensation:** The deeper the ultrasound beam travels into the tissue, the more it gets attenuated. To compensate for this, depth selective gain adjustment is provided by TGC (time gain compensation) of the ultrasound machine.
- **Image resolution:** We differentiate axial, lateral and temporal resolution. The higher the resolution- the better the image quality in general. Besides other factors, resolution depends on frequency, frame rate and line density.
- **Beam steering and focus zones:** Like optical lenses can focus light beams, electronic focusing through beam steering is used to get better “vision” at a defined focus zone- which is a certain depth at the image set by the operator.
- **2D-Mode:** The black and white ultrasound image which displays sound information about depth and laterality of structures in a 2-dimensional picture.
- **Doppler Principle:** There is a certain shift in frequency when the wave hits a moving target like blood. The velocity of the target is proportional to the frequency shift and can be displayed in the image. This principle was discovered by Austrian Christian Doppler in the first half of the 19th century.
- **Color-Doppler Mode:** A color coded image with red for velocities towards and blue for those away from the scanner.
- **Power-Doppler Mode:** A color coded image that doesn't differentiate the direction of flow, but only the absolute amount of velocity at a higher sensitivity than Color Doppler.

Artefacts and pitfalls:

- **Anisotropy:** This expression refers to the fact that nerves can look differently depending on their individual appearance and especially on the angle of the transducer relative to the nerve. With little movements of the transducer it is like a game of “now you see me- now you don't”. Only with a strict 90 degree perpendicular angle to the nerve at the position of the ultrasound plane, optimal imaging conditions can be produced. Nevertheless, nerves always have a certain “honeycomb” pattern called fascicular.
- **Reverberations:** When the sound beam is oscillating between two strong ultrasound reflectors like bone, calcifications, the needle or the surface of the body, reverberations can occur. Always check in multiple planes and different transducer angles not to be fooled.
- **Mirror artefacts:** A structure close to a tissue layer with strong sound reflecting properties is displayed twice. The false image is exactly at the same distance of the tissue layer than the true structure. Mirror artefacts can appear in 2-D and in Doppler images.
- **Shadowing:** Strong ultrasound reflectors like bone or air prohibit the beam to go any deeper and reflect almost the total amount of energy back. This is why we cannot see behind bone and air with ultrasound. Always be careful not to bring air into the tissue, otherwise image quality will be destroyed.
- **Dorsal enhancement:** A pseudo echo gain can be observed for the tissue behind cysts or blood vessels, which are appearing dark in the image. This is the opposite effect of shadowing and sometimes can mimic nerves.

Summary: Basic knowledge of ultrasound physics is essential to optimize image quality. Artefacts are very common in ultrasound and every sonographer has to be aware of them to correctly interpret the image.

5

ROLE OF INFLAMMATION AND ANTI-INFLAMMATORY DRUG THERAPY IN ACUTE POSTOPERATIVE PAIN

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Once tissue has been injured by a surgical trauma, multiple chemical mediators are released from damaged and inflammatory cells. The resulting “inflammatory soup” is rich in cytokines, growth factors, bradykinin, purines, amines, lipids, ATP, serotonin, histamine, protons, potassium, prostaglandins and inflammatory enzymes such as inducible nitric oxide synthase (iNOS) and the inducible COX-2. At the cellular level, inflamed regions show a substantial influx of inflammatory cells, arterial dilatation, and increased blood flow, fluid and plasma leakage with a resulting oedema. Both the oedema (mechanical pressure) and the inflammatory mediators activate nociceptors, evoking pain (Julius and Basbaum, 2001).

The efficacy of NSAIDs and selective COX-2 inhibitors (coxibs) is attributed generally to blockade of cyclooxygenase enzymes that convert arachidonic acid (a lipid substrate derived from membrane phospholipids) into inflammatory prostaglandins. Phospholipase A2 enzymes liberate free fatty acid from membrane phospholipids and control the flow of arachidonic acid available for prostaglandin synthesis. Prostaglandin E₂ (PGE₂) greatly potentiates the pain produced by pain-producing mediators such as bradykinin or histamine (Simmons et al., 2004). PGE₂ contributes to peripheral sensitization and hyperalgesia by binding to G-protein-coupled receptors that increase levels of cAMP within nociceptors. Peripheral inflammation mediates via IL_{1β} spinal induction of COX-2, increasing spinal PGE₂. PGE₂ interacts with receptors on the central terminals of nociceptors and results in central sensitization. PGE₂ stimulation of prostaglandin (EP) receptors in the dorsal horn increase NMDA channel opening, augmenting the excitatory effect of glutamate (Svensson and Yaksh, 2002). This argues that COX inhibitors exert their pain relieving effects by modulating nociception at both peripheral and central sites (Svensson and Yaksh, 2001). There is also strong support for a pronociceptive role of PGI₂ in inflammatory pain (Zeilhofer and Brune, 2006). PGI₂ production catalysed by COX-1 seems to be involved in peritoneal pain (Simmons et al, 2004). Also COX-1 is upregulated in the spinal cord after a peripheral injury (Zhu and Eisenach, 2003; Zhu et al., 2003 and 2005).

A molecular target, through which PGE₂ sensitizes primary sensory fibres, is a voltage gated sodium channel that is resistant to tetrodotoxin (TTX-R Na⁺-channel). These TTX-R Na⁺-channels contribute considerably to action potential firing rate and duration in small-diameter sensory neurons. PGE₂ increases excitability of dorsal root ganglion (DRG) neurons, by

shifting the voltage dependence of the TTX-R Na⁺-channel activation in the hyperpolarizing direction. This reduces the extent of membrane depolarisation needed to initiate an action potential (Julius and Basbaum, 2001).

NSAIDs inhibit cyclooxygenase 1 (COX-1) peripherally and centrally (Zhu et al., 2003 and 2005), as well as cyclooxygenase 2 (COX-2) in the central nervous system (CNS), and peripherally in injured or inflamed tissue (Yaksh et al., 2001). The coxibs selectively inhibits COX-2 in peripheral tissues and in the CNS (Yaksh et al., 2001). NSAIDs and coxibs also inhibit inducible nitric oxide synthase (iNOS), nitric oxide (NO) being an inflammatory mediator and intracellular signal molecule involved in sensitization of neuronal cells (Amin et al., 1995; Ryu et al., 2000; Fermor et al., 2002). COX-2 inhibition reduces PGE₂ stimulation of prostaglandin (EP) receptors in the dorsal horn and thereby reduces NMDA channel opening and the excitatory effect of glutamate (Svensson and Yaksh, 2002).

The specific and non-specific COX inhibitors have similar analgesic effects on postoperative pain (Rømsing and Møiniche, 2004). Early after experimentally induced neuropathy, spinal COX-1 expression increases (Zhu and Eisenach, 2003). Inhibition of COX-1 during the early stages in an experimental neuropathic pain model seems to prevent further development of allodynia and hyperalgesia (Hefferan et al., 2003). This suggests a role for COX-1 inhibition in the prevention of postoperative neuropathic pain (Zeilhofer and Brune, 2003; Zhu and Eisenach, 2003). The importance of COX-1 inhibition in the management of pain may have been underestimated. Ketorolac, a COX-1 preferring inhibitor, has excellent efficacy on acute pain (Rainer et al., 2000; De Oliveira et al., 2012). There is evidence that in order to achieve optimal analgesia, inhibition of both COX isoenzymes is advantageous (McCormack and Twycross, 2001; Zeilhofer and Brune, 2003; Zhu and Eisenach, 2003; Zhu et al., 2003 and 2005).

Paracetamol inhibits weakly COX-1 and COX-2 in vitro, but reduces prostaglandin synthesis markedly in vivo, and acts as a COX-2 selective inhibitor of prostaglandin production when the levels of arachidonic acid are low (Botting, 2000; Graham and Scott, 2005). The many similarities between COX-2 selective inhibitors and paracetamol in their clinical effects and adverse effect-profiles may be explained by this (Graham and Scott, 2005). Even though paracetamol is a poorer COX- inhibitor than the NSAIDs and coxibs, very high (toxic) doses eventually lead to complete inhibition of COX-1 and COX-2 throughout the body (Brune and Hinz, 2004).

Glucocorticoids are the most potent anti-inflammatory agents currently available (Newton, 2000), but have not traditionally been regarded as analgesics for acute pain. However, a recent meta-analysis on glucocorticoids (dexamethasone >0.1 mg/kg) given for acute postoperative pain with 2,751 patients included, concluded that a single perioperative dose of dexamethasone is an effective adjunct in order to reduce postoperative pain and opioid consumption (De Oliveira et al., 2011).

To achieve anti-inflammatory and analgesic effects, glucocorticoids bind to intracellular receptors, modify gene transcription, and induce synthesis of proteins (Schleimer, 1993; Barnes, 2005). They reduce the prostaglandin synthesis by inhibiting phospholipase A₂ (PLA₂), and by blocking the expression of COX-2 mRNA in peripheral tissues and in the central nervous system, but do not affect COX-1 (O'Banion et al., 1992; Schleimer, 1993; Barnes, 2005).

PGE₂ synthases have gained much attention as targets for analgesic and antihyperalgesic agents. One membrane bound form, microsomal PGE synthase-1 (mPGES-1), which is closely associated with COX-2, contribute most to pain sensitization and is suppressed by glucocorticoids (Zeilhofer and Brune, 2006). Other effects contributing to the analgesic effect include the suppression of leucocytes and mediators of inflammatory hyperalgesia such as iNOS, TNF α , IL₁ β , and IL₆, by downregulating the nuclear transcription of their RNA (Schleimer, 1993; Ferreira et al., 1997; Barnes, 2005). Reduced vasodilatation and capillary leakage reduce oedema and pain due to increased pressure in closed compartments (Schleimer, 1993; Holthe and Kehlet, 2002).

Glucocorticoids also inhibit release of neuropeptides from nerve endings, signal transmission in nociceptive C-fibres and ectopic discharge from traumatized nerves (Johansson et al., 1990; Johansson and Bennett, 1997). They also induce expression of the anti-inflammatory cytokine IL₁₀ and reduce the activation of nuclear factor-kappa B (NF- κ B). Activated NF- κ B in the glia induce COX-2 and proinflammatory cytokines that contribute to central neuroplastic changes and thus sensitization, resulting in lower pain thresholds and spontaneous neuronal firing, manifested as allodynia and hyperalgesia (Xie et al., 2006). Glucocorticoid-induced effects that require protein-synthesis have about 2 hour's latency of onset (Ferreira et al., 1997).

In order to take advantage of these anti-inflammatory effects for reduction of postoperative inflammation and pain, preoperative administration of glucocorticoids has been advocated. However, there are reports of rapid onset of analgesic and anti-hyperalgesic effects of glucocorticoids: After surgery and experimental human pain, significant pain-reduction have been observed before 45 minutes (Romundstad et al., 2004; Stubhaug et al., 2007). Rapid and striking anti-hyperalgesic effects of glucocorticoids have been demonstrated in human experimental pain (Stubhaug et al., 2007). These findings indicate specific analgesic and anti-hyperalgesic mechanisms not linked to the effects requiring protein-synthesis. Rapid reduction in neural discharge within seconds to a few minutes due to non-genomic effects on membrane receptors is a documented effect of steroids (Falkenstein et al., 2000; He et al., 2003).

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The subspecialty of regional anaesthesia challenges clinicians with the "must have" of a profound anatomical knowledge. The rapid development of ultrasound guided techniques and their increasing popularity has brought answers but questions concerning (sono-)anatomy as well. Modern ultrasound devices are able to provide images in excellent quality that even small peripheral nerves/cutaneous branches can be visualised. Thus, a thorough understanding and detailed knowledge of topographical anatomy is mandatory. The following abstract is a brief summary of the most frequent anatomical variations that may be encountered during the performance of common peripheral nerve blocks on the upper and lower extremity.

Brachial plexus:

The brachial plexus is formed by the ventral rami of the spinal nerves C5-Th1. The term 'prefixed' refers to a contribution of C4 to the brachial plexus (41/100 cases (1)) whereas 'postfixed' means that T2 is involved in the formation of brachial plexus (4/100 cases (1)). Significant variations in brachial plexus anatomy have been found in up to 53.5% of plexuses examined in cadaver studies (2).

- **Interscalene:** The most frequent variant involves the C5 and/or C6 roots. Both roots (together or separately) can be found within the substance of the anterior scalene muscle and pierce the latter on its anterior surface (3). The C5 as well as C6 root may pass distally on the anterior surface of the anterior scalene muscle. A frequent finding during an ultrasound guided interscalene brachial plexus block are bridges of muscular tissue between the roots of the brachial plexus (most often between C5/C6 and the remaining roots). These bridges may limit the spread of local anaesthetics to deeper parts of the brachial plexus to some extent.
- **Supraclavicular:** in most instances the trunks are arranged lateral to the subclavian artery. The suprascapular nerve originates from the superior trunk and shows some variability concerning its level of origin. The dorsal scapular artery if present in the supraclavicular region regularly pierces the brachial plexus and therefore does not represent an anatomical variant (4).
- **Infraclavicular:** variation of plexus anatomy mainly regards the position and arrangement of the three fascicles in relation to the axillary artery.
- **Axillary:** the positions of the median, ulnar, radial and musculocutaneous nerves in relation to the brachial artery show a remarkable degree of variability (5,6). The location of the radial nerve is quite constant within a smaller range of variability whereas the median and ulnar nerves are frequently found at different positions. The musculocutaneous nerve normally passes distally through the substance of the coracobrachialis muscle in between the coracobrachialis and biceps muscles. It can also accompany the brachial artery for a longer distance. Branches of the musculocutaneous nerve are sometimes visualised within the substance of the biceps muscle.

In rare instances the brachial plexus may exist as a single trunk.

Lumbosacral plexus:

The lumbar plexus is formed by the ventral rami of the spinal nerves (T12)-L4. A part of L4 unites with L5 to form the lumbosacral trunk (N. furcalis). Together with the ventral rami S1-S3 they form the lumbosacral plexus. In a "prefixed" plexus fibres from L3/L4 form the N. furcalis whereas in a "postfixed" plexus the N. furcalis is formed by L5.

- **Lumbar plexus (LP):** in the majority of cases the LP is located within the substance of psoas major muscle. In rare instances the whole plexus lies posterior to the muscle (7).
- **Femoral nerve (FN):** the FN emerges from psoas major on its posterior/postero-lateral surface distal to the level of L4 transverse process. Significant branching of the FN at that level has been described (7-9). Usually FN branches reunite cephalad to the inguinal ligament. The FN passes distally underneath the inguinal ligament on the anterior surface of iliopsoas muscle (lateral to the femoral artery). A position in between the femoral vessels as well as a position within the substance of iliopsoas muscle have been described (10). The saphenous nerve may pierce the sartorius muscle or pass anterior to it. The nerve may end at the knee level and is then replaced by fibres of the tibial nerve (10).
- **Lateral femoral cutaneous nerve (LFC):** the LFC normally passes distally underneath the inguinal ligament medial to the anterior superior iliac spine. A passage through the inguinal ligament or through a bony canal have been reported (11). In the majority of cases the LFC is covered by the fascia lata, in rare instances the LFC lies epifascial (11). In approximately two-thirds of cases the LFC appears as a single trunk, in the remaining third the LFC can be found bifurcated below the level of the anterior superior iliac spine. The LFC has been found to pierce the sartorius muscle, to pass over the muscle or to run along the lateral border of sartorius muscle (12). Two LFC

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CLINICAL ANATOMY: COMMON VARIATIONS THE ANAESTHESIOLOGIST SHOULD KNOW

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We all look different. This is also true for topographical anatomy (the relationship between anatomical structures) to some extent. Physicians 'throughout all specialities (surgeons, radiologists etc.) are often encountered with variant anatomy that may lead to misinterpretations in some instances.

branches appearing below the anterior superior iliac spine have been reported (13).

- **Obturator nerve (ON):** both branches of the ON (anterior, posterior) may pass posterior to the adductor brevis muscle. An accessory obturator nerve (8%-29% according to different authors) may arise from the lumbar nerves L2-4 with different contributions or from the ON. The accessory obturator nerve usually runs with the ON to the pelvic brim. It exits the pelvis on the medial border of the psoas muscle and terminates into three branches (innervation of pectineus muscle, hip joint, adductor muscles)(10).
- **Sciatic nerve (SN):** variations of the SN mainly regard the level of its bifurcation which can occur anywhere between the level of its origin and the fossa poplitea (10). The SN usually leaves the pelvis below piriformis muscle (foramen infrapiriforme). Several variations have been described at this site: 1) the fibular nerve pierces the piriform muscle whereas the tibial nerve passes below, 2) the tibial nerve passes above piriform muscle, 3) the SN pierces the piriform muscle, 4) the fibular nerve passes above and the tibial nerve pierces the piriform muscle, 5) the SN passes above piriform muscle (14). Variations in the course of the SN may cause the so called piriformis syndrome.

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14. Smoll NR. Variations of the piriformis and sciatic nerve with clinical consequence: a review. *Clin Anat* 2010; 23: 8-17.
- A. Anaesthetic mixture. Low doses of local anaesthetics are usually supplemented by an opioid, e.g. sufentanil. Compared with the high dose regimen low dose bupivacaine ($\leq 8\text{mg}$) was associated with a lower incidence of hypotension as well as a lower risk for nausea and vomiting; neonatal outcome was similar between the two regimens (1).
- B. Hypotension secondary to sympathicolysis is a frequent side-effect of spinal anaesthesia, however, different definitions of hypotension in use could affect comparisons of the efficacy of anti-hypotensive measures (2). In addition to a decrease in systemic vascular resistance, an increase in stroke volume and cardiac output are further haemodynamic consequences of spinal anaesthesia (3). Research was also extended to pre-eclamptic parturients yielding similar results as those obtained in healthy parturients (4).
- C. Volume therapy: Crystalloids and colloids are used either as a preload or concomitantly with spinal injection (co-load). Incidence of hypotension remained high with all strategies (5) but crystalloid preload seems to be least effective (6). Combination of volume administration with a vasopressor has been recommended (6).
- D. Choice of vasopressor: Recent investigations favoured phenylephrine, an alpha-agonist, over the long-term agent of choice ephedrine. Ephedrine use was associated with a significantly elevated risk of true foetal acidosis ($\text{pH} < 7.20$), accordingly base excess was also lower after ephedrine. Phenylephrine caused bradycardia more often. The effect on blood pressure was similar for both agents in our meta-analysis of randomised controlled trials (7). Early or prophylactic administration of phenylephrine by bolus or continuous infusion should be considered (8).
- E. Haemorrhage remains a major cause of morbidity and mortality after delivery (9). Interestingly, an analysis of data from a registry based on ICD codes revealed a decrease in the incidence of postpartum haemorrhage after spinal compared to general anaesthesia (10). This finding, however, awaits confirmation from other studies.

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ACUTE AND CHRONIC PAIN MANAGEMENT IN PEDIATRICS: CAN REGIONAL ANESTHESIA BE HELPFUL?

C. Ecoffey *Anesthesia and Intensive Care, University Rennes 1, Rennes, France*. Regional anesthesia is widely employed for acute postoperative pain control in children; regional anesthesia is also an efficient technique to treat chronic pain particularly complex regional pain syndrome. Central or perineural approaches can be performed as a bolus injection or as a continuous infusion of local anesthetics. However, bolus injections, even with the addition of adjuvants, are inadequate for prolonged surgery and long-term pain control.

Continuous infusion remains the technique of choice when there is a prolonged operation or severe postoperative pain. Indeed, effective pain management is a critical component of postoperative care and contributes to

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REGIONAL ANAESTHESIA FOR CAESAREAN SECTION: STATE OF THE ART

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Over the last years spinal anaesthesia has become the preferred anaesthetic technique for caesarean section. This lecture covers several topics:

fewer postoperative complications, shortened hospital stays, better quality of life, and a decreased incidence of chronic pain postoperatively. In addition, the literature confirms the very low rate of complications and adverse effects of regional anesthesia in children.

However, clinicians need to be aware of the key points for performing a block and placing a catheter in children: good knowledge of anatomic and physiologic differences between adults and children is necessary; the use of newer local anesthetics, such as ropivacaine and levobupivacaine, increases the therapeutic window; and that it is mandatory to work with dedicated pediatric equipment. Through the use of ultrasound the success of blocks can be improved and the risks reduced.

Epidural continuous block infusion: Continuous epidural analgesia for children was described in 1954 (1) and, since the mid-1980s, has enjoyed considerable popularity. The continuous epidural analgesia is associated with improved postoperative outcomes, such as less incisional pain, decreased muscle spasms (2, 3), and decreased atelectasis and respiratory complications (4) and may increase gastrointestinal motility (5). Newborn infants who have been managed with continuous epidural analgesia may be intubated for shorter periods, recover more quickly, and experience less pain (6, 7). The combination of a local anesthetic such as long acting LAs and an opioid such as fentanyl or sufentanil can optimize pain relief while minimizing side effects (8). However, despite the plethora of published literature on pediatric epidural analgesia, prospective outcome studies demonstrating the clinical benefits and cost effectiveness of continuous epidural analgesia over the simple intravenous opioid infusion in children are lacking. Continuous infusions have also been used to allow physical therapy in chronic regional pain syndromes.

Many pediatric anesthesiologists who were strong and early advocates of the technique, are more reticent in their support today. Indeed, audits of epidural infusions in children have shown that 17–22% of infusions are terminated prematurely (9, 10) and that undesirable effects or complications occur in 67% of patients (9). Adverse effects of epidurally administered narcotics include respiratory depression, pruritus, urinary retention, nausea and vomiting, and sedation. Adverse effects of epidurally administered local anesthetics include urinary retention, hypotension, numbness, motor weakness and, rarely, systemic toxicity. Epidural analgesia exposes also patients to rare additional risks, at the time of insertion and during the course of the postoperative infusion, as recently reported in a large 5-yr prospective audit of 10 000 paediatric epidural catheter techniques currently taking place in the UK to try to establish the relative risk of these problems in modern practice (11). Complications may be venous air embolism, postdural puncture headache, inadvertent intravascular administration of local anesthetic, nerve trauma, back pain, epidural hematoma or infection (including osteomyelitis, epidural space infection).

In addition, the commonest problems with pediatric regional anesthesia are technical: either failure to establish a block or failure of maintenance of the block. Epidural analgesia is reliant upon optimal positioning of the catheter tip within the epidural space at the appropriate level for the surgery performed (12). Even with optimal positioning, analgesia may be inadequate (because of pain or discomfort remote to the surgical site from intravenous cannula, wound or chest drains, urethral or suprapubic catheters, bladder or skeletal muscle spasm), unilateral (e.g. epidural septa) or patchy (e.g. air in epidural space). Furthermore, the epidural catheter tip may be misplaced, in which case the likelihood of achieving satisfactory analgesia is diminished. The tip may be located distant to the nerves supplying the dermatomes that need to be blocked, or the catheter may have been inserted into the subdural space.

Finally, epidural infusions are more costly to maintain than intravenous opioid infusions postoperatively. Drugs for epidural infusion are often prepared in a sterile pharmacy environment, increasing the base cost of agents usually higher than intravenous opioids. In addition, routine pain service consultations take longer in patients receiving epidural analgesia because, in addition to checking for adequate analgesia, attention must also be paid to pressure care, the state of the epidural insertion site and dressing, degree of motor blockade and dermatome cover.

In conclusion, the risks of epidural catheter insertion and continuous infusion postoperatively are justified in some groups: those with cognitive impairment (especially self-mutilating behaviour), patients with cerebral palsy predisposed to painful muscle spasms postoperatively, neonates undergoing major laparotomy or tracheo-oesophageal fistula repair where epidural analgesia may reduce the likelihood of postoperative mechanical ventilation (in both) and the potential for barotrauma jeopardizing surgical repair (in the latter), in older children and adolescents where chest physio-

therapy is critical (e.g. cystic fibrosis or chest trauma) and in those undergoing extensive laparotomy, painful thoracic surgical procedures such as pectus excavatum repair.

Peripheral continuous block infusion: Single shot peripheral blocks are nowadays widely used in children but they can provide analgesia only for few hours. Continuous peripheral nerve blocks have gained a new place in the therapeutic arsenal of paediatric analgesia, following the principle of benefits/risks analysis. Due to fewest complications compared with continuous epidural blocks (13), continuous peripheral catheter techniques are becoming popular in children for femoral (14), brachial plexus (15), fascia iliaca (16), lumbar plexus (17), and sciatic blockade (18, 19). Paravertebral block is also an alternative technique, but this technique is close an epidural technique (20). Ultrasonography improved the catheter placement (21).

Otherwise painful rehabilitation and physiotherapy are probably the main indication, because only if pain is under control, good rehabilitation can be performed. Catheters can be maintained in position for several days and even at home (22). A recent study reported the efficacy of continuous peripheral nerve blocks with elastomeric disposable pumps (23) associated with initial Bier blocks for the treatment of recurrent complex regional pain syndrome in children (24). All the studies published so far underline the efficacy and safety of analgesia via a peripheral catheter and no complications or side effects linked to the long-term infusions have been described with only a few accidental removals and some drug leakage (25). They are at least as efficient as epidural analgesia, but produce fewer side effects (18). As the continuous regional analgesia is considered a safe and efficacious technique for postoperative pain relief in children after lower limb surgery, the feasibility of patient-controlled regional analgesia in a similar acute pain situation was also evaluated. Both techniques are efficacious and satisfactory. However, patient-controlled regional analgesia with ropivacaine 0.2% can provide adequate postoperative analgesia for pediatric orthopedic procedures with smaller doses of ropivacaine and lower total plasma concentrations of ropivacaine than with continuous regional analgesia (26).

In conclusion, continuous regional anesthesia should be the first choice of the anaesthesiologist involved in the treatment of pediatric acute or chronic pain. Indeed, undermanaged acute pain causes a major health care problem: chronic postoperative pain develops in 1 of 10 surgical patients. Finally, in few patients regional anesthesia can be also performed for palliative care service (27).

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9

EPIDURAL ANALGESIA AFTER ABDOMINAL SURGERY: ALIVE AND KICKING OR DEAD AND BURIED

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 For at least 2 decades epidural analgesia has been the technique of choice for providing pain relief after major abdominal and thoracic surgery. In ad-

dition to having the potential to provide excellent dynamic analgesia, epidural analgesia was claimed to reduce cardio-respiratory morbidity and to encourage return of gastro-intestinal function. More recently, with the introduction of Enhanced Recovery (ERAS) programmes, the place of epidural seemed secure especially after major abdominal surgery: it seemed that no epidural meant no ERAS.

However in recent years the right of this technique to occupy this prominent position has been questioned. Around the world epidural analgesia appears to be in decline (1). Reasons for this include recognition that:

1. its benefits might have been exaggerated - the risk:benefit ratio has now moved against epidural analgesia for most procedures, especially with the trend towards less invasive surgery
2. there are effective alternatives which are compatible with ERAS programmes

Epidural Analgesia and Morbidity: current evidence: A number of small trials performed during the late 1980's and 1990's suggested that epidural analgesia after major abdominal surgery significantly reduced respiratory and GI morbidity. In 2000 a meta-analysis of these trials appeared to confirm the beneficial role of epidural analgesia (2) finding significant reduction in thromboembolism, respiratory depression, pneumonia and transfusion requirements after surgery. However this paper was quickly followed by 2 others (3,4) which placed these findings in doubt. The benefits of epidural analgesia appeared less than originally thought and appeared more procedure specific. The bottom line was, while epidural analgesia provided better pain relief, its benefits on respiratory morbidity was limited to patients with significant pre-existing respiratory dysfunction or following open abdominal vascular surgery. More recent publications appear to confirm these findings. So what does the evidence suggest now?

1. Cardiovascular morbidity: while high thoracic epidural analgesia can increase coronary blood flow by providing a sympathetic blockade, the benefits of this appear to be limited to a high risk group of patients undergoing major vascular surgery (4). Even in patients undergoing cardiac surgery, epidural analgesia does not appear to reduce CVS morbidity (5).
2. Respiratory morbidity: in contrast to CVS, there is consistent evidence that thoracic epidural analgesia reduces pulmonary morbidity, especially in the relatively few high risk patients mentioned above undergoing major surgery (6). However this does not apply to the majority low risk patients.
3. Gastro-intestinal morbidity: thoracic epidural analgesia has been shown to reduce the duration of ileus following intra-abdominal surgery by around 24h when compared with systemic opioids (7). This of course is beneficial for the early feeding protocols of ERAS programmes.
4. Thrombo-embolic morbidity: the last decade has seen the introduction of modern thrombo-embolic prophylaxis tailored to individual patient requirements. Epidural analgesia does not appear to offer any additional benefit over these measures (8). Moreover anticoagulating a patient with an epidural catheter in situ carries an additional risk of causing an epidural haematoma.
5. Enhanced Recovery after Surgery (ERAS): by avoiding the ill effects of systemic opioids, thoracic epidural analgesia has been considered a vital component of these programmes. As ERAS may reduce complication rates by 50% and length of stay by up to 2 days after abdominal surgery, the case for epidural analgesia appeared to be strong. However the evidence is less clear cut. A recent meta-analysis was unable to confirm which of the many ERAS interventions were responsible for these benefits (9). While epidural analgesia provides better analgesia and faster return of bowel function after colorectal surgery, it did not shorten hospital stay but did increase the risk of hypotension and urinary retention (10).

So what does epidural analgesia really offer us? Essentially, apart from a high risk group where it has been conclusively shown to reduce respiratory morbidity, we're back where we started with a technique that can provide excellent analgesia. There is a growing opinion that this is no longer justification enough for its routine use. This opinion is based on:

1. Surgical techniques: surgery is becoming less invasive. Current evidence suggests that epidural analgesia and systemic opioids provide comparable analgesia after laparoscopic colorectal surgery (11).
2. Analgesia Failure: epidural analgesia is very much an all-or-nothing technique: either it provides pain relief or it doesn't. A partially working

epidural (typically an opioid + local anaesthetic mix) is arguably worse than no analgesia as ward staff are unable to provide additional rescue opioids because of fears of respiratory depression. In practice failure isn't uncommon: rates of up to 30% are quoted (12). In our practice around 20% of patients have experienced moderate or severe pain on movement during the first 24 hours after surgery. This figure has remained fairly constant over the last decade despite a pro-active Acute Pain Service which is disappointing. These are complex and labour intensive techniques, and despite training, the general surgical ward is probably not the best place on which to manage this technique successfully.

3. Hypotension: epidural related hypotension is common (13). In a local audit we found that 30% of patients receiving epidural analgesia after major colorectal surgery experienced a significant fall in blood pressure (systolic < 90mmHg for more than 2 hours) during the 1st 24 hours after surgery. This is important as it has been shown that splanchnic (and therefore anastomotic) perfusion is related to blood pressure and not flow - a vasopressor is thus the most effective management (14). Our post operative epidural patients are managed on Level-1 areas on the general surgical wards. While these areas provide a greater level of monitoring, unfortunately they do not allow for any vasopressor intervention. Management of hypotension is therefore restricted to fluid challenging. When this fails the next step is typically to reduce the infusion rate until the epidural fails. Clearly this is unacceptable but providing an extended Level-2 facility (HDU) locally is unappealing in the current financial climate.
4. Rarer major complications of epidural analgesia: In 2009 the NAP-3 report (15) confirmed the low risk of major complications after epidurals. The quoted risk was such that a clinician would be unlikely to experience a complication during their working life. Unfortunately complications seem to occur in clusters and we were on the receiving end of such an effect. Over a 6 year period we experienced 12 major complications of post operative epidural analgesia: 6 abscesses, 3 meningitis and 3 haematomas. 3 patients were unfortunately left paraplegic (16). Since 2006 we have had one further epidural haematoma which fortunately did not result in spinal cord injury. So it is possible that you may come across such a complication. Regular leg strength monitoring which serves as a surrogate of spinal cord health is essential if patients are not to be caused permanent harm should they be unfortunate enough to develop one of these complications.
5. Patient satisfaction data: while poor analgesia after surgery should be associated with poor patient satisfaction scores, this primary outcome measure has been little studied. Until it is, we should be reluctant to assume that analgesia alone is enough reason to insert an epidural, especially in light of the well documented rare but potentially catastrophic complications.

Alternatives to Epidural Analgesia

So while epidural analgesia may not be indicated for the majority of patients undergoing abdominal surgery, some form of analgesia is still required. A systemic multimodal analgesic regimen is good starting point but for the best chance of providing effective analgesia a regional technique should be added. There are a number of options:

1. IV lidocaine: a recent meta-analysis has suggested that an intravenous infusion of lidocaine peri-operatively after abdominal surgery reduced pain, ileus, ponv and hospital stay (17). However, given the relatively high incidence of toxic levels, the safety of this technique on the general surgical wards needs to be established.
2. Intrathecal morphine: while the PROSPECT group do not recommend this technique after abdominal surgery, a number of recent publications have demonstrated the short term analgesic benefits of intrathecal morphine after laparoscopic colorectal surgery (18,19). Compared with epidural analgesia, intrathecal morphine was less effective but patients receiving this technique were discharged home sooner after surgery (19). Controversies with this technique include the optimal dose of morphine and where patients receiving this technique should be monitored for the first 24 hours after surgery.
3. Wound infusions: Effective analgesia has been reported after periumbilical midline colorectal surgery using a multi-aperture catheter placed between the parietal peritoneum and posterior rectus sheath by the surgeon at the time of wound closure (20). Compared with placebo an extraperitoneal infusion of local anaesthetic provided better analgesia, less opioid consumption and reduced hospital stay. Catheter posi-

tion is crucial for the success of this surgical technique. Subcutaneous catheter placement has been shown to be ineffective in this group of patients (21). This is a simple and safe technique - its major drawback is the cost of the equipment. Nonetheless it is an option for providing useful analgesia after a less invasive incision.

4. Abdominal wall infusions: The introduction of ultrasound into regional anaesthetic practice has led to the development of novel and useful techniques for providing analgesia after abdominal surgery:
 - 4.1. Transversus Abdominus Plane (TAP) catheters: the original lumbar triangle approach provided reliable analgesia for incisions below the umbilicus (22). For higher incisions an oblique subcostal TAP approach has recently been described (23) and found to be an effective alternative to epidural analgesia for upper abdominal surgery (24).
 - 4.2. Rectus sheath catheters: originally placed by the surgeon before wound closure, increasingly these are being inserted under ultrasound guidance by anaesthetists (25). Rectus sheath catheters have been shown to compare favourably with epidural analgesia in colorectal and urological patients (26). However this technique performs best after smaller midline incisions and may therefore be less useful for the horizontal incisions typical of laparoscopic assisted surgery.
5. Paravertebral and interpleural infusions: can provide useful analgesia after unilateral abdominal surgery (27,28). For midline incisions, catheters would need to be inserted bilaterally. Recently an ultrasound guided approach to the paravertebral space has been described (29). However the paravertebral approach remains a more technically challenging technique than an abdominal wall catheter. This together with fears of causing bilateral pneumothorax has limited uptake of both of these techniques to unilateral incisions eg open cholecystectomy.

Typically an epidural catheter is used for all these infusion techniques. While the evidence suggests these can function adequately, it is unclear whether a more purpose designed multi-aperture catheter would be an improvement. These are available but are significantly more expensive. Likewise there is controversy whether these techniques are best served by a nurse-led bolus regime or a potentially safer continuous infusion. Nonetheless all are useful alternatives to epidural analgesia after lesser abdominal incisions.

Does Epidural Analgesia still have a role?

A correctly placed epidural can provide excellent analgesia following major surgery. Despite this epidural analgesia is in decline: in my hospital peri-operative usage has fallen by 50% over 10 years. Reasons for this include recognition that:

1. this is a complex and labour intensive technique with a local failure rate on the surgical wards of around 20%.
2. earlier reports of the benefits of epidural analgesia on morbidity and mortality appear to have been exaggerated
3. recent suggestions that epidural analgesia might reduce the risk of cancer recurrence and surgical site infection have not been confirmed
4. surgery has become less invasive
5. effective alternatives are available
6. epidural analgesia is an invasive technique with the potential for major complications

Locally we have introduced a list of incision specific analgesic guidelines based on the PROSPECT recommendations (30) and our local experience and audit. We now only recommend post operative epidural analgesia for patients having an extensive abdominal incision or those with significant respiratory morbidity. For the patients undergoing lesser incisions we advise either an abdominal wall catheter or intrathecal morphine with appropriate post operative monitoring. Audit of our analgesic data suggests that there has not been a significant deterioration in the quality of analgesia that is provided by these techniques. I would suggest that this is a reasonable approach for other units to follow.

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10

LOCAL ANESTHETICS - SUBSTANCES, PHARMACODYNAMICS, PHARMACOKINETICS

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Local anesthetics are a group of drugs characterized by their ability to block neuronal sodium channels. Thereby, they cause regional and temporal interruption of nerve impulse propagation. Next to these classic actions, increasing evidence suggests further relevant effects on, e.g., the immune system and coagulation. On basis of structure, local anesthetics are divided into amide-type and ester-type local anesthetics, and on basis of block duration they are divided into short- and long-acting local anesthetics. Their major molecular target concerning conduction block is the voltage-gated sodium channel localized in the neuronal cell membrane. This is a transmembrane protein with two subunits, alpha and beta, where alpha is the actual channel harboring the local anesthetic binding site, and beta is responsible for modulation of activation and inactivation, and voltage-dependence (1). To bind to the "local anesthetic receptor", the molecule must first pass through the cellular membrane in an uncharged form, before combining with hydrogen ions and acquiring a charged form which allows binding to the receptor on the internal portion of the ion channel. The main hypotheses how lidocaine leads to channel blockade are the generation of an electronic charge within the channel pore, and / or conformational changes in the channel induced via the S4 segment of the alpha channel subunit. The affinity of local anesthetics towards an open receptor is higher than towards the closed form (2).

Potency of a local anesthetic is determined by its lipophilicity, and block onset is influenced by the pKa value. Molecular weight, protein binding and intrinsic vasoactivity are subordinate in importance. In interpreting the onset of action of local anesthetics, the distribution of local anesthetic into perineural tissues must be taken into account, as well as the fact the typical cross-sectional view of a nerve reveals only a quarter to a third of tissue to be neural, the remainder being composed of connective tissue and blood vessels. The efficacy of local anesthetics in blocking nerves is expressed by the Cm, the minimal inhibitory concentration. It is defined as the concentration of local anesthetic which blocks a nerve within a defined time *in vitro*. It is inversely proportional to lipophilicity and pH value, and proportional to nerve fiber diameter. Nerve fiber diameter and myelination determine nerve block properties as well. The heavier the myelination of peripheral nerves, the harder it is to achieve blockade. Therefore, unmyelinated fibers or lightly myelinated fibers (sympathetic, temperature, pain) are more sensitive to local anesthetic than heavily myelinated fibers (motor). However,

this very mechanistic view is confounded by other factors such as a differential distribution of ion channel subtypes across different types of nerve membrane. Finally, (equi)potency ratios differ according to site of injection.

The questions which local anesthetic to choose for peripheral or neuraxial regional anesthesia typically comes down to a choice between one of the three long-acting local anaesthetics, i.e. bupivacaine, levobupivacaine, and ropivacaine. Arguments in favour of the newer L-stereoisomers that have been cited include better differential blockade and improved cardiac safety in case of systemic overdose (3). However, most studies investigating differential blockade failed to take into account equipotency ratios, and the same is true for toxicity. Bupivacaine and ropivacaine are nearly equipotent when toxic thresholds are considered. Concerning toxicity, resuscitation seems to be more difficult following bupivacaine-induced toxicity due to slow-out binding kinetics as compared to, e.g., ropivacaine (4). However, intralipid as a potential adjuvant in resuscitation may be more effective in bupivacaine-induced toxicity owing to its lipophilic properties (5). No clear evidence exists to discard bupivacaine in favour of the newer stereoisomers in adults.

Local anaesthetics are not metabolized at the site of injection, and the main determinant for their local concentration accordingly is absorption into the systemic circulation and subsequent hepatic metabolism. Absorption from the site of injection is biphasic, with an initial fast peak reflecting the fluid phase and later a slower second peak corresponding to resorption from the lipid compartment (3). Presumably due to local tissue distribution, increased lipophilicity translates into slower systemic absorption. Addition of epinephrine slows the first phase of absorption (6). The distribution of local anesthetics after absorption is governed by organ perfusion, lipophilicity and protein binding. Most importantly, concentrations of local anesthetic may rapidly rise in the heart and brain, potentially causing toxic effects. In serum, local anesthetics are bound to albumin and alpha-1-acidic glycoprotein. The latter, despite its relatively low concentration in serum, is the primary determinant for binding of local anesthetics. Moreover, alpha-1-acidic glycoprotein belongs to the acute-phase class of proteins, and is upregulated following trauma or surgery (7). This is believed to protect against systemic toxic effects of continuous local anesthetic infusion.

Metabolism of amide local anesthetics is achieved by hepatic enzymes of the cytochrome P450 class. Hepatic extraction ratios vary according to substance. The enzyme system is immature at birth, and clearance improves during the first months and years of life (8). Patient factors such as age, heart failure and hepatic insufficiency may impair local anesthetic metabolism. Lastly, drugs such as propranolol indirectly inhibit oxidation of local anesthetics.

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MANAGEMENT AND INDICATIONS OF CONTINUOUS PNB CATHETERS IN DAILY PRACTICE: SOLUTIONS, INFUSION REGIMEN, DEVICES?

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Interest: The patient scheduled for a major orthopedic surgery encounters the twin problem of the mandatory nature of optimal postoperative analgesia and the occurrence of possible adverse events of drugs and /or techniques used. The control of postoperative pain is justified by its effect on the local or general impact of the surgery. The interest in terms of morbidity has been demonstrated in populations with an increased perioperative risk (1,2). However the main goals of postoperative analgesia are patients comfort and optimization of early postoperative rehabilitation that only guarantee of better clinical and economic (3) interest. Analgesic techniques improve surgical prognosis (outcome of the intervention, duration and progress of the post-operative period) (1). They allow for more intensive physiotherapy as painful exacerbations are controlled (1). Pain control during mobilization is one of the main objectives to be achieved. The limit of morphine intravenous PCA lies in its inability to control postoperative pain during physiotherapy and early passive and active mobilization. This should motivate the development of strategies for post-operative pain relief using continuous perineural devices and techniques (3, 4).

A recent meta-analysis (4), including 19 prospective controlled studies and more than 600 patients reported that the use of a peripheral nerve catheter is always better than IV PCA morphine in terms of pain at rest, pain during mobilization (Figures 1 and 2) and incidence of adverse events related to the technique. These results confirm the results from Liu et al. study (3) who claimed that that postoperative regional technique will be dramatically increased in the near future to obtain important benefits.

The painful paroxysms during the postoperative rehabilitation, combined with muscle spasms, represent the main obstacle to an early physiotherapy, guaranteeing an optimal functional outcome especially among the elderly. The analgesic efficacy of a nerve block in single injection is limited to few postoperative hours (5, 6). The majority of the studies insists on the efficacy of perineural catheterization compared to IV PCA morphine. Prospective and randomized trials reinforce the supremacy of perineural catheterization compared to single injection block in the post-operative rehabilitation period for joints and ligaments surgeries (7,8). Physiotherapy was initiated early in the postoperative period and its progression was much faster in continuous block patients. Compared to the PCA morphine IV, the catheter provides better postoperative pain relief (9-12). Ilfeld et al. (13) underlined the interest of continuous infusion for physical therapy early in this context. Singelyn et al. (14) applying the same rehabilitation program to patients scheduled for TKA, including an early passive mobilization reported that pain scores at rest and mobilization were significantly lower in patients receiving regional analgesia compared to IV PCA morphine. The time required to achieve a 90 °degree knee flexion were respectively 17 ± 7, 9 ± 6 and 8 ± 5 days for morphine IV PCA groups, and epidural catheter femoral (p < 0001). The length of hospital stay was longer (21 ± 3 days) in group IV PCA morphine compared to other patients (17 ± 3 and 16 ± 4 days for femoral and epidural catheters groups). Capdevila et al. (15) have studied the phase of rehabilitation beyond the hospital. The rehabilitation program, initiated in the first days after surgery was focused on mobility. The maximum amplitudes of knee flexions were significantly increased in the fifth day and out of the hospital in regional blocks patients compared to IV PCA morphine. The time needed to obtain this criterion was longer in IV PCA morphine patients. It is important to note that in this study, the blocks provided postoperative analgesia as effective as epidural but limited the incidence of side effects (urinary retention: 53% versus 0%, dysesthesia 41% versus 20%, 78% hypotension versus 52 %...). Similar results were recently reported by Barrington et al. (16) comparing the continuous femoral block and continuous epidural and Salinas et al. (17) who demonstrated the value of continuous femoral block in terms of duration and quality of postoperative analgesia compared to single shot blocks. Williams et al. (18) also related very interesting results in cruciate ligament repairs with a high superiority of continuous analgesic infusions of local anesthetics on a compared to saline or a single shot blocks.

Finally, this rapid overview of the CPNB interests would be incomplete if continuous CPNB in ambulatory practice was not addressed. Recent randomized double-blinded, placebo-controlled trials provided data involving patients discharged at home with CPNB (19-22). These studies included patients scheduled for moderately-painful orthopedic procedures who had an infraclavicular, interscalene, or posterior sciatic popliteal perineural catheters. Patients receiving perineural local anesthetic infusions achieved clinically lower resting and breakthrough pain scores while requiring fewer oral analgesics. Patients who received perineural local anesthetic experienced additional benefits related to improved analgesia. Zero to 30% of patients with perineural ropivacaine reported insomnia due to pain, compared with 60-70% of patients using only oral opioids. Patients receiving perineural ropivacaine infusion awoke from sleep because of breakthrough pain episodes an average of 0 times on the first postoperative night, compared with 2 times for patients receiving perineural saline. Obviously lower opioid consumption in patients receiving perineural local anesthetic resulted in fewer opioid-related side effects. Patients receiving perineural local anesthetic reported satisfaction with their postoperative analgesia of 8.8-9.8 compared with 5.5-7.7 for patients receiving placebo. The benefits of such analgesia appear to be highlighted by less hospital readmission. Whether these benefits result in an improvement in patients' health-related quality of life or outcome benefits is only partially studied. Ilfeld and colleagues (23) compared an overnight continuous femoral nerve block (cFNB) to a 4-day ambulatory cFNB with ropivacaine 0.2%. The CPNB technique did not increase the ambulation distance the afternoon after surgery but significantly decreased the time until three specific readiness-for-discharge criteria (adequate analgesia, independence from intravenous analgesics, and ambulation of at least 30 m) are met after total knee arthroplasty in 50 patients. Catheters were removed on postoperative day 4. Patients given 4 days of perineural ropivacaine attained all three discharge criteria in 25 (21-47) h, compared with 71 (46-89) h for those of the control group receiving saline. Capdevila et al (24) compared a CPNB infusion of ropivacaine 0.2% to patient controlled intravenous morphine in 83 patients scheduled for ambulatory orthopedic surgery for functional recovery and postoperative analgesia. Basal-bolus ropivacaine infusion decreased the time to a 10 minutes' walk, optimized all daily activities, and decreased the amount of ropivacaine used. The morphine group had greater pain scores and consumption of morphine and ketoprofen compared with ropivacaine group. The incidence of nausea/vomiting, sleep disturbance, and dizziness increased, and the patient satisfaction score decreased in the morphine group. After ambulatory orthopedic surgery, 0.2% ropivacaine delivered as a perineural infusion optimizes functional recovery and pain relief.

What kind of infusion technique? Basically, infusates may be administered using three kind of infusion regimen: exclusively as a basal infusion or bolus dose, and a combination of these two modalities. Surprisingly, studies of LA infusion regimen strategy are mixed in their conclusions. RCTs involving femoral and fascia iliaca compartment blocks continuous infusions have reported few differences in analgesia among the various delivery regimens (other than reduced local anesthetic use with bolus-only dosing). Differences were reported for sciatic nerve catheters for which providing a basal infusion maximizes analgesia and other benefits, although the data regarding the benefits of adding patient-controlled bolus doses are less clear. In these specific blocks providing automated, hourly, 5-mL bolus doses of levobupivacaine via a popliteal sciatic catheter decreased pain scores compared with patients receiving a continuous, 5-mL basal infusion of 0.125% levobupivacaine. That result was not reported for femoral ropivacaine infusion which failed to detect differences in sensory or motor effects). Adding patient-controlled bolus doses to these 2 regimens alleviated the difference in pain scores. Studies reported constantly less total consumption of local anesthetic with regimens providing patient-controlled bolus doses: it permits to decrease the basal infusion rate (as the most recent studies involving the use of US guidance to insert the catheters); decrease the incidence of an insensate extremity; and increase the duration of infusion/analgesia for ambulatory patients discharged with a finite volume of LA in elastomeric/electronic pumps. In contrast to the lower extremity, investigations of interscalene and infraclavicular perineural infusion are more uniform and suggest that including a basal infusion improves baseline analgesia, decreases the incidence and severity of breakthrough pain, and decreases sleep disturbances and supplemental analgesic requirements. Again the use of US guidance seemed to permit a decrease in infusion hourly doses of local anesthetic. Furthermore, adding patient-controlled bolus doses to a basal infusion decreases total local anesthetic consumption and supplemental analgesic requirements, and may provide increased independent activity. Studies claiming for the best infusion regimen mixing various volumes or LA concentration deserve some attention. One study provides evidence that

a high basal rate combined with low-volume, patient-controlled bolus doses reduces baseline pain scores and sleep disturbances, and decreases the incidence and severity of breakthrough pain, but at a cost of increasing local anesthetic consumption. However, other similar investigations report few differences in varying the basal infusion rate. Unfortunately, because of the heterogeneity of catheter types, insertion techniques, and additional factors, there is little evidence for an "optimal" infusion regimen. Most published investigations report a basal rate of 4 to 10 mL/h (lower rates for catheters of the lower extremity; higher rates for the upper extremity), a bolus volume of 2 to 10 mL, and a bolus lockout period of 20 to 60 minutes. Similarly, the maximum recommended hourly total dose of local anesthetic during perineural infusion remains unknown, but a wide safety margin has been documented in clinical trials.

Clinical use of stimulating catheters and ultrasound guidance: Some anesthesiologists prefer to use a stimulating catheter for CPNBs. The rationale for using a stimulating catheter is that it provides an objective method to confirm that the catheter tip stays in as close proximity to the target nerve as the final stimulating needle tip position. Controversy and conflicting results exist about stimulating versus nonstimulating catheters. Evidence of clinically relevant superiority has not clearly been demonstrated. In patients scheduled for shoulder or foot surgery, the use of stimulating interscalene or popliteal sciatic nerve catheters can improve the onset time and the final result of the sensory blockade. Birnbaum et al (25) investigated whether placement, and use of stimulating catheters for interscalene brachial plexus blocks improves short-term postoperative analgesia. Patients in the stimulating catheter group had significantly decreased pain scores at rest but patient satisfaction and plasma concentrations of ropivacaine did not differ among the groups. In Rodriguez et al (26) study in patients scheduled for popliteal sciatic nerve blocks, despite the fact that multiple attempts were required for catheter insertion in all stimulating catheter group patients, slightly lower VAS scores for postoperative pain and fewer intravenous opioid rescue analgesia were observed. In Casati et al study (27) the use of a stimulating catheter for continuous posterior popliteal sciatic nerve block resulted in a significant shorter onset time of sensory and motor blocks and less 0.2% ropivacaine consumption, and need for rescue pain medication. However, no difference in quality of pain relief at rest and during motion was reported between groups. In contrast, stimulating femoral catheters have not been shown to improve the quality of analgesia after major knee surgery (such as total knee arthroplasty or anterior cruciate ligament reconstruction) compared to nonstimulating catheters. Morin et al (28) compared femoral nerve stimulating catheters with catheters that were placed using the conventional technique of blind advancement in 81 patients undergoing major knee surgery. The onset time of sensory and motor block was almost similar in both groups. There was no differences in postoperative intravenous morphine consumption, and visual analog scale pain scores at rest and movement, or maximal bending and stretching of the knee joint during the 5 days after surgery. In Hayek et al study (29) the use of stimulating catheters for continuous femoral nerve blockade after TKA does not offer significant benefits over traditional nonstimulating catheters. The stimulating technique did not permit differences in the amount of ropivacaine administered, numeric pain rating scale scores, acute functional orthopedic outcomes, side effects, or amounts of oral opioids consumed. The same results are reported in a very recent trial (30) where continuous femoral block was a part of a multimodal analgesia regimen. There was no difference between groups in visual analog scale scores at rest on POD 1 and POD 2, during active and passive physiotherapy; and in markers of early recovery after surgery. Only Dauri and colleagues (31) reported that the use of a stimulating catheter was associated with faster onset time for the femoral nerve block, less patient-controlled regional analgesia boluses as well as intravenous rescue ketorolac, but pain scores were similar in both groups. There are two primary reasons that stimulating femoral catheters have not been shown to significantly improve analgesia after TKA. First, it is likely that any catheter tip placed under the fascia iliaca fascial plane would provide effective femoral analgesia, especially if enough volume is infused. Second, nociceptive areas from the knee are also supplied to a large extent by the sciatic nerve and the posterior division of the obturator nerve. Thus, it is difficult to make any definitive conclusions on the benefit of stimulating versus nonstimulating femoral catheters for major knee surgery unless the sciatic and obturator nerve contributions to postoperative pain are controlled. In the last few years, ultrasound-guided (USG) peripheral nerve blocks have increased in use. The potential benefits of utilizing ultrasound for continuous peripheral nerve/plexus blocks include the ability to directly visualize the neural and perineural anatomy, especially in the setting of normal

anatomical variations. In a few studies, USG for single shot peripheral nerve blocks has been shown to improve the efficiency of single-injection peripheral nerve blocks by decreasing the procedural time, the number of needle passes, and the onset time of the sensory blockade as well as increasing the overall success rate. The results concerning the interest of USG for CPNB are sparse. There's no prospective randomized study to date directly comparing ultrasound guidance versus peripheral nerve stimulation for CPC placement. Theoretically, ultrasound has the potential to confirm catheter tip location (direct visualization of the catheter tip or indirectly by visualizing local anesthetic spread) (8, 31). Ultrasonography for peripheral catheter placement can be a challenging technique. Methods to indirectly assess perineural catheter tip location are piezoelectric vibration of the catheter tip (32), injection of agitated microbubbles (33), which appears as a hyperechoic injectate within the anechoic LA fluid, or use of color flow Doppler (34), where the injectate appears as a mix of colors superimposed on the gray-scale background. Only two large prospective observational studies (35,36) in ambulatory patients demonstrated the effectiveness of USG as the primary modality (with or without needle nerve stimulation) to place peripheral nerve catheters. Both studies reported that 98% of catheters provided optimal postoperative analgesia with a low incidence of minor side-effects (complications rate was 0.4%). The 1st attempt catheter success rate was 96%. There were few interventions requiring an anaesthetist or a dedicated nurse, although it was clearly explained to the patient that a contact person for any questions or problems was available by phone 24 hours a day.

The masked face of the iceberg: the infectious risk: Continuous peripheral nerve block (CPNB) techniques continue to be increasingly used. Continuous PNB catheter infection is an issue that has received little attention to date. The frequency of infection associated with peripheral nerve catheters remains poorly defined (37-40). Although the risk of infection during CPNB is a major issue, the published literature has mainly focused on the conflicting evidence of the frequency of infectious complications associated with epidural anesthesia. Recent studies show that between 23%-57% of peripheral nerve catheters may become colonized, with 0%-3% resulting in localized infection (37-45). Severe infectious complications recently reported in the literature include psoas abscess complicating continuous femoral nerve blocks (37,46), axillary abscess and necrotizing fasciitis (38,47) after continuous and single shot axillary nerve blocks, and thigh and interscalene abscesses after continuous popliteal sciatic and interscalene nerve blocks respectively (39,48). An exogenous source of contamination is frequently suspected. The most frequently detected microorganism on the skin surface and in colonized catheter is *Staphylococcus epidermidis* (37-40), whereas *Staphylococcus aureus* is mainly reported in infections or abscess formation (37-39,45,48). Several risk factors such as appropriate patient selection (intensive care unit or trauma patients), catheter site insertion, prophylactic antibiotic use, local anesthetic solution contamination and catheter duration have been suspected to modify the risk of infection related to CPNB. The current recommendations to control infectious complications associated with CPNB are based on existing literature and guidelines for the prevention of epidural or intravascular catheters-related infection. The ASRA guidelines on this topic have been published in Regional Anesthesia and Pain Medicine Vol. 31 No. 4 July-August 2006 (50). These recommendations highlighted the importance of asepsis during regional anesthesia needle and catheter insertion, including handwashing, use of protective barriers (mask, gloves, gowns and drapes), and skin disinfectants. The role of subcutaneous tunneling and of bacterial filters is still controversial. Guidelines for practice improvement have to be build accordingly to specific actual risk applied to each procedure and certainly cannot be extrapolate without some restrictions (51). CPNBs are increasing in popularity, the incidence of infection associated with CPNB is thankfully rare. However, infectious complications will become undoubtedly more common.

Conclusion: Continuous PNB catheters promotes early mobilization and improve the functional prognosis of patients, while reducing the cost and duration of hospital stay. Perineural catheters are not associated with the same incidence of side effects as morphine systemic analgesia or epidural analgesia, and promote a low incidence of neuropathy (0.2%) and local inflammation (3%). They are not contraindicated in patients receiving anticoagulants. It is now clearly lawful to ask two questions: do we still have excuses and we still have the right not to use the continuous peripheral blocks when indicated in orthopedic surgery?

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12

LOW DOSE SPINAL ANAESTHESIA FOR CAESAREAN SECTION: ADVANTAGES, DISADVANTAGES, TIPS AND TRICKS

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Subarachnoid block is widely used for Caesarean section (CS) ¹.

Hypotension is the most common side effect (20 - 100%) ²⁻⁵ and has both maternal and neonatal consequences. Different strategies have been

attempted to prevent spinal-induced hypotension: low-dose bupivacaine, prophylactic vasopressors, different fluid therapy regimens and recently, the previous administration of ondansetron before subarachnoid block ⁶.

A. Advantages

We should administer enough local anaesthetic doses that allow a safe and comfortable CS avoiding **adverse effects** for both, mother and foetus.

1. Maternal effects.

1.1. Systemic toxicity:

It is related to high plasma local anaesthetic concentrations and more common after epidural than after spinal administration. It can be reduced by:

- 1.1.1. Aspirating the catheter before injecting
- 1.1.2. Adding epinephrine to the solution to delay intravascular absorption
- 1.1.3. Using a test dose
- 1.1.4. Injecting a local anaesthetic with a lower toxicity profile
- 1.1.5. Reducing the total dose injected
- 1.1.6. Administering the dose incrementally.
- 1.1.7. Using flexible epidural catheters ^{7, 8}.

1.2. Allergic reactions.

1.3. High spinal block:

Consequences of high spinal may include:

- 1.3.1. Massive sympathectomy that results in hypotension
- 1.3.2. Block of the cardiac accelerator fibers (T1 to T4), which inhibits compensatory tachycardia.
- 1.3.3. Hypoperfusion of the brainstem causing respiratory depression and nausea.
- 1.3.4. Dyspnoea resulting from anaesthesia of the chest.
- 1.3.5. Complete diaphragmatic paralyses if the C3 to C5 roots are blocked.
- 1.3.6. Aspiration of gastric contents due to loss of consciousness and compromise of airway reflexes.

1.4. Hypotension ^{9, 10}.

The incidence of hypotension is related to the speed of onset of the neuraxial block and the dose of local anaesthetic administered ¹¹. The use of ultra-low dose local anaesthetic techniques (e.g., bupivacaine 0.04 %) is associated with a lower incidence (9 %) of hypotension ¹².

The precise definition of hypotension is controversial and does not account for the pain of labour, which tends to increase baseline blood pressure; specific maternal conditions associated with elevated blood pressure, such as preeclampsia; or a parturient with a low baseline systolic pressure. Other key point is the application of other interventions such as colloids, ephedrine, phenylephrine or lower leg compression in order to reduce the incidence of hypotension. However none of them has been shown to eliminate the need to treat maternal hypotension during spinal anaesthesia for CS ¹³. Furthermore, prophylactic management has been associated with side effects: maternal iatrogenic pulmonary oedema, hypertension, arrhythmias ¹⁴ and foetal acidosis ^{15, 16} and increased heart rate and variability ¹⁷.

Reports of hypotension after intrathecal opioid administration during active labour probably represent a relative decrease in blood pressure as a consequence of pain relief, and not a direct effect of the opioid ¹⁸.

It is also important to remark that hypotension is not completely due to the total dose of anaesthetics. Other factors can modify the haemodynamics, such as the velocity of administration of drugs in the epidural space ¹⁹.

1.5. Pruritus ²⁰.

1.6. Nausea and vomiting:

The incidence is greater with the relatively poorly lipid soluble morphine compared to more lipid soluble opioids ²¹.

1.7. Respiratory depression:

It is rare in labouring patients. Factors that increase the likelihood of respiratory depression include a large opioid dose, poor opioid lipid solubility, concomitant use of additional sedatives and opioids by other routes, and the use of the sitting position soon after injection of opioids.

1.8. Urinary retention ²².

1.9. Shivering ²³.

2. Foetal effects:

2.1. Reduced placental perfusion:

Maternal hypotension may reduce placental perfusion, and results in decreased foetal oxygenation, manifested by deterioration in the foetal heart rate pattern (e.g., bradycardia, repetitive late decelerations) and acidemia ^{24,25,26}.

2.2. Foetal bradycardia

Intrathecal administration of opioid may induce a tetanic uterine contraction leading to foetal bradycardia ²⁷. Although the mechanism is not completely

understood, the incidence of foetal bradycardia is nearly twice as high when the intrathecal rather than the epidural route administers opioids ²⁸.

So, if we administer low doses of spinal anaesthetics / opioids for CS, we'll probably have fewer incidences of these adverse effects, and better haemodynamic profile. This is especially important in women with severe diseases ²⁹.

To perform an optimal CS, the D4 dermatome sensory level should be achieved.

The use of neuraxial opioid was very popular in recent years, and they may augment the analgesia produced by local anaesthetic through direct binding with the spinal opioid receptors. The addition of opioids allows to reduce the total dose of local anaesthetics and to improve the analgesia. Theoretically, the reduction of local anaesthetic by addition of an opioid would provide better haemodynamic stability and good anaesthetic status. In this way, Chu et al ³⁰ studied the impact of different doses of fentanyl (7.5, 12.5 or 15 mcg) added to bupivacaine in 75 CSs, reporting that the combination of bupivacaine with a dose of fentanyl as low as 7.5 mcg did not produce actual clinical effects. As the dose of fentanyl was increased to 12.5 mcg or 15 mcg the quality of surgical analgesia was better and the postoperative analgesia lasted longer. It seemed that the clinical effect might reach its ceiling at the dose of 12.5 mcg. Belzarena et al ³¹ compared in 120 healthy women who underwent CS with spinal anaesthesia using 0.5% hyperbaric bupivacaine, the effect of fentanyl 0, 0.25, 0.5 or 0.75 mcg/kg. Surgical anaesthesia was excellent in 100% of treated patients and in 87% of group 0. Respiratory rate decreased significantly in groups 50 and 75 and was recorded as early as 4 min after the administration of the drug. Nevertheless, respiratory depression did not develop in any patient, and 40 min later all groups had a similar respiratory rate. Regression of anaesthesia to the T-12 dermatome took a longer time as the dose of fentanyl increased, but all patients had recovered by 240 min after the injection. Effective postoperative analgesia lasted longer and significantly increased with the dose of fentanyl administered. Neonatal status was the same in all groups. Sedation and pruritus were the main side effects. The combination of bupivacaine and a low dose of fentanyl (0.25 mcg/kg) provide excellent surgical anaesthesia with short-lasting postoperative analgesia and very few negative side effects.

Oloffson et al. ³² conclude that subarachnoid (12.5 mg) and epidural (100 mg) injections with bupivacaine both produced adequate anaesthetic quality in women undergoing elective CS. The addition of fentanyl (10 micrograms subarachnoidally or 100 micrograms epidurally) did not significantly improve the quality of these already profound blockades.

Intrathecal morphine ³³ has been also studied for the relief of post-CS pain (0.1 and 0.25 mg), finding that 0.1 mg of intrathecal morphine gave excellent analgesia with minimal to no side effects. Ventilatory responses to CO₂ showed no evidence of depression attributable to either the 0.25 or 0.1 mg of morphine, but significant depression of the CO₂ responses was observed with the greatest dose after administration of subcutaneous morphine.

Spinal anaesthesia is the technique most often applied in cases of scheduled CS. The "classical" or conventional doses of spinal anaesthesia described for CS include 7 to 10 mg of hyperbaric tetracaine, 60 to 75 mg of lidocaine or 7.5 to 15 mg of bupivacaine (conventional dose of 0.06-0.07 mg.cm⁻¹), with or without fentanyl 10 to 25 mcg or morphine 0.1 to 0.25 mg. Hirao et al. ³⁴ compared morphine 0.1 mg with tetracaine 10 mg, bupivacaine 10, 12.5 and 15 mg and the total volume was adjusted to 3.1 ml with 10% glucose solution. They reported that all the four spinal agents provided an adequate analgesic level (T5) without serious complications with the time interval requiring for anaesthetic level to reach T5 tended to be shorter with a larger amount of bupivacaine. The incidence of intraoperative supplemental analgesic and hypotension and the dosage of ephedrine used to treat hypotension were greater in the patients anesthetized with tetracaine 10 mg than in those anesthetized with bupivacaine 10 mg, which is equipotent to tetracaine 10 mg. High dose bupivacaine was recommended in an urgent case, whereas low dose bupivacaine was recommended when maternal hypotension must be strictly avoided.

There are some references describing the use of low (or even ultra-low) doses of anaesthetics for CSs. Many authors have tried decreasing the local anaesthetic dose by adding opioids to achieve adequate analgesia with greater hemodynamic stability, although the ideal dose remains to be established.

Two regimens of spinal hyperbaric bupivacaine (11 or 6.5 mg) dose with fentanyl (20 mcg) were studied in 42 patients undergoing elective CS, observing that low doses of bupivacaine and fentanyl provides acceptable intraoperative conditions for a high percentage of patients undergoing CS, and both have a similar incidence of hypotension. The low dose generates

a less intense intraoperative motor blockade with similar spread of the sensory block. The low dose was not efficacious for 10% of the patients who received it.³⁵

Intrathecal opioids are synergistic with local anaesthetics and intensify sensory block without increasing sympathetic block, avoiding hypotension following spinal anaesthesia. The combination makes it possible to achieve spinal anaesthesia with otherwise inadequate doses of local anaesthetic. Bupivacaine 5 mg with fentanyl 25 mcg provided spinal anaesthesia for caesarean delivery with less hypotension, vasopressor requirements, and nausea than spinal anaesthesia with 10 mg bupivacaine.³⁶

Lee et al.³⁷ reported that the addition of fentanyl 20 mcg or sufentanil 2.5 mcg for spinal anaesthesia provides adequate intraoperative analgesia without significant adverse effects on the mother and neonate.

Bernat et al.³⁸ described in 50 ASA 1-2 patients undergoing CS, randomized to 5 treatment groups receiving no opioid or 15 mcg of fentanyl with hyperbaric bupivacaine (10, 11, 12, 13 and 14 mg), that acceptable operative conditions with a low incidence of hypotension are provided with an 11 mg dose of hyperbaric bupivacaine.

Small-dose (6.6 mg) of hyperbaric versus plain bupivacaine, both combined with sufentanil 3.3 mcg have been also compared in 98 parturients finding that the use of hyperbaric bupivacaine in this manner provides a more reliable block and a lower incidence of hypotension than plain bupivacaine, which was reflected in a lower incidence of hypotension and nausea.³⁹

Kang et al.⁴⁰ compared the combination of small-dose of 5 mg hyperbaric bupivacaine plus 25 mcg fentanyl (0.5 ml) and cerebrospinal fluid (CSF) 0.6 ml or 8 mg hyperbaric bupivacaine plus 0.5 ml of CSF. The combination of small-dose bupivacaine with fentanyl could provide more stable hemodynamic status, longer postoperative analgesia, and lower incidence of shivering. The incidence of pruritus in this group was high, but it was usually mild.

Bryson et al.⁴¹ compared 4.5 mg and 12 mg doses of intrathecal bupivacaine on maternal haemodynamics and determined if anticipated reductions in side effects were reflected in increased patient satisfaction. They reported that the proportion of patients requiring ephedrine (> 70%) and the quantities of ephedrine used were similar in both groups (NS). Use of supplemental analgesia, side effects, and measures of patient satisfaction were comparable in both groups. Intrathecal bupivacaine 4.5 and 12 mg yielded similar sensory block and side effects during Caesarean delivery. Patients receiving 4.5 mg did, however, experience significantly less motor blockade of shorter duration.

Turhanoglu et al.⁴² assessed the efficacy of low-dose bupivacaine with fentanyl to reduce the incidence of hypotension in spinal anaesthesia for CS (n=40), receiving 10 mg bupivacaine or 4 mg bupivacaine plus 25 mcg fentanyl. They observed that the development of hypotension after spinal block in subjects undergoing CS was not prevented despite low-dose (4 mg) bupivacaine plus 25 mcg fentanyl, but the severity of maternal hypotension, and the number of ephedrine treatments and the total dose of ephedrine were decreased. Sensory block was adequate for surgery in all patients. Hypotension occurred in all patients receiving 10 mg (100%) and in 15 patients receiving 4 mg of bupivacaine (75%). Three patients in group receiving 4 mg bupivacaine required i.v. fentanyl supplementation after delivery. In 1 of these patients, i.v. fentanyl was not adequate, and epidural supplementation of 1% lidocaine was required.

The new local anaesthetics have been also compared in CSs.

Parpaglioni et al.⁴³ determined that using plain levobupivacaine the ED50 for a satisfactory obstetric subarachnoid block is 10.6 mg. Gautier et al.,⁴⁴ using a lower dose, found that levobupivacaine provided unsatisfactory results in 20% of patients, compared with 3% plain bupivacaine. Gori et al.⁴⁵ described that the gravity (position of the patient) did not influence on the spread of levobupivacaine in women undergoing spinal anaesthesia for CS. Moreover, the block levels were distributed in a relatively narrow range and the success rate was high, resulting in a predictable anaesthesia.

Coppejans et al. in 91 elective patients studied either 10 mg ropivacaine or 6.6 mg bupivacaine or levobupivacaine both combined with sufentanil 3.3 mcg intrathecally in spinal-epidural anaesthesia. The ropivacaine group required additional local anaesthetics by the epidural route in 23% of the cases versus 10% in the bupivacaine group and 9% with levobupivacaine. Hemodynamic values were comparable between the three groups although a trend towards better systolic blood pressures and a lower incidence of severe hypotension were noticed in favor of levobupivacaine. Apgar scores and umbilical pH values did not differ.⁴⁶

B. Disadvantages

The main disadvantages of low dose spinal anaesthesia are the less duration of sensory and motor block. Numerous authors have reported these may difficult the CS and even finish in general anaesthesia. From previous prospective trials, it is clear that lowering the spinal dose improves maternal haemodynamic stability. Doses of intrathecal bupivacaine between 5 and 7 mg are sufficient to provide effective anaesthesia. Complete motor block is, however, seldom achieved and adequate anaesthesia is limited in time.³ Other author reported the same conclusions. Bryson et al.⁴¹ described that intrathecal bupivacaine 4.5 and 12 mg yielded similar sensory block and side effects during Caesarean delivery, but patients receiving 4.5 mg did, however, experience significantly less motor blockade of shorter duration. Arzola et al.⁴⁷ concluded in a meta-analysis that low-dose bupivacaine (≤ 8 mg) vs. conventional dose (>8 mg) in spinal anaesthesia compromises anaesthetic efficacy (risk of analgesic supplementation: high grade of evidence [risk ratio (RR)=3.76, 95% confidence interval (95% CI)=2.38-5.92]), despite the benefit of lower maternal side-effects (hypotension (RR=0.78, 95% CI=0.65-0.93), nausea/vomiting (RR=0.71, 95% CI=0.55-0.93); moderate grade of evidence). Neonatal outcomes (Apgar score, acid-base status) and clinical quality variables (patient satisfaction, surgical conditions) showed non-significant differences between different dose regimens.

The faster recovery could be seen as one advantage (e.g., less time in the post anaesthetic care unit), but we must remember it goes associated with an earlier onset of postoperative pain, and the pain (and its treatment) could develop adverse effects.

C. Tips

The main tips are do not use low dose spinal anaesthetics when the patient has previous abdominal surgery (possibility of peritoneal adhesions, technical difficulties and prolonged operating time), and also in morbid obese parturient (prolongation of surgical time).

Reyes⁴⁸ described a case report of a successful CS requiring a very low total dose of 5 mg hyperbaric spinal bupivacaine without any spinal or intravenous supplements in a morbidly obese (BMI=66 kg/m²) preeclamptic parturient. However, Carvalho et al.⁴⁹ investigate the ED(50) and ED(95) of intrathecal bupivacaine in morbidly obese parturient (body mass index equal to or more than 40) undergoing caesarean delivery. Forty-two patients were randomly assigned to receive intrathecal hyperbaric bupivacaine in doses of 5, 6, 7, 8, 9, 10, or 11 mg (n = 6 per group) coadministered with 200 mcg morphine and 10 mcg fentanyl. Obese and no obese patients undergoing caesarean delivery do not appear to respond differently to modest doses of intrathecal bupivacaine. This dose-response study suggests that doses of intrathecal bupivacaine less than 10 mg may not adequately ensure successful intraoperative anaesthesia. Even when the initial block obtained with a low dose is satisfactory, it will not guarantee adequate anaesthesia throughout surgery.

Combined spinal low doses - epidural has been used in situations where the haemodynamic state should be maintained, such as preeclamptic women.⁵⁰ Berends et al.⁵¹ compared the maternal and neonatal effects of conventional epidural anaesthesia and combined spinal epidural anaesthesia (CSE) for CS in 30 severe preeclamptic patients, concluding that combined spinal and epidural anaesthesia (CSE) is a safe alternative to conventional epidural anaesthesia in severe preeclamptic women. A case report of a low-dose sequential combined-spinal-epidural anaesthesia for CS in a patient with tetralogy of Fallot (the most commonly encountered congenital cardiac lesion in pregnancy) has also been reported.⁵²

D. Tricks

There are two ways to reduce spinal dose requirement for CS: epidural volume extension and low-dose sequential combined spinal-epidural blockade.⁵³

The effect of epidural volume extension with 5 ml saline on spinal blockade as part of a combined spinal epidural technique in 90 term parturient undergoing elective CS has been reported as deprived of benefits.⁵⁴ Kucukguclu et al.⁵⁵ reported also the same conclusions, no effect of epidural volume extension with 10 ml saline on the profile of spinal anaesthesia with the combined spinal-epidural technique for CS using hyperbaric or plain bupivacaine.

Low-dose spinal anaesthesia as part of a combined spinal-epidural technique is a valuable method in improving maternal and foetal outcome during anaesthesia for operative delivery.³

There are anaesthesiologists who prefer to use only low doses of local anaesthetics intrathecally and only use the epidural route if it is necessary.

Others combine a low dose of subarachnoid local anaesthetic with epidural supplementation.

The “ideal” combinations of spinal and epidural doses have been studied. Fan et al.⁵⁶ reported in 80 parturient the effects of different doses of intrathecal hyperbaric bupivacaine (0.5%) combined with epidural lidocaine (2%). They found that at least 5 mg of bupivacaine should be administered intrathecally (2.5 mg of bupivacaine provided insufficient muscle relaxation) combined with 10-12 mL of lidocaine 2%, resulting in satisfactory anaesthesia with rapid onset and minimum side effects with the advantages of both spinal and epidural anaesthesia and few of the complications of either.

Spinal 0.5% hyperbaric bupivacaine with fentanyl (20 mcg) at a conventional dose of 0.07 mg.cm(-1) has been compared with 0.25% levobupivacaine 7.6 mg with fentanyl (20 mcg) and epidural volume extension with 6 mL of saline through an epidural catheter in 62 patients. The motor block and duration was less intense in the levobupivacaine groups, but one patient required general anaesthesia because of insufficient sensory block achieved.⁵⁷

Finally, another trick is to make the approach into the intervertebral space L2-L3 to facilitate better dissemination of local anaesthetics into the CSF.

The local anaesthetic concentration could have a significant role in the extension of motor block. Celleno et al.⁵⁸ described that intensity of motor block is different between levobupivacaine 0.75% and 0.5%. Moreover, density of the local anaesthetic is another important factor with respect to the cerebrospinal gravity in determining the difference in the left and right side intrathecally distribution of the drug.⁵⁸

In conclusion, we can use conventional (>8 mg), low (< 8 mg), or ultra-low (< 4-5 mg) doses of spinal bupivacaine for CS. How to select the adequate dose depends on various factors, including the medical history of the woman, the existence of previous epidural analgesia for labour and even the hospital and the obstetricians who are going to perform the surgery.

Low and ultra-low doses may be a very important part of the anaesthetic care in patients where the haemodynamic stability could be compromised (e.g., cardiac pathology, pulmonary hypertension...). The risks of using low or ultra-low doses, such as incomplete analgesia or muscle relaxation could be avoided with combined spinal-epidural or continuous spinal anaesthesia techniques, in order to supplement doses if necessary.

Finally we should not forget other manoeuvres to reduce the incidence and severity of maternal hypotension after spinal anaesthesia.

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13

THE LESS THAN OPTIMAL EPIDURAL. CAUSES AND MANAGEMENT

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Failure of epidural anaesthesia and analgesia is a frequent clinical problem. Current estimates concerning the incidence of failed epidurals are hampered by lack of a uniform outcome parameter. The definitions given cover a spectrum ranging from insufficient analgesia to catheter dislodgement to any reason for early discontinuation of epidural analgesia. The failure rate in thoracic epidurals has been reported in the range between 13% and 47%, with similar results obtained for lumbar epidural catheters used for major abdominal surgery. In a heterogeneous cohort of 2140 surgical patients, Ready and coworkers found a failure rate of 32% for the thoracic, and 27% for the lumbar epidural.¹ The incidence of failure for obstetric epidural catheters ranges between 13.1% to

23.5%. This lower failure rate may be due to the lumbar insertion site, or be associated with the difference between labour and post surgical pain.

Technique of epidural anaesthesia and analgesia

Basically, two reasons for epidural failure can be differentiated, i.e. faulty position of the epidural catheter, or insufficient analgesia through a correctly placed catheter. Motamed and coworkers performed an imaging study using computed tomography to study failed epidurals, and found that both phenomena contributed equally to epidural failure.²

Catheter not in the epidural space

Epidural catheters may primarily be placed erroneously, or dislodge during the course of treatment. Primary malposition of epidural catheters has been described, among others, in the subcutaneous paraspinal and paravertebral space, in the pleural cavity, and intravascularly. Even when the epidural space is correctly identified, the catheter will not necessarily follow a straight line when being advanced, but may deviate in different directions. The epidural catheter may exit the epidural space via the lateral foramen at levels above or below the insertion site. Furthermore, secondary migration of the catheter after successful initial placement does occur. During normal patient movement, epidural catheters may be displaced by centimetres. Next to gross body movements, changing epidural pressure and cerebrospinal fluid oscillations might also contribute to this phenomenon.³ In conclusion, catheter position may be primarily erroneous, catheters may kink or deviate during insertion, and may migrate secondarily due to body movements and cerebrospinal fluid oscillations.

Localization of the epidural space

Placement of the epidural catheter in the correct position requires tools to properly identify the epidural space. There is considerable variation in the methods used to detect whether the needle is in the epidural space. The use of saline for the loss of resistance (LoR) detection has become more popular over the years and a majority of Canadian and UK anaesthetist indicated that this was their preferred method. Air is also commonly used, whereas the hanging drop technique or other variations were less popular. The hanging drop technique depends on a negative pressure in the epidural space, which sucks the hanging drop into the needle. However, recent experimental evidence highlighted that negative pressure is suboptimal in reliably detecting the epidural space, and if at all, is prudent only in the sitting position. A clinical trial comparing 40 patients undergoing epidural anesthesia using LoR with air versus hanging drop resulted in equal success rates. However, of note, identification of the epidural space was 2 mm deeper for the hanging drop as compared to LoR, possibly indicating increased risk of dural perforation with hanging drop. The discussion whether to best use air or saline for LoR to achieve optimal success rate and minimize adverse events is ongoing. A meta-analysis by Schier and colleagues in 2009 included 5 RCTs comparing air vs. saline: four in the obstetric population and one nonobstetric, giving a total population of 4422 patients. No significant difference in any outcome was found, except a 1.5% reduction in postdural puncture headache when using saline vs. air.⁴ Finally, whatever technique is used, it is of importance to realise that the ligamentum flavum is not continuous in all patients, and the presence of midline gaps may make the loss of resistance to needle advancement and injection of air/saline less perceptible. A number of technical aids for epidural anaesthesia has been described, none of them exhibiting sufficient accuracy and practicability to as yet justify the increased effort and cost of routine use. Next to serving as an educational tool and enhancing the learning curve for epidural anaesthesia, ultrasound has been advocated to determine anatomical parameters prior to epidural puncture. While some evidence exists to support this practice at lumbar levels, corresponding investigations in the thoracic region have not shown precise correlation, most probably due to the oblique angle of insertion of the epidural needle as an additional confounding factor. Pre-assessment of epidural space depth has been shown to correlate well with actual puncture depth in obese parturients. Finally, the measurement of pulsatile waveforms within the epidural space, optical spectroscopy, electrical nerve stimulation, and acoustic guidance have been described. In conclusion, the use of LoR with saline is the preferred technique among anaesthesiologists to localize the epidural space, this practice being supported by literature with regard to post punctural headache, and possibly success rates. Nevertheless, use of the preferred technique by a senior anaesthetist is a strong predictor for success and is therefore recommended.

Choosing the optimal puncture site

Numerous studies have shown that anaesthesiologists tend to be inaccurate when determining the precise level of neuraxial puncture. Of note,

most studies show that there is a clear tendency to puncture more cranially than intended.

Midline vs Paramedian

Few studies examined the effect of median versus paramedian needle placement upon block success. In summary, after appropriate local infiltration, the paramedian approach seems to offer advantages concerning catheter insertion, and vascular puncture that need to be confirmed in larger-scale trials.

Catheter insertion and fixation

Insertion of an epidural catheter should be at least 4 cm into the epidural space, with recent studies reporting higher success rates when slightly more than 5 cm were achieved. Of note, tunnelling the epidural catheter for 5 cm in a cohort of 82 patients was associated with significantly less inward, but not outward, motion of the catheter, but the percentage of catheters maintaining original position was not statistically different. In more than 200 patients undergoing either thoracic or lumbar epidural anaesthesia, tunnelling led to significantly decreased catheter migration, with a modest clinical net result of 83% of functioning catheters, after 3 days as compared to 67% without tunnelling. Suturing of the epidural catheter was similarly associated with less migration, but at the cost of increased inflammation at the puncture site. Increased inflammation was also observed in tunnelled catheters.

Test dose

The optimal way to determine accurate position of the epidural catheter has been debated. When administering a test dose, the two main objectives are to detect intrathecal and intravascular catheter placement. The optimal strategy to detect intrathecal catheter placement was long considered to be lidocaine coupled with epinephrine, but the evidence remains inconclusive. Specific regimens to detect intravascular catheter position have been reported for non-pregnant adult patients (fixed epinephrine test dose), parturients (fentanyl test dose), and children (weight-adjusted epinephrine test dose).⁵ We recommend a test dose consisting of lidocaine (to detect intrathecal placement) and epinephrine (to detect intravascular placement).

Epidural space anatomy and material

Even if the catheter is inserted into the epidural space in the first place, several anatomic circumstances may impede optimal analgesia. First, the orifice of the catheter can be in the lateral or anterior epidural space, thereby leaking the local anaesthetic preferably to one side, producing an unilateral block. Anatomical variations in the epidural space have been described. Inadequate distribution of local anaesthetic may also be the consequence of pathology in the epidural space. Deposition of mucopolysaccharides has also been described to possibly impede block formation. Finally, problems with the material itself may be responsible for epidural failure. Manufacturer's errors may occur, such as faulty markings on the epidural catheter. This can lead to erroneous depth of catheter placement resulting in inadequate analgesia or intravascular placement. Debridement in the catheter or disconnection may similarly cause epidural failure. One important preventable cause for obstruction of the epidural infusion system is air lock in the filter. Depending on the manufacturer, as little as 0.3 to 0.7 ml of air is sufficient to cause obstruction. Knotting of the catheter inside or outside the body can cause obstruction. Only 13% of lumbar catheters inserted in a group of 45 men were advanced more than 4 cm without coiling, with coiling occurring at a mean insertion depth of 2.8 cm. Coiling may lead to kinking, obstructing flow and hindering withdrawal. The frequency of knotting catheters is estimated to be 1:20,000-30,000 epidurals. Based on 18 case reports, Brichant et al. concluded that 87% of the knots occurred less than 3 cm from the tip of the catheter and that 28% of the knots were associated with a loop in the catheter. Removal of a presumably knotted catheter can be attempted after sensitivity has returned to monitor for neurological symptoms during catheter removal. It should never be gone through with once radicular symptoms or pain occur. It has been suggested that removal is easiest if position at insertion and removal are similar. Surgical removal of a broken catheter is not obligatory if the patient remains asymptomatic. In summary, catheters may deviate during insertion. Next to insufficient analgesia, kinking and knotting of catheters may rarely ensue. Direct retrieval of the catheter should be attempted, preferably in the same position as during insertion. In case of catheter fracture, surgical retrieval is not mandatory if the patient is asymptomatic. Manufacturing faults may include faulty length markers. Air at small volumes may lock the anti-bacterial filter.

Pharmacology of epidural anaesthesia and analgesia

Choice and dosing of local anaesthetic and adjuvants is crucial in the management of epidural anaesthesia and analgesia.

Bupivacaine vs levobupivacaine vs ropivacaine

The three main local anaesthetics for epidural anaesthesia and analgesia are bupivacaine, levobupivacaine, and ropivacaine. Improved possibility to achieve

differential blockade, and increased cardiac safety have driven the increased use of the newer isoforms. The equipotency of these three drugs has been the subject of many clinical studies. The order of clinical potency has been described as bupivacaine > levobupivacaine > ropivacaine.⁶ Ropivacaine has a longer duration of action than bupivacaine, such that decreased potency could be offset by longer presence at site of injection to result in clinical near-equipotency. However, comparison of equal doses of bupivacaine and ropivacaine is difficult as the difference in potency is approximately 40-50%. This has profound consequences because to interpret differential toxicity, this difference in potency needs to be taken into account. If one transponds this potency difference to local anaesthetic doses causing convulsions in animal models, near equipotency of bupivacaine and ropivacaine concerning toxicity becomes apparent. One may next argue that patients intoxicated with ropivacaine are thought to be easier to resuscitate than those intoxicated with bupivacaine based upon enhanced receptor binding and more profound effects on mitochondrial respiration and thus cardiac performance of the latter. However, the therapy advocated to support resuscitation of patients intoxicated with local anaesthetics, intralipid, may be more beneficial in bupivacaine- than in ropivacaine-induced toxicity owing to the lipophilic properties of bupivacaine. In summary, there is no clear-cut evidence base to refute bupivacaine in favour of the newer isoforms when used for epidural anaesthesia or analgesia in adults.

Addition of opiates

The addition of small doses of opiate allows for dose reduction in local anaesthetics while improving quality of analgesia. The vast majority of studies support the use of a combination of local anaesthetic and opioid over either drug alone. The addition of opiates allows for smaller concentrations of local anaesthetic, thereby possibly reducing motor block postoperatively, or during labour. In fact, it has been stated that the entire concept of low-dose local anaesthetics for analgesia is feasible only when opioids are used as adjunct therapeutics. Moreover, recent data suggest that epidural opioids can enhance the quality of suppression of the surgical stress response. The optimal dose of added opiate is debated, and many combinations have been investigated. Importantly, epidural opioid concentrations are affected in a complex way by the addition of epinephrine. Profound differences exist between hydrophilic opioids (such as morphine) and lipophilic opioids (such as fentanyl and sufentanil). Microdialysis studies demonstrate that epidural morphine has a longer residence time in the epidural space, and results in higher CSF concentrations as compared to sufentanil and fentanyl. This long residence time results in a spinal mechanism of action, and consequently, clinical studies show a substantial dose reduction in morphine when used epidurally instead of intravenously. Corresponding evidence for lipophilic opioids such as fentanyl and sufentanil, however, is more conflicting. In a recent study undertaken in healthy volunteers, differences were observed between continuous and bolus infusion. While continuous infusion resulted in non-segmental analgesia (indicating supraspinal action), bolus injection resulted in segmental analgesia (indicating significant spinal contribution). Therefore, the elicitation of a spinal analgesic mechanism may depend on sufficient concentrations of fentanyl in the epidural space to allow for diffusion into the CSF, i.e., estimated above 10 mcg/ml, which exceeds current postoperative analgesia regimens.⁷ Finally, some potential disadvantages of epidural opioid administration should be discussed. First, the safety of opioids in obstetric analgesia has been subject of discussion. Potential disadvantages of epidural opioid application include possible interference with breast-feeding. Concerning placental transfer, sufentanil was suggested to be superior to fentanyl when used for epidural labour analgesia. Clinical studies have found subtle advantages of sufentanil over fentanyl when added to bupivacaine in obstetric epidural analgesia. Second, biphasic respiratory depression may occur when opioids are given epidurally. With hydrophilic opioids such as morphine, the first peak corresponds to absorption from the epidural space into the systemic circulation and occurs 30-90 minutes after injection, while a second depression occurs 6-18 hours later as morphine spreads towards the brainstem. In lipophilic opioids, there is only an early depression due to absorption and rostral spread. In summary, the addition of opioids allows for the use of low doses of local anaesthetics while retaining analgesic efficacy. Pharmacokinetics of epidural opiates differ between substances (hydrophilic versus lipophilic) and site of injection.

Addition of epinephrine

The addition of epinephrine causes two desired effects. First, vasoconstriction causes delayed absorption of local anaesthetic into the systemic circulation, with higher effect-site and lower plasma concentrations. Second, epinephrine has specific antinociceptive properties predominantly mediated via α -2 adrenoreceptors.⁸ Effects of epinephrine with regards to local

anaesthetics and opiates are supra-additive. For example, the MLAC of bupivacaine is reduced by 29% in labouring parturients. Removing epinephrine from a low-dose thoracic epidural ropi-fenta infusion caused dynamic pain peaks, while epinephrine improved pain relief and reduced nausea. Overall, it has been suggested that adding epinephrine at the lumbar level does not confer the same benefits as compared to thoracic levels. Studies point towards a concentration of 1.5-2 μ g/ml as an effective concentration. Finally, some potential risks of adding epinephrine should briefly be discussed. Potential side effects have been described in obstetrics, where Eisenach and colleagues observed a small but significant prolongation of analgesia; which was said to have to be weighed against potential risks of epinephrine-containing solutions in obstetrics (longer labour, decreased uterine blood flow). Indeed, a slightly longer duration of second stage of labour was observed by Soetens et al. Delicate balance in obstetric analgesia, with balance between beta-mimetic effect of epinephrine absorbed into the systemic circulation and reduced endogenous epinephrine levels due to more effective analgesia.

In summary, epinephrine strengthens analgesia by delaying resorption of local anaesthetic from the epidural space, and by direct antinociceptive action at the spinal cord.

Bolus versus continuous dosing

The advent of patient-controlled epidural analgesia has profoundly changed the administration of postoperative pain treatment. In labour analgesia, van der Vyver et al. clearly demonstrated in a meta-analysis that patients undergoing obstetric PCEA needed less co-analgesic interventions, while requiring less local anaesthetic, and potentially having a decreased likelihood of motor block, albeit without a difference in maternal satisfaction.⁹ Importantly, mode of delivery was unaffected. Using pain scores and cumulative local anaesthetic dose as outcome parameters, conflicting evidence has been put forward to prove or refute background infusions. It is important to keep in mind that PCEA requirements are determined by the site of surgery, surgery involving malignant disease, weight and age seem most important in determining requirements. In summary, the optimal configuration for postoperative epidural analgesia is a patient-controlled form with background infusion.

Dose versus volume

The influence of dose, concentration and volume upon spread of epidural anaesthesia and analgesia has been subject of considerable research, and different constellations of volume and concentration have been assessed. In general, the main determinant of epidural action is the local anaesthetic dose, with volume playing a less important role.¹⁰ There is also evidence supporting a significant role of volume in spread of anaesthesia. For example, the number of dermatomes blocked during labour analgesia was higher in a high-volume bupivacaine group than a low-volume group when the same dose was administered. However, if the difference between injected volumes differs by more than 200% for the same concentration, the block will spread further in the high-volume group. The incidence of side-effects such as motor block has been controversially discussed. Moreover, there is evidence that reducing dose increases probability of differential blockade. It should be kept in mind that differential blockade is a complex phenomenon, in part caused by differential conduction block of spinal nerves and roots, and in part by differential central somatosensory integration. Co-administration of opioids may further confuse this situation, because introducing opioids in higher volumes may affect a larger number of opioid receptors. As is valid for the administration of opioids, differences exist between lumbar and thoracic epidural anaesthesia. Motor block may be more pronounced in lower lumbar than in thoracic block, because of proximity of motor fibers supplying the lower extremity. In labour, low-dose epidural analgesia may be associated with less operative vaginal deliveries. The use of smaller doses in higher volumes has been advocated for obstetric analgesia. In summary, dose is the primary determinant of epidural anaesthesia, with volume and concentration playing a minor role.

Conclusion: Failure of epidural anaesthesia and analgesia occurs in up to 30% in clinical practice. Most often, technical reasons are to blame for inferior success. Epidural catheters may be erroneously placed, or may migrate secondarily after initial correct placement due to body movement or oscillations in cerebrospinal fluid. Moreover, catheters may deviate from the midline during insertion. The optimal depth of insertion in adults is approximately 5 cm. The most widely used method for localizing the epidural space is loss of resistance to saline, but personal experience seems to be the most important factor predicting success. None of the technical tools available has sufficient accuracy and predictability to justify routine use. No large-scale studies have compared the median and paramedian approach, but limited evidence points towards less risk of vascular puncture, and improved

catheter insertion when the paramedian approach is used. Routine tunneling seems appropriate only for caudal epidural catheters. The optimal test dose should combine lidocaine (to detect intrathecal placement) and epinephrine (to detect intravascular placement). In the case of catheter knotting, direct retrieval of the catheter should be attempted once anaesthesia has worn off, surgical intervention is rarely indicated. The choice of long-acting local anaesthetic seems to be less important clinically. Dose is the primary determinant of epidural anaesthesia, with volume and concentration playing a minor role. Addition of opiates may substantially increase the success rate of epidural analgesia. Epinephrine strengthens analgesia by delaying resorption of local anaesthetic from the epidural space, and by direct antinociceptive action at the spinal cord. The preferred method of delivery for postoperative analgesia is patient controlled epidural analgesia with background infusion. The interested reader should be referred to a most recently published review article on this subject.¹¹

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ULTRASOUND-GUIDED (USG) SELECTIVE NERVE BLOCKS FOR KNEE SURGERY

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Background and aims: The administration of peripheral nerve blocks for knee surgery includes a long range of various block types and techniques. In addition, there have been many block combinations previously described in the literature where blind landmark-techniques, electrical nerve stimulation and ultrasound guidance have been employed.

The knee joint and the overlying skin and muscle are supplied by nerves from the lumbar and sacral plexus. The cutaneous and articular sensory in-

ervation of the knee region is complex and displays considerable variation.¹ Thus, it would seem to be relatively simple to provide complete analgesia and anaesthesia for practically any kind of knee surgery if both the lumbar and sacral plexus are blocked. However, these are two rather centrally placed block techniques, and we would like to point out that it is of utmost importance for the anaesthetist administering the peripheral blocks for knee surgery to be sure of what kind of blockade is most warranted to serve the needs of the patients and the needs of the surgeon - for any kind of specific surgical procedure. What kind of blockade will benefit the patients the most? Is it important that the patient can walk out, or is it acceptably that the patient also have some residual motor blockade.

The aim of this refresher course paper regarding the administration of "Ultrasound-guided (USG) selective nerve blocks for knee surgery" is to highlight some of the current possibilities to provide various USG blocks and block combinations for several types of knee surgery. In this paper and the ESRA lecture we aim to focus on USG blocks providing surgical anaesthesia for knee arthroscopy (KA) and anterior crucial ligament reconstruction (ACL-R), and on the administration of various USG blocks for post-operative analgesic regimes including blockade of the saphenous nerve (SAPH), the obturator nerve (ON), the lateral cutaneous femoral nerve (LCFN), the femoral nerve (FN) and various combinations hereof. Finally, we will provide a short topical review concerning the most comprehensive type of knee surgery; i.e. total knee arthroplasty (THA). When appropriate we will substantiate our USG block methods with magnetic resonance (MR) imaging.

Methods: This refresher course paper is based on some of the papers we have published previously, but also based on some of the scientific projects we have currently undertaken.²⁻⁶ We briefly attempt to describe some of the techniques and block combinations we are currently using in our daily clinical practice, and we supply with MR imaging in the lecture when appropriate, since we believe it is of utmost importance to verify the various USG blockade techniques with other well known visual techniques for confirmation of spread of the injected local anaesthetic solution.

Results: Primarily, we wanted substantiate, that it is indeed possible to produce sufficient and consistent surgical anaesthesia and analgesia for surgical procedures such as KA and ACL-R. We have previously provided evidence to this effect.⁵ Aiming to obtain surgical anaesthesia for KA, we would take use of the quadruple block to anaesthetize the FN, ON (both anterior - ONA - and posterior - ONP - branches) and the LCFN. This has previously proved sufficient for KA procedures without any negative side effects.⁵ To obtain surgical anaesthesia for ACL-R, we would take use of the quintuple block. The quintuple block is the quadruple block combined with a block of the sciatic nerve (anterior approach).⁵ Adhering to these principles we would abide to the principles of Prof. P. Marhofer and Prof. S. Kapral, Austria: only block the nerves as peripheral as possible and as central as necessary. The quadruple and quintuple block combinations allow the anaesthetist to administer the blocks prior to surgery in a preparatory area under full monitoring ensuring that the patient are instantly ready to be moved into the operating theatre without costly time delay. Concerning lean management, fast track surgery and bypassing the PACU area the quadruple and quintuple block combinations seem very well suited for day care surgery procedures such as KA and ACL-R.

Postoperative pain management:

ACL-R: We recommend either an USG SAPH/ONP or an USG FN/ONP blockade (Fig. 1, 2, 3). In our current research programme we aim to elucidate whether a combined block of the FN/NOP or a combined block of the SAPH/NOP would prove equally effective concerning postoperative pain management, or whether there would be any significant disadvantage in the motor block resulting from the FN blockade.

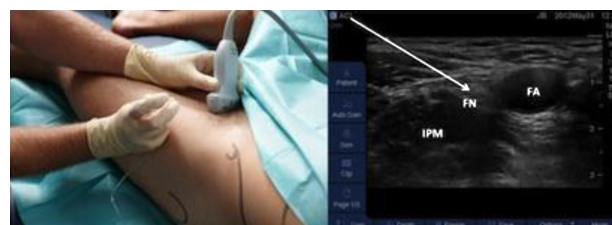


FIG. 1. USG FN block

KA: We recommend an USG SAPH/ONP blockade.



FIG. 2. USG SAPH block

Many anaesthetists regard the KA procedure as a minor procedure relative to postoperative pain. However, more than 50% of patients suffer from significant pain. We are currently undertaking a randomized, placebo-controlled and double-blind trial after IRB approval to investigate whether an USG block combination of the SAPH/ONP versus placebo (saline) will significantly reduce postoperative pain and opioid consumption.



FIG. 3. USG ONP block

We have supplied this paper with MR imaging.

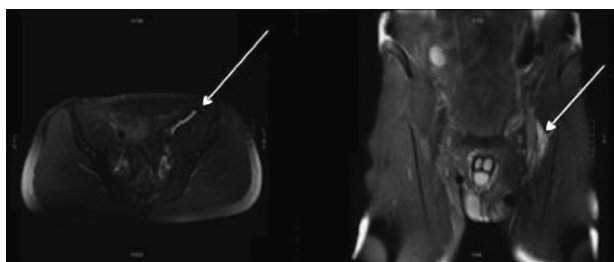


FIG. 4. MR femoral nerve block

We believe it is of utmost importance to verify the various USG blockade techniques with other well known visual techniques for confirmation of spread of the injected local anaesthetic solution

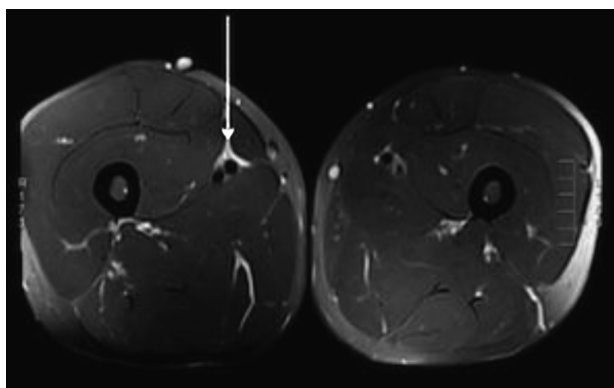


FIG. 5. MR saphenous nerve block

TKA: For this most comprehensive knee surgery procedure we are generally very concerned not to block the motor function of the thigh. Nothing would be easier for the anaesthetist than to administer a total block of the lumbar and sacral plexus, and there would be no acute pain following the procedure. However, the patients may stumble and fall do to the loss of motor function.

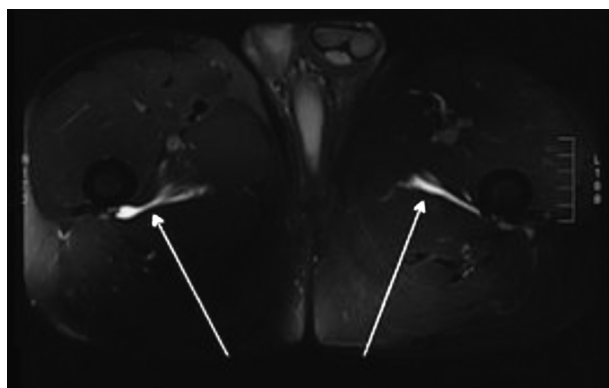


FIG. 6. MR ONP block

The TKA patients are a different lot as compared to the KA/ACL-R patients, and we must not generalize in this respect. Thus, we are currently recommending an USG SAPH/ONP blockade for postoperative pain management. We have also undertaken a randomized, placebo-controlled and double-blind trial after IRB approval to investigate whether an USG block combination of the SAPH/ONP versus SAPH/placebo (saline) will significantly reduce postoperative pain and opioid consumption.

Finally, we would like to mention the probable role of the continuous adductor canal block previously described by Lund et al.¹ Maybe the adductor canal block will prove to be the best solution for TKA patients.¹ As of now - we do not know.

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Pain after knee arthroplasty: the quest continues - part 2:

Pain treatment after knee arthroplasty has been the subject of intense research for almost forty years (1). A simple Medline query using the search words "knee arthroplasty" and "postoperative pain" yields no less than 1788 hits, and in the past ten years alone, 170 original cohort studies may be identified specifically investigating the efficacy of analgesic regimes following the procedure (2, 3). Many reports on the same subject usually hints at

the fact that no single regimen is perfect. High efficacy may compete with undesirable side effects, or vice versa. This is truly the case with pain after knee arthroplasty, in which one of the fundamental side effects include motor block of the quadriceps muscle. A quest for alternatives that minimize impaired mobilization has therefore been undertaken for many years now. Effective pain management includes epidural or femoral nerve block, local infiltration analgesia (LIA), systemic opioids, and combinations of adjuvant drugs or additional nerve blocks. Each technique has its advantages and disadvantages (Fig/Table 4).

Pain strategy	CNS function	Intestinal function	Cardio-respiratory function	Mobilization
Systemic opioids	Sedation, altered mental state, pruritus	Nausea, reduced food intake, constipation	Respiratory depression	Reduced
Local infiltration analgesia	No change	No change	No change	No change
Femoral nerve block	No change	No change	No change	Reduced
Epidural	Dizziness, pruritus	Constipation	Hypotension	Reduced
Adjuvant drugs	Sedation, altered mental state	No change	No change	No change

FIG. 4. (part 2): Organ-specific side effects

A comparison of techniques therefore does not only include analgesic efficacies, but also functional outcomes such as mobilization, food intake and general well-being.

Analgesic outcomes of different regimes.

In an effort to estimate the efficacy of each treatment regime in minimizing the group of patients having unacceptable pain in the first 24 hours postoperatively, all original studies relating to the treatment of postoperative pain following knee replacement surgery were identified by a Medline search from 2002 through 2011. Cohorts were included if they had extractable data for the size of the cohort with treatment failures in the first 24 hours following surgery, by the following criteria:

- 1) maximal VAS pain at rest >5 out of 10
- 2) maximal VAS pain on movement >7 out of 10
- 3) iv morphine (or equivalent) demand >20 mg/day

These outcomes and thresholds for acceptable pain are certainly debatable, but they may be adequate surrogate measures for across-study comparisons. By this methodology, 376 cohorts were identified from 170 studies, and extractable data for the three criteria were available for 311, 172 and 244 cohorts, respectively. Interventions were classified into predefined major groups (opioids, LIA, femoral and epidural) no matter the specific method, dosage or regime used within that group. This implies that groups may be heterogeneous. Also, we did not distinguish between the design of the original study, randomized or non-randomized, but focused on prospective cohorts alone, in which relevant data could be extracted from tables, figures or text in the original manuscript.

Functional outcomes of superior analgesic regimes.

Figures 1-3 illustrate our main findings.

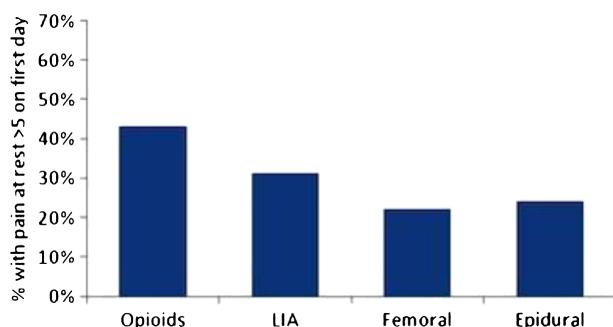


FIG. 1. (part 2): Pain at rest

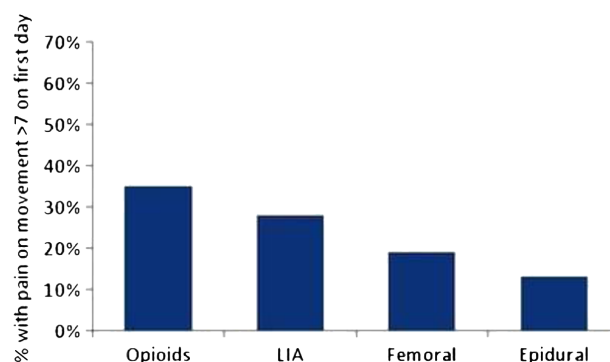


FIG. 2. (part 2): Pain on movement

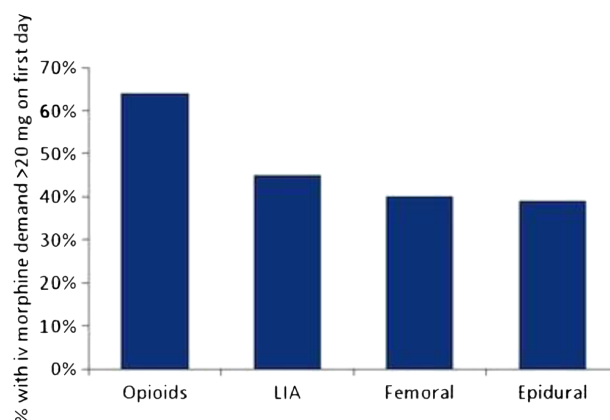


FIG. 3. (part 2): Morphine demand

Clearly, perineural regimes such as femoral nerve blocks and epidurals are superior regardless of the criterion for analgesia used. However, most practitioners find these regimes troublesome since they impede mobilization in some way, and epidurals may have opioid-related side effects if these drugs are added. However, recent findings using the modified Barthel/100 index following multiple nerve blocks on the lower extremity suggest that a fully functional femoral nerve block has little impact on the motor functions used for activities of daily living (4), suggesting that most patients are able to compensate adequately for the motor paralysis such nerve blocks invariably infer (5). This implies that a long-lasting femoral nerve block is still an attractive option for analgesia after knee arthroplasty. However, an alternative should be available for the subgroup of patients that are not able to compensate for unilateral quadriceps muscle weakness. In a recent study, patients (who had epidurals for postoperative pain) were randomized into a standard rehabilitation programme or a fast-track rehabilitation programme; the latter consisted of positive psychological imaging, competitive care by comparing the progress of other patients, early mobilization, intensive physiotherapy with focus on ADL function, and individual case management (6). Patients in the fast-track group were mobilized and discharged significantly earlier and had lower opioid consumption, suggesting that psychological factors and surgical ward logistics rather than motor abilities are important for postoperative rehabilitation. To underline this point, a comparison between LIA and epidural revealed only marginally reduced length of stay in the LIA group (7).

The value of other perineural blocks.

Several combinations of nerve blocks after knee arthroplasty have been tested in clinical studies. Although improved analgesia is foreseeable, the addition of a sciatic to a femoral nerve block does not seem to influence time-to-discharge readiness (8). The value of perineural blocks with less motor affliction are still controversial. A study investigating combined saphenous and obturator nerve blocks reduced morphine consumption compared to placebo, but results were considerably poorer than could be expected from

studies on femoral or epidural blocks (9). Although not entirely discouraging, such results suggest that the search for optimal pain management by the perineural route is still ongoing. We should also consider a stronger focus on psychological and logistical aspects of postoperative care when administering peripheral nerve blocks in terms of patient acceptance, expectations and perceived value.

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15

COMBINED ULTRASOUND-GUIDED LUMBAR AND SACRAL PLEXUS BLOCK FOR SURGICAL ANESTHESIA AND POSTOPERATIVE ANALGESIA IN HIP SURGERY

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Introduction: Fragile high-risk patients with severe cardiac co-morbidity are often admitted for emergency hip surgery. Blockade of the lumbo-sacral plexus presents a safer alternative for surgical anesthesia compared to general or spinal anesthesia with better hemodynamic stability and effective perioperative analgesia reducing the need of opioids.

The lumbo-sacral plexus: The lower limb including the hip is innervated by the lumbo-sacral plexus. The nerves innervating the hip joint are derived from the ventral rami of the spinal nerve roots of the lower part of the lumbar plexus (L2-L4) and the upper part of the sacral plexus (L4-S1) (1). The lumbar plexus consistently innervates the hip joint capsule via the femoral nerve (L2-L4) and the obturator nerve (L2-L4) and with variable contribution from the accessory obturator nerve (L3-L4). The sacral plexus consistently innervates the hip joint capsule via the superior gluteal nerve (L4-S1), the quadratus femoris nerve (L4-S1), the upper segments of the tibial (sciatic) nerve (L4-S1) and the upper segments of the common peroneal nerve (L4-S1), and with variable contribution from the inferior gluteal nerve (L5-S1) (1-3).

The lumbar intervertebral foramina of L1-L4 are located between the anterior and the posterior layer of the psoas major muscle and the ventral

rami of the lumbar spinal nerve roots exit directly into this compartment - coined the "psoas compartment" by Chayen (4). The lower part of the lumbar plexus (L2-L4) is consistently located inside the psoas compartment. The terminal nerves from the lumbar plexus emerge from the backside of the psoas muscle at the level of the transverse process of L5. The femoral nerve and the lateral femoral cutaneous nerve emerge at the lateral border of the psoas muscle and descend across the anterior surface of the iliac muscle posterior to the iliac fascia. The iliac fascia is continuous with psoas fascia which covers the antero-lateral surface of the psoas major muscle. The obturator nerve descends between the psoas major muscle and the L5 vertebra. At this level the lumbosacral trunk (L4-L5) descends medial to the obturator nerve and runs across the pelvic brim and the ala sacra to join the sacral plexus in the pelvis anterior to the sacral bone (5).

The psoas compartment is delineated by the smaller posterior layer and the larger anterior layer of the psoas major muscle. The posterior layer of the psoas muscle attaches proximally to all the transverse processes of the lumbar vertebrae and the intertransverse ligaments down to the transverse process of L5. The anterior layer of the psoas muscle attaches proximally to the lateral sides of the bodies of the lumbar vertebrae and their intervertebral discs from the lower part of the T12 vertebra down to the upper part of the L5 vertebra (1). From the upper end of the psoas major muscle down to the level of the transverse process of L5, the psoas major muscle is enclosed within an anatomical tube made of the psoas fascia antero-laterally and the lumbar vertebral bodies medially and the transverse processes and the intertransverse ligaments posteriorly and the anterior lamella of the thoracolumbar fascia postero-laterally. Below the level of the transverse process of L5 the psoas major muscle descends antero-laterally away from the neuraxis creating an anatomical space between the ala sacra posteriorly, the promontory medially, the iliac vessels anteriorly and the psoas major muscle antero-laterally. This anatomical space contains the lumbo-sacral trunk and the obturator nerve and laterally this space communicates freely behind the psoas major muscle with the fascial space containing the femoral nerve and the lateral femoral cutaneous nerve between the iliac fascia and the iliac muscle. Caudally the anatomical space is appositioned to and communicates with the fascial space between the piriformis muscle and the presacral fascia containing the sacral plexus.

The sacral plexus originates from the lumbo-sacral trunk (L4-L5) and the anterior rami of the sacral nerves S1-S3. The lumbo-sacral trunk descends on the anterior surface of the ala sacra and joins the anterior ramus of the sacral nerve S1 - with minor contribution from S2 - to innervate the hip region. The anterior rami of the sacral nerves emerge from the anterior sacral foramina to become sandwiched together with the lumbo-sacral trunk in the fascial space between the piriformis muscle fascia and the dense parietal pelvic presacral fascia on the anterior surface of the sacral bone. The sacral plexus and its terminal nerve branches - including the sciatic nerve and the posterior femoral cutaneous nerve - exit the pelvis through the greater sciatic foramen anterior to the piriformis muscle - just below the sciatic notch.

The lumbar plexus block: Analgesia of the lumbar plexus can be obtained with local analgesic in the psoas compartment. The lumbar plexus nerves exit the psoas compartment approximately at the level of transverse process of L5. The lumbar plexus inside the psoas compartment can be approached at the level of the interspaces between the transverse processes of L2/L3, L3/L4 or L4/L5.

Almost 40 years ago in 1974 Alon Winnie described the paravertebral lumbar plexus block at the level of the L4/L5 interspace in a review for plexus blocks for lower extremity surgery (6). Winnie marked the intercrestal line - a horizontal line connecting the uppermost points of the iliac crests - indicating the L4/L5 interspace, and he marked a perpendicular second line through the posterior superior iliac spine parallel to the sagittal midline. A needle was inserted at the intersection of these two lines perpendicular to the skin, but with a slight mesial direction. If the transverse process of L4 was encountered, the needle was redirected slightly more caudad and advanced until a paresthesia was produced. Winnie injected 40 cc of local anesthetic. Winnie said that the local analgesic was injected between the quadratus lumborum and psoas major muscles and the solution dissected cephalad and caudad within this space to produce anesthesia of the lumbar and sacral plexuses. However, producing paresthesia at this level requires the needle to penetrate into the psoas compartment inside the psoas muscle. Winnie did not present any data.

Another variant of the L4/L5 approach to block the lumbar plexus in the psoas compartment was described by Chayen in 1976 (4). Chayen measured 3 cm caudad and 5 cm lateral from the spinous process of L4 (the midpoint

of the intercrestal line) and inserted the needle perpendicular to the skin until the needle tip encountered the transverse process of L5. The needle was redirected cranially into the interspace between the transverse processes of L4 and L5 and advanced through the quadratus lumborum muscle until loss-of-resistance. 30 mL of local analgesic was injected in the psoas compartment. The psoas compartment was defined by the authors as the fascial space between the anterior and the posterior layer of the psoas muscle. The loss-of-resistance is due to penetration of the anterior lamella of the thoracolumbar fascia and the adherent posterior layer of the psoas muscle. The posterior layer of the psoas muscle adheres to the transverse processes and the intertransverse ligaments and the anterior layer of the thoracolumbar fascia down to transverse process of L5. The authors used the psoas compartment block for surgical anesthesia in 67 patients scheduled for hip surgery with a success rate of 93%.

Capdevila et al also approached the lumbar plexus at the L4/L5 level and inserted the block needle - guided by electrical nerve stimulation and quadriceps femoris motor response - and then inserted a catheter below the transverse process L4 between the middle and the lateral third of a line segment connecting the spinous process L4 and the perpendicular line intersecting the Posterior Superior Iliac Spine (PSIS). They found that the distance from the transverse process of L4 to the lumbar plexus was consistently around 18 mm independent of sex and body size (7). Most of the patients had complete lumbar plexus blockade but not blockade of S1. Ilfeld et al used a similar approach in 2010 but combined nerve stimulation with ultrasound guidance (8). The authors obtained a high success rate of sensory blockade of the femoral nerve.

Hanna et al made a cadaver study of the lumbar plexus with ink injection in 1993.

They inserted a needle across the upper margin of the transverse process of L3 and advanced the needle until they got loss-of-resistance and injected 10 mL of dye (9). They made a dissection study and found that in all cases the L1-L4 nerve roots were covered by dye, and the dye was contained within the psoas compartment.

Parkinson et al compared the psoas compartment block of Chayen (approaching the lumbar at the level of the interspace between the transverse processes of L4 and L5) with a technique much alike the technique used in Hannahs cadaver study (approaching the lumbar plexus at the level of the L3 transverse process). Parkinson called the L3 approach the technique of Dekrey (after a US navy anesthesiologist known as "the wizard of the needle" who never published his methods). Parkinson found the two techniques were equally effective - with a success rate of practically 100% for the lumbar plexus nerves - and no blockade of the sacral plexus nerves.

An approach at the level of the L3/L4 interspace guided by combined ultrasound and loss-of-resistance technique has been described by Morimoto in 2006 (10). A curved array probe was placed axially in the horizontal plane to identify the spinous process of L3. The probe was shifted laterally to locate the transverse process of L3. A Touhy needle was inserted from the lateral end of the probe and advanced in-plane until bony contact with the transverse process of L3. The needle was walked off the bone superiorly and advanced until loss-of-resistance, and 30 mL of local anesthetic was injected into the psoas compartment. Complete unilateral motor and sensory anesthesia extending from T11 to S2 was achieved within 15 minutes with haemodynamic stability and uneventful hip surgery in one patient. A similar approach either at the level of the L3/L4 or the L4/L5 interspace using combined ultrasound and nerve stimulation guidance was used by Doi et al in 2010 (11). The end-point of injection was quadriceps femoris motor response to electrical nerve stimulation. The authors obtained a success rate of sensory analgesia of 93% in the entire distribution of the lumbar plexus in 67 patients. They had bilateral blockade in 3% of the patients. The authors did not report data on sacral plexus blockade.

Madison et al described a variant of the in-plane approach to the lumbar plexus in the L3/L4 interspace with the curved array probe oriented in the horizontal plane using solely ultrasound guidance (12). The endpoint of injection of local analgesic was ultrasound visualization of location of the needle tip inside the psoas major muscle. This was just a technical note and the authors did not report any outcome data.

Karmakar described an approach to block the lumbar plexus inside the psoas compartment at the level of the interspace between the transverse processes of L3 and L4. The probe was oriented in the parasagittal plane 3-4 cm lateral to the sagittal midline and the transverse processes of L2, L3 and L4 were identified by counting from below upwards from the transverse process of L5 immediately above the sacrum. The needle was

advanced in-plane from the caudal end of the probe guided by ultrasound combined with electrical nerve stimulation searching a quadriceps femoris motor response (13). The lumbar plexus was sometimes seen as a hyper-echoic structure in the posterior part of the psoas muscle. Karmakar injected 20-25 mL of a mixture of lidocaine 1% and ropivacaine 0.25% with adrenaline. Surgical anesthesia was produced in two patients scheduled for hip fracture surgery by combining ultrasound guided lumbar plexus block with a parasacral plexus block.

The sacral plexus block: Mansour described a parasacral technique for analgesia of the sacral plexus in 1993 (14). A line is drawn from the PSIS to the lowest point of the ischial tuberosity. A point is marked three fingers breadth beneath the PSIS along this line indicating the posterior inferior iliac spine. A needle is inserted in this point guided by electrical nerve stimulation and perpendicular to all planes. If the sciatic notch it contacted, the needle is walked off the bone in the inferior direction along the line. Then the needle is advanced until the endpoint of a hamstring muscle motor response is obtained with an appropriate electrical current. 10-15 mL of local analgesic is injected into the fascial space between the piriformis muscle and the presacral pelvic fascia.

An ultrasound-guided technique to block the sacral plexus block, in combination with the use of conventional nerve stimulation, has been described by Ben-Ari et al (15). However, despite reporting good visualization of the sacral plexus, no structured approach to get to sacral plexus into view and no assessment of the success rate of the sacral plexus block was performed. Our group has published a simple, effective and structured ultrasound guided approach to block the sacral plexus - the so-called PSPS (Para Sacral Parallel Shift) technique (16). It can be performed solely by ultrasound guidance or combined with nerve stimulation. The probe is aligned between the PSIS and the midpoint of the line connecting the PSIS and the greater trochanter. The iliac bone line is identified ultrasonographically. The probe is moved inferomedially with a *parasacral parallel shift* (PSPS). When the beam of the probe arrives at the sciatic notch, the ultrasonographic continuity of the iliac bone line is interrupted. This is exactly where the sacral plexus exits the pelvis. The probe is tilted slightly caudad and the hyper-echoic sacral plexus is visualized between the sacrum and the ischial bone and beneath the triangular piriformis muscle. The needle is advanced in-plane from the lateral end of the transducer through the piriformis muscle and until the needle tip touches the sacral plexus. The identity of the sacral plexus may be confirmed by nerve stimulation with a sciatic motor response in the range of 0.3-0.5 mA. Then 10-20 mL of ropivacaine 0.5% is injected with sonographic observation of perineural spread in the fascial space between the presacral pelvic fascia and the piriformis muscle as the end-point with reposition of the needle tip if necessary using solely ultrasonographic guidance.

Lumbo-sacral block: Our research group has produced MRI images of the lumbosacral plexus. These images demonstrate that the lumbar plexus nerve branches and the lumbosacral trunk and the upper sacral branches of the sacral plexus can be approached with one single injection between the upper border of the sacral bone and the lower border of the transverse process of L5. Below the promontory the loose retroperitoneal connective tissue may allow the spread of local anesthetic to the contralateral lumbo-sacral plexus nerve branches. A curved array probe is oriented parasagittally across the upper edge of the iliac crest. Parallel shifting of the probe medially brings the transverse process of L5 and the sacral bone into view. The needle is inserted from the cranial end of the probe and advanced in-plane between the transverse process of L5 and the sacral bone until a loss-of-resistance is obtained when the needle penetrates the iliolumbar ligament. Local analgesic is injected. We have tried out this technique successfully in six patients for postoperative analgesia and for surgical anesthesia in two patients scheduled for hip surgery. The two latter patients had complete sensory and motor anesthesia from L1 to S1 and partial anesthesia of T12, S2 and S3. They both had partial anesthesia from L1 to S1 contralaterally. Both patients had severe cardiac comorbidity but they both had uneventful open hip surgery with hemodynamic stability with this single shot lumbo-sacral block as the sole anesthetic. This technique is not difficult to learn, and the sonoanatomic bony landmarks are easy to recognize. We call this the *Supra Sacral Parallel Shift* (SSPS) technique.

Conclusion: Analgesia of the lower lumbar plexus and the upper sacral plexus for surgical anesthesia or postoperative analgesia of the hip can be obtained with ultrasound guidance using the combination of a lumbar plexus block using a psoas compartment approach and a sacral plexus block using the PSPS approach. Alternatively, the *Supra Sacral Parallel Shift* seems to be

an easy and effective single injection approach to block the lumbo-sacral plexus for surgical anesthesia and perioperative analgesia.

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NETWORKING OF DATABASES FOR REGIONAL ANESTHESIA: FRACTURED NECK OF FEMUR

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Proximal femur fractures occur in aged patients. Approximately 100,000 patients are treated annually in German hospitals and approximately 55,000 in England. The majority of these patients is female and has many comorbid

conditions affecting cardiovascular, renal, pulmonary, endocrine systems. Therefore, current quality indicators in larger national databases focus on survival rates. For example, The PERFECT Hip Fracture Database in Finland report since 1999 [1], the National Joint Registry for England and Wales [2] was established in 2002 and the Norwegian Hip Fracture Register started in 2005 [3]. The national hip fracture database [4] was launched in 2007 and the German Institute for Quality and Patient Safety report data on hip fracture surgery since 2003 [5]. Within hospital mortality has been 9.4% in England and 5.2% in Germany. Improving this figure clearly is extremely complex and depends on many interdependent factors ranging from patient conditions and structural as well as procedural components. Even though that anaesthetic management has been claimed to be of major importance for the overall success in hip fracture surgery it is extremely hard to definitely show it.

In particular, the use of regional anesthesia related to survival after hip fracture surgery has been subject in many investigations. Earlier metaanalysis [6] concluded that regional anaesthesia compared to general anaesthesia for hip fracture patients in terms of early mortality was of marginal significance. Parker et al. [7] have pointed out that methodologically flawed randomized controlled trials, many ill reflecting current clinical practice, were insufficient to draw sound conclusions from a borderline statistically significant decrease in mortality (data from eight trials involving 1668 patients) at one month. However, in a recent narrative Analysis Luger et al. [8] concluded from 56 references, covering 18,715 patients with hip fracture that spinal anaesthesia is associated with significantly reduced early mortality, fewer incidents of deep vein thrombosis, less acute postoperative confusion, a tendency to fewer myocardial infarctions, fewer cases of pneumonia, fatal pulmonary embolism and postoperative hypoxia whereas general anaesthesia may have a lower incidence of hypotension and a tendency towards fewer cerebrovascular accidents.

However, when pain and pain related outcomes are selected, regional anesthesia clearly is effective in hip fracture surgery [9,10] and national guidelines for acute postoperative pain therapy recommend the use of regional anesthesia [11,12].

The number of patients included in randomized controlled studies is of many magnitudes lower than the actually treated patients. With the advent of altered legal issues the conduct of randomized controlled trials has become much more difficult. Consequently high quality outcome data from randomized controlled trials in regional anesthesia are hardly available. An alternative to describe the influence of regional anesthesia on patient outcome may come from registries. Several attempts to improve knowledge in this field include surveys or single centre reports of individual databases.

Registries covering data on regional anesthesia are scarce. The ASRA has initiated a surveillance system [13] in 2009 and a specific ultrasound related registry has been reported [14]. Recently an analysis of the New York State Inpatient Database from 18,158 patients treated for hip fractures over 2 years revealed that regional anesthesia was associated with a lower risk of inpatient mortality and pulmonary complications [15]. In 2003 the project Quality in Postoperative Pain Therapy (QUIPS) [16] started with the extra documentation of perioperative data on acute pain collected on the first postoperative day in order to describe overall quality within wards. The registry currently covers more than 150,000 patients and has been extended by the European Union funded pain-out project in nine countries [17]. The scientific working group of the German Society of Anaesthesiology and Intensive Care has defined a data set, which can be used in those departments where digital documentation is mandatory [18]. Using this methodology, a continuously growing registry has been setup. Data related to hip fracture surgery are currently analysed from both registries.

In principal, observational, register-based studies are less conclusive than data from randomized clinical trials but if confounders can be controlled registries may show the same results as randomized controlled trials [19]. The number of registries continuously is growing in many fields of medicine. Improvements in robustness led to increased use for quality management, research and economic descriptions. For digitally oriented nations in developed areas it can be expected that information technology rapidly will further these developments in order to improve patient care.

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EPIDURAL ANESTHESIA VS. PARAVERTEBRAL BLOCKS

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Epidural anesthesia and paravertebral blocks (PVB) have been used for more than a century. Epidural and paravertebral blocks are both used as sole anesthesia techniques for surgical procedures and as postoperative pain treatment.

Epidural anesthesia

The epidural space is the outermost part of spinal channel, situated outside the dura mater. It proceeds from the foramen magnum at the base of the skull to the tip of the sacrum. Epidural blocks can be placed at any level of the spine. Drugs injected to the epidural space can diffuse to the cerebrospinal fluid and act on the spinal nerve roots as well as the dorsal horn. Due to leakage through the intervertebral foramina from the epidural space to the paravertebral space, drugs act on the spinal nerves. The epidural space can be accessed by midline or paramedian needle approach. Loss of resistance to saline or air, hanging drop technique, and ultrasound visualization are used to confirm the position of the epidural needle. Catheters are placed to provide continuous infusions or repeated bolus injections of drugs. An "optimally balanced drug solution" that consists in a combination of local anesthetic, opioid, and adrenergic agonist can be used to obtain effective pain relief with a minimum of dose-related side effects (1).

Paravertebral blocks

Paravertebral blocks (PVB) can be performed at a cervical, thoracic, lumbar, and sacral level. Common to all four sites is the needle placement in the paravertebral space in proximity to the spinal nerve roots. Thoracic paravertebral blocks (TPVB), particularly, have obtained increasing interest during the recent years. In a transversal view, the thoracic paravertebral space shows a triangular shape, determined by the parietal pleura ventrally, the costotransverse ligament dorsally and the body of the vertebra, intervertebral disks, and intervertebral foramina on its medial side. The paravertebral space contains spinal nerves, the sympathetic chain, vessels to and from the spinal cord, and adipose tissue. The spinal nerve roots in the paravertebral space are described as being surrounded by cerebrospinal fluid and covered with arachnoid and dura (2). The thoracic paravertebral space communicates with both the epidural space and the intercostal space. Compared with thoracic epidural techniques, TPVB techniques are easy to learn. The blocks are performed by a predetermined distance technique, loss of resistance, by the aid of electrical nerve stimulation, or ultrasound guidance. Multiple injection techniques at several spinal levels or single injections, one-sided or bilateral, are possible. Catheters can be placed in the paravertebral space to allow continuous drug infusions. As with peripheral nerve blocks, local anesthetic concentrations are usually much higher than for epidural anesthesia. Pneumothorax is a complication of TPVB with an incidence of 0.5% (3).

Epidural vs. paravertebral blocks

Epidural anesthesia is a widely used technique for anesthesia and postoperative analgesia. However, the method has undesired side effects such as hypotension and urinary retention. Severe complications including spinal hematoma, epidural abscess, and cauda equina syndrome can occur (4).

TPVB is now competing in popularity against the use of epidural anesthesia. The technique is regarded as equally effective with an advantageous profile of side effects and complications compared with epidural anesthesia. Norum and Breivik performed a systematic review of comparative studies on the use of epidural and paravertebral blocks for pain after thoracotomy (5). Because of a small number of patients and the heterogeneity of studies, no conclusion on analgesic efficacy and safety could be given. In the authors' view, optimal thoracic epidurals were not performed in any of the studies. The segmental siting of epidural catheters was frequently inappropriate, local anesthetic concentrations were too high, and the lack of opioids and adrenaline as part of a balanced epidural drug solution was criticized. Complications have been reported for epidural blockades in several studies based on a large number of registered procedures (4,6). However, at the present time, no comparable large amount of data is available for PVB. Hence, a rather low number of serious complications reported for this method might not be representative.

PVB are performed on the root level of the spinal nerves. But, they should not be seen as peripheral blocks only. The paravertebral and the epidural space represent a continuum. A PVB can be seen as a one-sided (or sometimes bilateral) epidural blockade in addition to the spinal nerve blocks. In a radiographic study, 70% of the paravertebral injections performed had epidural spread (7). Both high epidural and total spinal anesthesia have been reported after TPVB. The arteries supplying blood to the medulla traverse the paravertebral space to the epidural space. Needle placement or injection into the thoracic radiculomedullary arteries can lead to spinal cord infarction or spinal hematoma (5,8). Virtually all complications related to an epidural block might also occur with a PVB.

Ultrasound guidance has been used for epidural anesthesia and PVB. Visualization of the injecting needle and target structures is likely to improve safety for both techniques. For paravertebral blocks, ultrasound guidance may

augment the success rate of correct needle placement while catheter positioning appears unreliable (9).

Conclusion: PVB can be seen as a more peripheral approach to the epidural space. It, therefore, seems reasonable that PVB may have a lower risk of serious complications than a central epidural blockade. However, without being aware of the serious complications related to PVB, the method might become highly risky. Appropriate monitoring and readiness to handle potentially life-threatening complications are essential for epidural anesthesia and PVB alike. Guidelines for the use of epidural anesthesia in patients with anticoagulant treatment must also be applied for PCB. The risk-to-benefit of PVB and of epidural must be estimated carefully for each and every patient. Patients must be informed by the anesthesiologist about the possible complications related to both methods.

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ADJUVANTS TO LOCAL ANESTHETICS IN THORACIC PARAVERTEBRAL NERVE BLOCKADE

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Introduction: Adjuvants to local anesthetics have been used for more than 30 years in regional anesthesia. There are several reasons why adjuvants are added to local anesthetics: to permit a decrease in the volume and/or concentration of the local anesthetic (LA), prolong sensory analgesia and/or to improve the sensory analgesia.

Opioids and clonidine are the most widely used adjuvants in regional anesthesia. Epidural opioids in small doses may act synergistically with epidural local anesthetics in providing analgesia. (1). However, for peripheral nerve blocks the evidence for improving efficacy for addition of opioids is controversial (2).

Therefore the site of administering an opioid with a local anesthetic, i.e. peripheral nerve or neuraxial, appears to be crucial for achieving the goal of improving post-operative analgesia. Thoracic paravertebral block is considered to be a peripheral nerve block, but a peripheral nerve block that is performed in close proximity with the epidural space and limited spread of discrete amounts of local anesthetic can occur. (3)

Common thoracic paravertebral block adjuvants administered

The 2 most investigated adjuvants in thoracic paravertebral block, fentanyl and clonidine, will be further discussed.

Fentanyl

Opioid receptors are present in the brain, the dorsal horn of the spinal cord, the dorsal root ganglia and in the end terminals of primary afferent neurons (4). When opioids are administered in peripheral nerve blocks they can act either on the opioid receptors located on the end terminals of primary afferent neurons or on the opioid receptors in the brain and the dorsal horn of the spinal cord through systemic absorption.

Analgesic effect

One study directly compared levobupivacaine 0.1% and a mixture of levobupivacaine 0.05% with fentanyl 4 µg/mL for a continuous thoracic paravertebral block in patients undergoing breast surgery under general anesthesia; a control group received only general anesthesia. All groups received post-operative i.v. morphine patient-controlled analgesia. (5) Post-operative morphine consumption was significantly lower in the group with fentanyl, but pain scores were not different between groups. Incidence of nausea was significantly higher in the fentanyl group.

A limitation of this study was however that the morphine consumption in the levobupivacaine 0.1% group was comparable to the morphine consumption in the control group, which was attributed to a too low concentration of levobupivacaine used for the continuous thoracic paravertebral infusion. The improved analgesia in the levobupivacaine-fentanyl group could thus be attributed to a local effect of fentanyl, a systemic effect of fentanyl or a combination of both.

Plasma levels of fentanyl in continuous thoracic paravertebral block

In 25 patients undergoing thoracic surgery with surgically inserted thoracic paravertebral catheters serum plasma levels of fentanyl were assessed at regular time intervals after an initial paravertebral bolus of 100 µg followed by an infusion of fentanyl 10 µg/mL with bupivacaine 0.1% at a rate of 10-15 mL/hr. (6) At all times interval, plasma levels of fentanyl were above the minimum effective concentration of intravenous fentanyl administration, i.e. 0.63 ng/mL (7), and accumulating over time. The high serum plasma levels of fentanyl would suggest that the analgesic effect of thoracic paravertebral administered fentanyl will be predominantly through systemic absorption, although any local effect can not be excluded.

Serum plasma levels of fentanyl were also assessed in patients undergoing breast surgery with a continuous thoracic paravertebral block (8). A continuous infusion of levobupivacaine 0.05% with fentanyl 4 µg/mL at a rate of 0.15 mL/kg/hr (maximum 15 mL/hr) was initiated after a paravertebral bolus of 50 µg fentanyl. Plasma serum levels of fentanyl showed a trend towards accumulation and a mean maximum plasma concentration fentanyl of 0.72 ng/mL at 24 hours was achieved. However in all time intervals before 24 hours plasma fentanyl concentrations were in the range of 0.38-0.43 ng/mL.

A limitation of this study is however that post-operative pain scores and post-operative intravenous rescue morphine consumption are not reported in their study. Nevertheless, the authors proposed that plasma fentanyl concentrations between 0 and 24 hours would suggest that at least part of the analgesic effect of thoracic paravertebral administered fentanyl is mediated through a local peripheral mechanism. This proposed local effect by the authors is probably based on their earlier study in which they found that use of the same mixture of levobupivacaine 0.05% with fentanyl 4 µg/mL infusion resulted in significantly lower post-operative morphine consumption in the first 24 hours compared to the levobupivacaine 0.1% group; as stated earlier however, the morphine consumption in the control group in this study was comparable to morphine consumption in the levobupivacaine 0.1% group. (5).

Discussion: Serum fentanyl plasma levels of a continuous administration of paravertebral fentanyl approach the minimum effective concentration of intravenous fentanyl administration, which is 0.63 ng/mL (7).

A recent meta-analysis of the efficacy of paravertebral block for post-thoracotomy surgery concluded - based on indirect study comparisons - that the addition of paravertebral fentanyl to local anesthetic does not result in improved analgesia (9). Although serum fentanyl plasma levels of a continuous administration of paravertebral fentanyl approach the minimum effective concentration of intravenous fentanyl administration similar results have been found for epidural opioid administration. Prolonged infusion of epidural lipophilic opioids, such as fentanyl and sufentanil, also approaches serum plasma concentration and analgesic effect comparable to that of an intravenous infusion of these opioids alone. (10)

A large meta-analysis of post-operative epidural analgesia concluded that the addition of opioids to local anesthetics does not result in improved

analgesia compared with local anesthetic alone.(11) Two other meta-analyses of epidural analgesia only found weak evidence that addition of opioid to epidural local anaesthetic may provide improved analgesia compared to epidural local anaesthetics alone. (12-13)

Conclusion: Administration of fentanyl as an adjuvant for continuous thoracic paravertebral block will have an analgesic effect that after prolonged infusion will probably mediated predominantly be the result of systemic absorption, comparable to epidural administered lipophilic opioid administration. A concomitant local peripheral mechanism of paravertebral administered fentanyl analgesia however can not be excluded. In this respect, it has been suggested that in thoracic paravertebral block the dorsal root ganglia are probably directly affected (14) and thus part of the analgesic effect of paravertebral fentanyl may also be attributable to blocking the dorsal root ganglia opioid receptors.

Recommendation: Based on the limited available literature no definitive recommendation for or against the addition of thoracic paravertebral fentanyl can be made.

Adding fentanyl in low concentrations (4 µg/mL or less) with local anesthetics for continuous thoracic paravertebral infusion is not associated with adverse effects, other than an increased incidence of nausea.

More studies are needed to determine whether thoracic paravertebrally administered fentanyl may act synergistically with local anesthetics.

Clonidine

Clonidine is an α_2 -adrenoreceptor agonist; of the three subtypes (α_{2A} , α_{2B} , and α_{2C}) only the α_{2A} adrenoreceptor is responsible for the anesthetic and sympatholytic responses of clonidine. (15) α_2 -adrenoreceptors receptors are present in the central nervous system and the dorsal spinal cord.

Although specific α_2 -adrenoreceptors receptors on peripheral nerves axons are not present (16) an in vitro study has shown that high dose clonidine blocks conduction of C and A delta fibers.(17) The presumed mechanism by which peripheral perineural administered clonidine blocks conduction is that clonidine prolongs the hyperpolarization-activated current, resulting in prolongation of the hyperpolarization state of a nerve (i.e. nerve is not susceptible for stimulation). (18)

Analgesic effect

Two studies compared the effect of addition of clonidine to only a local anesthetic continuous thoracic paravertebral infusion.(5) (19) One study found a significant decrease in post-operative morphine consumption in patients undergoing breast surgery when clonidine was added to the local anesthetic, but no difference in pain scores compared to the control group without a thoracic paravertebral catheter.(5) In patients undergoing thoracotomy post-operative pain scores were significantly lower when clonidine was added to the continuous thoracic paravertebral local anesthetic infusion. (19) Both studies however also reported a significant incidence of hypotension when clonidine was added to the thoracic paravertebral local anesthetic infusion. (5) (19)

Plasma levels of clonidine in continuous thoracic paravertebral block

One study measured serum plasma levels of clonidine in patients patients undergoing breast surgery with a continuous thoracic paravertebral block (8). After a loading dose of 150 µg clonidine, a continuous infusion of levobupivacaine 0.05% with clonidine 3 µg/mL at a rate of 0.15 mL/kg/hr (maximum 15 mL/hr) was started. Plasma serum levels of clonidine showed a trend towards accumulation and a mean maximum plasma concentration clonidine of 1.74 ng/mL at 24 hours was achieved.

Discussion: Addition of clonidine 3 µg/mL to a continuous thoracic paravertebral infusion will result in a mean serum plasma level of 1.74 ng/mL, which is in the range of serum plasma levels of clonidine that will result in maximum hypotensive effects, i.e. 1.5-2.0 ng/mL.(20). When clonidine serum plasma levels exceed 2.0 ng/mL the hypotensive effect of clonidine is attenuated (20); a similar biphasic (low, then high) dose-response relation for blood-pressure occurs also when dexmedetomidine (another α_2 -adrenoreceptor agonist). (21)

A recent meta-analysis of the efficacy of paravertebral block for post-thoracotomy surgery concluded that the addition of clonidine increases the risk of hypotension, but may modestly improves analgesia. (9)

To the best of my knowledge there are no studies that evaluated the effect of a single dose of clonidine on paravertebral analgesia. The addition of a single dose of clonidine in peripheral nerve blocks has been extensively investigated. A recent meta-analysis by Popping et al. investigated the evidence for administering clonidine for peripheral nerve blocks and concluded that clonidine extends the duration of motor block and analgesia of intermediate and long-lasting local anesthetics by approximately only 2 hours.(22) Based on

this finding the authors suggested that for peripheral nerve blocks addition of perineural clonidine to long-acting local anesthetics could be questioned. There is currently also no evidence supporting the use of a continuous perineural peripheral infusion of clonidine. (22)

The addition of clonidine to local anesthetics in peripheral nerve blocks is associated with an increased incidence of hypotension, presumably as the result of systemic absorption(16); a dose of 150 µg clonidine or less appears to be associated with only limited or moderate hypotension. (22)

Epidural administration of clonidine will be rapidly absorbed into the cerebrospinal fluid compartment; the peak cerebrospinal fluid concentration coincides with the maximum analgesic effect. Conversely, although systemic absorption of epidural administered clonidine is also rapid the correlation between serum plasma clonidine concentration and analgesia however is very low; this is illustrated by the finding that the analgesic effect of epidural administered clonidine is much shorter than the the serum plasma half-life of clonidine. These findings suggest that the predominant analgesic effect of epidural administered clonidine is spinal and not systemic. (23)

The epidural combination of clonidine with local anesthetic results in improved postoperative analgesia compared to local anesthetic alone, but - similar to thoracic paravertebral block or peripheral nerve block - is associated with hypotension.(24)

Conclusion: Compared with as thoracic epidural block, thoracic paravertebral block is equally effective for post-thoracotomy analgesia and is associated with less hypotension.(25) Addition of thoracic paravertebral clonidine to a continuous infusion of local anesthetic will approach the mean range of serum plasma levels of clonidine that is associated with the maximum hypotensive effects of clonidine. Continuous infusion of thoracic paravertebral clonidine has been shown to increase the risk of hypotension. Irrespective of the route (paravertebral, epidural or peripheral perineural) by which clonidine as an adjuvans to local anesthetic is administered, hypotension occurs more often compared to administration of local anesthetic alone.

There is however evidence that the addition of clonidine to a continuous thoracic paravertebral infusion will result in improved analgesia.

Recommendation: Although adding clonidine to a continuous thoracic paravertebral infusion may improve analgesia, there is a significant increased risk of hypotension; this adverse effect may limit the application of clonidine as an adjuvans for thoracic paravertebral block.

No statement can be made on the effect of a single dose of clonidine, but it would appear based on literature regarding epidural and peripheral perineural administration that this would also increase the risk of hypotension.

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ULTRASOUND-GUIDED AXILLARY BRACHIAL PLEXUS BLOCK, HOW LOW CAN YOU GO?

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Introduction: Ultrasonography has brought vision and insight to the practice of peripheral nerve block. Ultrasonography has answered many questions such as: 'where is(are) the nerve(s)?', 'where does the local anaesthetic (LA) go?', and 'are there blood vessels close to the nerve(s)?'. While ultrasonography has answered many questions, it has challenged us to ask many more. In particular, the two hottest interrelated topics in ultrasound-guided peripheral

nerve block (USGPNB) are: optimal needle position prior to LA injection; and how much LA is necessary to facilitate successful peripheral nerve block.

This talk will focus on the assumption that extra-neural needle placement is the 'norm' and will review the available evidence on LA dose and USGPNB in upper limb regional anaesthesia. This talk will also focus primarily on the use of USGPNB for anaesthesia. It is likely that the LA dose requirements for anaesthesia and analgesia are somewhat different.

Considerations: It has been demonstrated that successful peripheral nerve block requires blockade of more than 70% of the transmembrane sodium channel population present on the target segment of a peripheral nerve [1]. The suggested length of a target segment of peripheral nerve equates to length of nerve occupied by three consecutive nodes of Ranvier [1]. Given that sodium channel density, sensitivity and subtype is determined by a myriad of genetic and environmental factors, it is likely that significant inter-individual variability exists as to the number of LA molecules required to achieve adequate impairment of impulse propagation along a peripheral nerve.

Injectate volume: Traditionally, it was accepted that as long as the block needle was in the same ball park as the target nerves, a sufficient volume of LA injectate would 'flood the fascial plane' and reach the desired target. By accepting the concept that injectate volume alone may compensate for technique limitations and inter-individual anatomical variation, LA dosing in peripheral nerve block evolved based upon the maximal allowable drug dose in the largest, convenient-to-administer volume (30-40ml). Large volume nerve block is akin to using a shotgun to shoot a mosquito. While the outcome may be successfully achieved, there will inevitably be collateral damage. As most peripheral nerves travel in close relation to large veins and arteries, both systemic absorption and unintentional occult intravascular injection of LA are possible with potentially catastrophic consequences (local anaesthetic systemic toxicity [LAST]) [2,3]. Local anesthetic may also cause harm to surrounding structures such as skeletal muscle [4]. Therefore limitation of the LA dose and volume used in USGPNB is advisable.

Ultrasonography transforms the block needle into a precision instrument and facilitates the deposition of small volumes of LA adjacent to target nerves. The next question that arises is: what is the smallest volume of LA required to achieve successful nerve block? In answering this question, study methodologies have largely fallen into two categories:

Dixon and Massey dose finding studies (step up/step down);

- O'Donnell BD, Iohom G. *Anesthesiology* 2009. [5]: 1 ml per nerve 2% lignocaine with 1:200,00 epinephrine in axillary brachial plexus block
- Casati A et al. *BJA* 2007. [6] MEAV50 Bupivacaine & Ropivacaine at Femoral Nerve; 14 +/- 2 ml

The relationship between nerve surface area and volume required to provide circumferential local anaesthetic spread.

- Eichenberger U et al *RAPM* 2009; [7] Volume relative to surface area study; LA dose = 0.11ml/mm² Ulnar nerve in forearm; ED50 1% mepivacaine = 0.7 ml
- Harper GK et al *BJA* 2010; [8] volume to 'surround axillary brachial plexus components; Median 3.4 ml; Ulnar 2.75 ml; Radial 2.58 ml; Musculocutaneous 2.3 ml

Injectate concentration: Although the volume of LA required to achieve successful nerve block may be an independent predictor of block success, it must be remembered that the number of LA molecules is also a consideration. Given the aforementioned requirement to have greater than 70% sodium channel blockade across a segment of peripheral nerve to achieve blockade of impulse propagation, it is likely that a 'critical number' of LA molecules is required. To date too few studies have addressed the relationship between USGPNB, LA volume and LA concentration to make any definitive statements. Further work is required on this topic.

Nerve structure [9]: Are all peripheral nerves the same? The answer to this is obviously no. However they all share some common features. At the level of the brachial plexus nerve roots, the fascicular bundles are tightly packed into a somewhat non-compliant sheath. This sheath consists of epineurium, an extension of the dura mater and an investing layer of connective tissue (mesoneurium). Within the nerve the majority of the tissue is primary neural tissue with little intraneural connective tissue. Thus extraneural LA at the level of the nerve root must traverse multiple layers to gain access to the axonal sodium channel. Contrast this with the peripheral nerve at the level of the forearm, which is invested in a thin, loose and compliant epineurium. The intraneural contents form the minority of the contents of the nerve with fatty loose connective tissue the predominant content. As such extraneural LA at the peripheral nerve has fewer physical barriers to overcome en route to the axonal sodium channel.

Local anaesthetic diffusion into a peripheral nerve is governed by Fick's Law: diffusion is directly proportional to lipid solubility, concentration gradient, membrane permeability and available surface area. As the nerve surface area to neural content ratio varies significantly from nerve root to terminal branch, this is likely a further consideration in determining the true minimal effective LA dose.

Injectate placement: I will briefly mention the thorny topic of ideal LA injectate placement. Intuitively by depositing LA close to the surface of a nerve, circumferential spread can be achieved with comparatively small doses of LA. In 21st century anaesthesia, the block needle is now a precision instrument which can be guided directly toward the peripheral nerve. Twenty first century technology has however inherent limitations. Spatial resolution in commercially available ultrasound does not adequately permit visualisation of the epineurium. Therefore the exact 3-D relationship of block needle and target nerve on a 2-D screen is uncertain at best. Modern 'ultrasound visible' needles further distort the picture by increasing the 'noise' generated by the needle, thereby improving needle visibility at the cost of the visibility of surrounding structures, including the target nerve. The danger in deliberately placing the block needle very close to the target nerve is inadvertent intraneural needle placement, which may result in inadvertent intraneural injection and nerve injury [10]. While it is not the intention of this talk to discuss the topic of intraneural injection, the take home message is that as we attempt to achieve USGPNB with small doses of LA thereby limiting the dose dependent LAST, the risk of intraneural injection increases. Technological solutions are required to address this issue.

Conclusion: The talk will discuss the above considerations and open the discussion on local anesthetic dose and USGPNB. The accompanying table summarises many of the papers addressing the topic of dose and USGPNB.

Upper Limb Block	Author, Year, Journal	Study Drug	Study Type	Technique	Outcome
Interscalene	Bruin G 1996 RAPM	Bupiv 0.5%	Letter RCT	Stim Stim	5 ml 10 ml 10 ml
	Al-Kaisy 1998 RAPM	Bupiv .125%	RCT RCT RCT	Stim U/S	5 ml 10 ml
	Krone 2001 RAPM	Bupiv 3 conc.		U/S vs Stim	
	Riazi 2008 BJA	Ropiv 0.5%			
	Renes 2009 RAPM	Ropiv 0.75%			
Supraclavicular	Kapral 1994 A&A	Bupiv 0.5%	RCT Vs Ax Series	U/S U/S U/S	30 ml 40 ml ?15 ml
	Chan 2003 A&A	Lido/Bupiv	Technique Letter	U/S U/S	33 ml 32 ml
	Soures 2007 RAPM	None None	Dose-find.		
	Morley 2009 Anaes	Lido 1.5%			
	Tran 2011 RAPM				
Infraclavicular	Tran 2011 RAPM	Lido 1.5%	Dose-find.	U/S U/S vs	35 ml 0.6ml/kg
	Sauter 2008 A&A	Mepiv 1.5%	Dose-find.	Stim U/S	15 ml
	Sandhu 2006	Lido 2%	Case		
	J ultrasound med				
	Marhofer 2010 Anaes	Mepiv 1%	Dose-find.	U/S U/S	0.11/mm2 2-3 ml
Axillary	Harper 2010 BJA	Lido 1.5%	Dose-find.	U/S U/S	1 ml 40ml longer
	O'Donnell 2009	Lido 2%	Dose-find.		
	Anesthesiology	Mepiv 1.5%	40 V 15 ml		
	Schoenmakers				
	2012 RAPM				
Forearm Nerves	Eichenberger 2009 RAPM	Mepiv 1%	Dose-find.	U/S	0.11/mm2

[Table 1]

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WHAT IS THE OPTIMAL NEEDLE POSITION DURING US-GUIDED PERIPHERAL BLOCKS?

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Background and aims: The optimal needle position for peripheral nerve blocks and the corresponding location of local anesthetic distribution have been studied in several clinical or experimental trials in the last few years. Especially needle guidance and the injection of a nerve blocking substance in the intraneural space was the objective of studies and case series¹⁻⁷. Several methodological limitations of the present trials are the reasons why unanswered questions regarding the etiology and the triggers of nerve injury related to peripheral nerve blocks persist. With respect to experimental studies in animals consistent neurological follow up data are lacking whereas clinical studies can not provide histological data and reproducible information regarding the precise position of the needle tip (i.e. intra- or extraneurally prior and during the injection of local anesthetic solution)¹⁻⁷. However, we challenged the question whether the toxicity of local anesthetics or the volutrauma within the intraneural space may lead to structural nerve damage. Correspondingly we injected local anesthetics or Ringer's solution into pig nerves via a surgical approach in pigs. For histological analysis we applied an established score for histological assessment. Primarily defined endpoints of the study were the presence and the magnitude of posttraumatic regional inflammation, occurrence of intraneural haematoma and signs of myelin damage.

Methods: Intraneural injection was applied in 7 anaesthetized pigs to a total of 42 brachial plexus nerves. In each animal up to 6 exposed plexus nerves underwent an injection in the intraneural space. Either a volume of 2 ml of bupivacain 0.5% or Ringer's solution was applied. After 48 hours of maintaining general anaesthesia 56 nerves including negative and positive controls were resected. The specimens were processed for visual examination and the detection of inflammatory cells (haematoxylin eosin, i.e. CD68-immunohistochemistry for visualisation of macrophages), myelin damage (Kluver-Barrera staining) and intraneural haematoma. Considering myelin, haematoma and inflammatory cells, the grade of nerve injury was scored ranging from 0 (no injury) to 4 (severe injury).

Results: Statistical analysis showed significant nerve lesions in the interventional groups compared to the negative controls (p=0.02). According to the applied injury score, there was no significant difference between the bupivacaine group [median (interquartile range) 1 (1-1)] and the Ringer's group [1 (0-2) P =0.59]. The occurrence of posttraumatic regional inflammation

was directly related to the applied interventions according to an aseptic trauma-related inflammation (30–65% monocytic cells). Fascicular injury (myelin damage) was found in nearly approx. 17% of the examined specimens of the Ringer's group and in approx. 10% following the injection of bupivacaine. All specimens showed signs of swollen fascicles and edema independent of the applied substances.

Conclusions: In our study, the magnitude of nerve injury following intraneural injection was not related to the applied type of substance. Posttraumatic inflammation and structural damage of nerve tissue were notable signs of nerve injury after intraneural injection. According to the present data a volutrauma due to intraneural injection and not the local toxicity of local anaesthetic on peripheral nerve can be designated an important trigger for nerve injury. However, even in this experimental study we can not specify whether the injected substances were administered in the perineural or fascicular space. We speculate that the observed fascicular damage rate of 10–17% corresponds with the rate of intrafascicular needle placement with following injection.

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THE BRACHIAL PLEXUS IS NO LONGER INVISIBLE

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Background and aims: Axillary block is the most commonly performed brachial plexus block. Ultrasonographic guidance has been introduced as an aid to nerve localization, for brachial plexus blockade in the axillary region. Finding the correct position for the block may be guided by nerve stimulation or ultrasound. Neither the ultrasound nor the nerve stimulation gives us a direct view on the anatomic structures in the axillary region. With modern microendoscopes and modern microendoscopy-guided techniques of puncture it is possible to get a visualisation of the whole anatomic structures during puncture, finding the target structure till identification of specific and different characteristics of the anatomic structures like nerves, vasculature, tissue, or bones. The Aim of the study was to evaluate the practicability of the

transcutaneous microendoscopy-guided puncture of the axillary region to identify anatomic structures around the brachial plexus.

Methods: An interdisciplinary team of anaesthesiologists, ENT-surgeons, anatomists and pathologists evaluated practicability of transcutaneous, microendoscopy-guided puncture of the axillary region with modern modular microendoscopes (Polydiagnost - Pfaffenhofen, Germany) in 15 fresh cadavers. All steps were documented by ultrasound, video and photo. Full sight on all anatomic structures was the precedent condition for the whole procedure. All cadavers had been examined several times from different positions to reach the anatomic structures of the brachial plexus in the axillary region.

Results: The identification of the brachial plexus was accomplished successfully in every 15 fresh cadavers. We could see and document the different anatomic structures from the beginning of the puncture of the skin to the nerves of the brachial plexus. Finally we found a nerve and vessel pathway.

Conclusions: Modern microendoscopes give good visualization of brachial plexus in the axillary region. The superior ability of direct visualisation of the anatomic structures in the axillary region is useful to understand the course and the branching of the nerves and vessels and the anatomic characteristics. The microendoscopy with modern modular microendoscopes might be a useful tool in further studies of the brachial plexus.

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PERIPHERAL NERVE BLOCKS IN ANESTHETIZED PATIENTS

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Few issues in regional anesthesia have generated as much controversy as whether peripheral nerve blocks (PNBs) carry higher risk for neurologic complications in an anesthetized patient versus an awake patient.^{1,2}

Opinions vary from heavy premedication being essential to the success of regional anesthesia to its being negligent. This is because regional anesthesia-associated nerve injury is a major source of morbidity for patients, and a potential source of liability for both anesthesiologists and surgeons. PNBs are of particular concern because nerve block technique involves placing the needle tip in the immediate vicinity of the nerve or plexi and the concern is that needle-nerve contact in anesthetized patients may not elicit patients' responses and communication of the paresthesia. In the absence of the response, theoretically, the unabated needle advancement can go unchecked and result in nerve injury of intraneural injection.

Unfortunately, no data or large-scale controlled studies on the safety of PNBs in awake versus anesthetized patients exist, nor are such studies likely to be available in the future. In the absence of randomized controlled studies on this issue, clinicians have drawn conclusions and made logic-based recommendations solely on their interpretation of the few available case reports, clinical experience, informal hear-say, and anecdotal discussions. Owing to the lack of data, firm recommendations published against the use of heavy sedation or general anesthesia (GA) in patients receiving PNBs may have far-reaching medico-legal connotations that can be based on inaccurate and biased observations. Therefore, the purpose of this review is to summarize the available literature that supports or refutes the practice of administering nerve blocks in anesthetized patients. We will discuss the current controversies in the hopes to provide some additional insight into the problematic. Although case reports are often undervalued, they comprise a detailed account of events in specific patients as opposed to large epidemiologic studies that contain only limited detail regarding the block techniques. Therefore, in the absence of randomized controlled trials, we will place emphasis on what is known from the cases reports and series of cases.

Symptoms of Intraneural Injection: The premise for performing PNBs only in awake patients is based on the supposition that an awake patient can provide information that will reduce the chance of intraneural injection and therefore decrease the risk for neurologic injury. If all intraneural injections are painful, the awake, protesting patient would seem to be the best monitor to prevent an intraneural injection. However, there are three limitations to this logic.

First, a number of reports of intraneural or neurologic complications of PNBs in the literature have not been associated with pain on injection (Table 1). Second, the point at which pain occurs on injection may already be

too late to prevent neurologic injury. For example, in the closed-claim study, Cheney and coworkers³ describe occasions where patients developed nerve injuries even though the anesthesiologist stopped the injection as soon as the patient reported pain. Indeed, studies utilizing animal models of intraneural injection suggest that nerve fascicles can be disrupted with miniscule amount injectates (e.g. as little as 0.1 mL) at the onset of the injection.^{4,5} Third, pain is notoriously difficult to assess in terms of quality and intensity, making it difficult to distinguish between the discomfort that is commonly reported on injection (which is considered normal) and that of intraneural injection.⁶

Table 1. Reports of peripheral nerve injury with major conduction blocks

Cheney FO, et al. ³	Nerve injury associated with anesthesia in a closed-claims analysis. Of the 3 injuries to the radial nerves, 1 was associated with parasthesia, 1 with general anesthesia (GA), 1 in an awake patient without parasthesia. None of the 3 minor nerve injuries was associated with parasthesia during performance of the blocks.
Aurore Y, et al. ⁷	A prospective study on complications of regional anesthesia. 12 nerve injuries associated with PNBs were reported. All 12 patients were awake, and parasthesia was present in only 2 patients (15%). Of note, a nerve stimulator had been used to localize the nerves in 9 patients with injury.
Webster GC, Linn B. ⁸	Nerve injuries in 2 patients after interscalene brachial plexus block (ISB). Both patients were awake; nerve stimulation and short bevel needles had been used to localize nerves; neither patient had parasthesia.
Tan FK, Ferreira R. ⁹	A brachial plexus injury following supraclavicular brachial plexus block using a parasthesia technique. The patient was awake, block performance was unremarkable, and there was no pain on injection.
Gillespie BL, et al. ¹⁰	A case of reflex sympathetic dystrophy complicating ISB. The patient had been awake, a parasthesia technique had been used, and the patient had no pain or discomfort on injection of local anesthetic (LA).
Stahs S, et al.	A neurologic complication after anterior sciatic nerve block that resulted in common peroneal nerve neuropathy. A nerve stimulator technique had been used in a conscious patient. High resistance was noted, but there was no pain on injection.
Bonney SH, Fridic AK. ¹²	Sciatic nerve palsy following an uneventful sciatic nerve block in a fully awake patient who had no pain on injection.
Buchner G, et al. ¹³	A case of persistent phrenic nerve injury following an ISB in an awake patient. No information on pain on injection was provided; however, pain was probably absent since the anesthesiologist was able to complete the injection of 50 mL of LA.
Kaufman BR, et al. ¹⁴	7 cases of neurologic injury in which all patients had substantial discomfort at some point during block placement and went on to develop neurologic injury and disabling chronic pain. None of the patients had an early follow-up by an anesthesiologist, and all information had been gathered by retrospective chart review. Consequently, it is not known whether the patient had pain during nerve localization or during actual injection of LA.
Aurore Y, et al. ¹⁵	A prospective study of regional anesthesia complications. In this series, 4 patients had neurologic injury due to PNBs. 12 epidural anesthetics and 4 PNBs were associated with discomfort. However, it is not known whether patients with PNBs had parasthesia or pain on injection. Since numbness is not a hallmark of PNB injury, one must assume that this refers to the neurologic injury.
Walton et al. ¹⁶	An uneventful nerve stimulator-guided ISB in an awake patient resulting in severe brachial plexus injury; there was no pain on either needle placement nor LA injection.
Candido ED, et al. ¹⁷	A prospective study of 695 patients having brachial plexus block standardized to technique, 14 and additives. 31 patients had neurologic symptoms likely due to ISB; all patients were awake and no patient had pain on injection. Parasthesia at injection was associated with higher risk for neurologic symptoms but no strategy to avoid neurologic symptoms after parasthesia occurred was suggested.
Fredrickson MJ, Kilfoyle DH. ¹⁸	A postoperative survey of neurologic symptoms after 1000 ultrasound-guided PNBs occurred in 2%, 5%, and 0.6% of patients at 10 days, 1 month and 6 months, respectively. Nerve neurologic symptoms were common in patients who experienced procedure-induced parasthesia (odds ratio = 1.7, <i>p</i> = 0.029).
Bogdanov A, et al. ¹⁹	Acute and nonacute complications associated with ISB and shoulder surgery: a prospective study.

Of note, pain on administration of local anesthetic (LA) into nerve tissue may be absent even with centroneuraxial blocks. For instance, Kao et al.²⁰ reported a case of nerve injury that was related to spinal cord trauma from a thoracic catheter that had been inserted while the patient had been under GA. However, the patient did not have pain during the administration of LA postoperatively. This is consistent with the observations of others that relying on pain to detect administration of LA into neural tissue is unreliable.²¹ The fundamental question remains what does one do with the parasthesia information. For instance, Fredrickson and colleagues¹⁸ reported that patients who experience parasthesia on needle placement have a higher risk of neurologic complications. However, apparently the report of parasthesia did not prevent the development of the nerve injury.

Normal versus abnormal discomfort/pain on injection

Injection of LA close to the nerves is often associated with discomfort on injection, resulting from “spraying” of the LA in the vicinity of the nerves.^{4,12,22} Dr. Alon Winnie⁶ famously coined the term *pressure parasthesia* and taught that this was a desirable sign of successful nerve localization and imped-

ing successful blockade for brachial plexus anesthesia. In actual clinical practice, however, variability of patient pain thresholds, individual patient's ability to verbalize a sensation of pain in the middle of a procedure, and an anesthesiologist's subjective interpretation of such responses make it very difficult to recommend where normal and abnormal pain or parasthesia on injection can be delineated. As an example, Barutell et al.²³ reported a case of discomfort on injection that was perceived as “normal pressure parasthesia”. Subsequently, the patient developed permanent neurologic damage although the discomfort had been detected by the patient and communicated to the anesthesia team.

Unfounded commonly heard recommendations

In the field of PNBs, a wide range of recommendations is often extrapolated from single observations. For instance, Walton et al.¹⁶ reported a case of brachial plexus palsy after total shoulder arthroplasty under an otherwise uneventful interscalene brachial plexus block (ISB). The authors concluded that PNBs should not be performed in anesthetized patients in order to minimize the risk for brachial plexus injury with ISB. Furthermore, the injection should be stopped immediately if parasthesia of “unusual severity” occurs. Ironically, their patient was neither anesthetized prior to the block nor had parasthesia or pain on injection.

Similarly, Candido et al.¹⁷ found that parasthesia on needle insertion was associated with higher risk for persistent neurologic symptoms after ISB, however, no strategy was suggested on how to avoid it. Benumoff²⁴, on the other hand, reported 4 cases of severe neurologic injury that resulted in cervical paraplegia in patients receiving ISB under GA. This report had far-reaching consequences within the anesthesia community, and many suggested that sedation and GA should be abandoned in order to decrease the risk for nerve injury.²⁵ This appears to be an over-reaction inasmuch as none of the patients had peripheral nerve injury, and all of the patients had received an intracordal injection, a complication that can be prevented by restricting depth of needle insertion, by adopting more lateral and lower approaches to ISB (away from the centroneuraxis), and by using ultrasound guidance to monitor needle placement.^{26,27}

Critics of “heavy” premedication and GA in this setting are reminded that the ISB is a superficial, relatively painless block procedure where excessive sedation and analgesia may *not* be necessary unless the patient requests heavy premedication before placing the block.²⁸ In contrast, many other PNBs involve deeper placement of the needle and several attempts at nerve localization that may result in intense patient discomfort.²⁹ Therefore, any generalized recommendations to avoid or limit premedication for PNBs carry the risk for limiting patient acceptance of PNBs. In one of the author's institutions, patients are sent an anesthesia satisfaction survey after their discharge home. Analyses of more than 5000 of these clearly indicate that the most satisfied patients are those with no recollection of any anesthetic procedure being done to them.^[*] Therefore, if PNBs are to be accepted by patients, adequate premedication and/or amnesia are necessary to avoid patient discomfort during needle placement.

Does GA really increase the risk for neurologic complications after PNBs?

Published data on complications of PNBs indicate that major neurologic injury after PNBs in awake patients occurs at a rate of 0.2%-0.4%.^{19,30,31} Most of these reports only included brachial plexus blocks, probably because these techniques are used more frequently than lower extremity nerve blocks. To date, no study has compared the risk for neurologic complications in awake versus anesthetized patients. In the report by Bogdanov and Loveland²², none of 548 patients who received an ISB after induction of GA developed permanent or long-term neurologic complications. Similarly, in a report presented at the 2005 Annual American Society of Regional Anesthesia (ASRA) Meeting, Tsai et al. presented the data on 226 PNBs of both upper and lower extremities, all performed in heavily sedated or anesthetized patients. None of the patients had neurologic complications. Bogdanov et al. used a modified approach to the classical ISB to reduce complications whereas Gadsden et al. used objective assessment of injection pressures to reduce the risk for intraneural injection during PNBs of both upper and lower extremities.⁴ These reports indicate that complications of PNBs may not be more common than complications reported in other similarly powered studies in awake patients. In fact, performance of PNBs in heavily premedicated patients or after induction of GA is probably a common practice. A recent informal poll conducted during the ASRA 2005 session on complications of PNBs indicated that approximately half of the attendees practiced blocks in heavily sedated or anesthetized patients. This is because PNBs rely on precision and are more easily placed in calm patients than in apprehensive

patients who can move about on needle manipulation or nerve stimulation or who can distract the operator by talking during the procedure. In addition, PNBs are often used in conjunction with GA; therefore, it is more practical to introduce them after GA to avoid the extra step of sedation and monitoring prior to entering the operating room and then inducing GA. However common, the recent recommendation of the ASRA is that this should be avoided whenever possible.²

Rescue blocks, multiple injection techniques, and “reverse” axis blocks

Incomplete nerve blockade occur in 3% to 30% of cases and usually involve only one or two of the terminal nerves.³² Several well established and universally accepted techniques of PNBs such as repetition of the block are used to rescue failed blocks despite the risk for intraneural needle insertion or injection into a partially anesthetized nerve.^[i] Common examples of rescue blocks after failed axillary, supraclavicular or ISB include elbow and wrist blocks.^{33,34}

Multiple injection techniques for upper and lower extremity blockade have been introduced into clinical practice because they appear to decrease onset time, increase success rate, and decrease the required dose of LA.³⁵⁻⁴² However, withdrawal and redirection of the needle to elicit multiple additional motor response after an injection of LA may carry a risk for direct needle trauma and intraneural injection into already anesthetized nerves. Nonetheless, this technique is uniformly accepted (e.g. midhumeral block, double-stimulation popliteal or sciatic block, most ultrasound-guided nerve blocks, etc.), and the available reports suggest that the risk for peripheral nerve injury is not elevated beyond that reported with blocks in non-anesthetized patients.⁴³

Regional anesthesia for elbow surgery has been challenging to accomplish. The most commonly used brachial plexus blocks, the classical approach to the ISB and the axillary block, are not sufficient because they do not result in reliable blocks of the ulnar nerve or do not provide adequate analgesia for the tourniquet, respectively. Thus patients undergoing elbow surgery or surgery involving both shoulder and elbow require concomitant use of these blocks for successful regional anesthesia.⁴⁴ Similar to the aforementioned examples of blocks after blocks, this technique is equivalent to a PNB in an anesthetized patient because the PNB is performed in an already anesthetized limb. To date, no reports of injuries have been reported with this technique.

Awake patients will have signs of CNS toxicity as a monitor before CVS toxicity ensues

The practice of PNBs often involves administering larger volumes and doses of LAs, although with ultrasound-guided blocks, there has been a trend towards reducing the doses. It has been postulated that heavy sedation or GA decreases the risk for early detection of severe systemic LA toxicity because it diminishes the patient's ability to report early signs and symptoms of rising LA serum levels. However, it should be noted that these are theoretical speculations. Others may argue that premedication offers protection through its anticonvulsive effect. Moreover, there are no reports of LA toxicity in adult patients under GA; essentially all reports of toxicity were in awake patients.⁴⁵⁻⁴⁸ In addition, concomitant use of GA allows for lower dose of LA required for PNBs. Therefore, one can equally argue that GA may actually offers protection from systemic LA toxicity.

Indeed, essentially all reports of LA toxicity in adults have been in awake patients. A typical clinical presentation of LA toxicity is in an asymptomatic patient during administration, followed by sudden seizure or arrhythmias immediately upon completion of the injection without prodromal symptoms.^{13,49} For instance, Edde and Deutsch⁵⁰ reported an occurrence of cardiac arrest after ISB in an awake patient who had no symptoms of toxicity until the entire dose (20 mL of 0.5% bupivacaine) had been administered. The most important steps in treating patients with severe toxicity are establishment of patent airway, hyperventilation, administration of oxygen, and hemodynamic support. More recently, infusion of intralipids has become suggested as one of the mainstays of the therapy.^{51,52} Of note, anesthetized patients who develop systemic toxicity are already in an environment ideally suited for aggressive resuscitation with airway secured and receiving high concentration of oxygen. Therefore, any suggestion that GA predisposes to a greater risk for severe systemic toxicity of LA is speculative, as there is no data to support this belief. Of note, LA toxicity is of potentially greater concern in the pediatric patient; hence, it remains puzzling that the practice of regional anesthesia in anesthetized patients is universally accepted in this patient population.

With the increasingly more commonly used ultrasound-guidance for nerve blocks and decreasing volumes and doses of local anesthetics to es-

tablish ultrasound-guided nerve blocks, this entire issue of possible greater safety of regional anesthesia in awake patients is likely to become mute.⁵³⁻⁵⁷

PNBs are OK after GA in pediatric patients, but not in adults

In contrast to adults, performing blocks in pediatric patients after GA is a universally accepted practice. In a recent report, 95% percent of blocks performed on 13,725 patients were placed while patients were under general anesthesia.^[ii] Pediatric patients often are not able to cooperate during needle insertion, nerve stimulation and the manipulation necessary to accomplish PNBs. In addition, most pediatric patients require GA for immobility during the surgical procedure. However, from the standpoint of risk for complications, this divergence in consensus on PNBs after GA between adults and pediatric patients does not make much sense. With the possible exception of infants, there are no substantial anatomical or neuro-physiological differences to justify this divergence in recommendations. While one can argue that complications of PNBs in children are rare, PNBs are infrequently used in the pediatric population, and there are no series comparable to those in adults to draw such conclusions.

Monitoring possibilities during PNBs

Since this discussion focuses on the impact of heavy sedation or GA on the risk for neurologic complications, it is important to discuss the available monitoring tools during PNBs. In general, there are two phases amenable to monitoring during placement of PNBs. These include A) needle placement guidance (percutaneous stimulation, ultrasound), B) avoidance of intraneural injection through report of pain on injection by the patient, nerve stimulation, and assessment of resistance (pressure) to injection, and C) avoidance of an intravascular injection.⁵⁸ With regard to intraneural injection, neither percutaneous stimulation nor ultrasound guidance is helpful. Percutaneous stimulation may be helpful in estimating the closest skin-nerve distance when guiding the needle insertion site. Ultrasound on the other hand, offers real-time needle guidance below the skin level. However, despite required skill, expense and inconvenience of the machinery, its resolution is insufficient to rule out intraneural needle placement with certainty.⁵⁹⁻⁶² One of the major obstacles in relying on ultrasound technology alone is also the dependence on operators skill and interpretation of the images.⁶³ Nerve stimulator-assisted PNBs became a regular practice in regional anesthesia and held promise for decreasing the risk for neurologic complications associated with a paresthesia technique.⁶⁴ However, it soon became apparent that nerve stimulators could not prevent neurologic injury.⁷ More recently, it has been suggested that the motor response to nerve stimulation is frequently absent at the point at which the needle makes contact with the nerve, and that intraneural needle placement is possible despite the use of nerve stimulators.^{59,65} Regardless, the presence of a motor response at a current of < 0.5 mA occurs only with the needle-nerve contact or an intraneurally placed needle.^{62,66} Occurrence of severe nerve stimulation has been documented with injections after stimulation of < 0.2 mA.^{67,68} Therefore, evoked motor response to nerve stimulation is an important monitor of needle-nerve relationship. Although its sensitivity is low, its specificity is extremely high.^{62,66}

Equipment Issues

Although the field of PNBs is in its infancy, research on functional regional anesthesia anatomy, outcome, and equipment is transitioning the field into a modern discipline. For instance, although spinal cord injury has been reported as a complication of ISB due to deep needle insertion, it is only in the very recent past that a needle with depth markings has been introduced to the market. Similarly, problems with the reliability and accuracy of nerve stimulators have been long identified, yet it is only within the last few years that manufacturers have offered constant current, PNB-specific nerve stimulators, depth coded needles etc.⁶⁹ Nerve stimulators still do not incorporate convenient, remote indicators of current delivery, intensity, and automatic disconnection when errors in function are detected.⁷⁰ Recently, a standardized PNB procedures form has been introduced.⁵⁸ Because intraneural injection may be associated with high resistance to injection, assessment of the resistance to injection is an important element in documenting PNBs.⁵⁸ However, subjective assessment of resistance to injection is inaccurate and can vary greatly among practitioners, making it analogous to documenting blood pressure by assessing the “finger feel” of the radial artery pulse instead of objectively measuring blood pressure with a sphygmomanometer.^{4,71}

Summary

Few issues in the practice of regional anesthesia have evoked such opinionated and diverging discussions as performance of PNBs in anesthetized or deeply sedated patients. This is most likely because administration of PNBs traditionally has been based on individual preferences, clinical impressions and other subjective methods. Although deep sedation and GA

may be of relevance to the risk for peripheral nerve injury with PNBs, there is no evidence in the literature that such practices actually decreases the risk for nerve injury. Regardless, the serious nature of complications resulting from inadvertent injections into the spinal cord mandates protocols to prevent them. In particular, regional anesthesia techniques involving needle insertion in the vicinity of the centroneurax should be practiced with extreme caution.¹ An insight into the appropriate depth of needle insertion and the use of needles with depth markings should be mandatory whether the patient is awake or anesthetized. It is the opinion of these authors that proper training in techniques and use of equipment and widespread adoption of combination of monitoring techniques to standardize performance of nerve blocks are far more likely to decrease the risk for complications than unfounded blanket statements, Figure 1.[2]

Unfounded statements about implication of appropriate sedation for patient acceptance can decrease the use of PNBs. Most certainly, the importance of appropriate premedication for patient perception and acceptance of regional anesthesia and is far better studied its role in risk of nerve injury.^{72,73} Future efforts should be directed toward developing more objective and exacting nerve localization and injection monitoring techniques that more reliably detect and prevent intraneural injection than the currently prevalent subjective methods. The results of these efforts will have far greater importance to the future of PNBs and their role in the practice of modern anesthesiology than far-reaching unsubstantiated statements with potentially negative impact on the future of the subspecialty.

[*] Hadzic et al. Unpublished data based on ongoing patients mail survey at St. Luke's-Roosevelt Hospital Center 1998-2005.

[2] NYSORA Teaching posters. http://www.nysora.com/peripheral_nerve_blocks/3347-our-contributors.html June 10, 2012

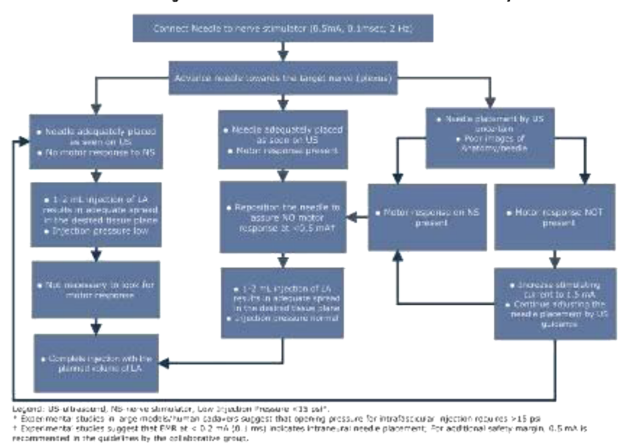
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[ii] Anesth Analg. 2012 Jun 13. [Epub ahead of print]

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Suggested Standard Monitoring For Nerve Blocks

Combined Monitoring: Ultrasound + Nerve Stimulation + Resistance to Injection



[Picture 1]

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23

SYSTEMIC LOCAL ANESTHETIC TOXICITY

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Local anesthetics (LA) may exert toxic effects at the local site of injection (local toxicity) and after absorption into the blood stream (systemic toxicity). The central nervous system (CNS) and the cardiovascular system (CVS) are the two main organs potentially affected by the LA systemic toxicity.

At blood concentrations just above those measured after normal absorption from injection site, LA exert toxic effects. The concentration leading to toxicity is usually directly related to potency of LA. Most agents exert neurologic toxicity at lower concentrations, followed by cardiac toxicity at higher concentrations. This is not true for racemic bupivacaine. With ropivacaine and levobupivacaine, the cardiac toxic reactions usually appear at the same times as the neurologic manifestation. In adults, the ratio of concentrations producing toxicity between bupivacaine and lidocaine is 4:1. The systemic concentrations attained are never high enough to block other ganglia or affect neuromuscular transmission.

CNS toxicity

At low to moderate plasma concentrations (1-5 µg/ml), lidocaine possess anticonvulsant properties. The first signs of CNS toxicity are subjective

(dizziness, tinnitus, sensation of drowsiness). Objective signs (shivering, muscular twitching, tremors initially involving the face) just precede the occurrence of seizures. Subjective signs are not observed in patients under general anesthesia nor in the younger patients. Usually, in patients under general anesthesia, the occurrence of seizures represents the first sign of toxicity. Hypercapnia is a factor facilitating the emergence of seizures because of a direct effect on CNS and also because it increases the free fraction of the drug. At the highest concentration, a global CNS depression occurs with respiratory depression followed by apnea and collapse. Seizures may occur: 1) rapidly after either a massive inadvertent intravenous injection, or because of a rapid absorption process at the site of administration; 2) several hours (even days) after initiation of perineural infusion for postoperative analgesia due to accumulation (1). In adults, convulsions occurring intraoperatively are usually free of major consequences when treated immediately but this might not be the same when seizures and respiratory depression occur on the ward during prolonged infusion. The treatment of convulsions, respiratory depression and/or coma is basically the same in children as it is in adults: 1) oxygenation and airway management; and 2) treatment of seizures, if still persistent after oxygenation, by using small doses of benzodiazepines or thiopental. A rapid infusion of a lipid emulsion (1 ml/kg Intralipid® 20% as a bolus followed by a rapid infusion) has revolutionized the treatment of systemic toxicity. Lipid emulsion therapy is now part of the guidelines on treatment for local anesthetic-induced toxicity (2).

CVS toxicity

Toxic cardiac manifestations occur at concentrations usually much higher than those at which CNS toxicity occurs. This is not true for racemic bupivacaine: cardiac toxic manifestations may occur before any sign of CNS toxicity, especially in young infants. Levo-bupivacaine is much less toxic for the heart than dextro-bupivacaine or the racemic mixture (3). Ropivacaine is also less toxic than racemic bupivacaine (3). However, it seems that with these two pure enantiomers CNS and CVS toxic manifestations occur at the same time. This is important because cardiac arrest may be hidden by seizures delaying the diagnosis. At toxic concentrations, bupivacaine slows intra-auricular and intra-ventricular conduction with increased PR duration and major QRS widening. Arrhythmias such as ventricular tachycardia (even torsades de pointes) or profound bradycardia may occur. These arrhythmias are often followed by either ventricular fibrillation or cardiac arrest with asystole. A major collapse coupled with a concomitant limited decrease in the myocardial contractile force occurs.

In adults, during continuous infusion for pain relief, subjective and objective signs of CNS toxicity usually precede cardiac manifestations, but this is not always the case in infants. General anesthesia, which is most often associated with regional anesthesia in pediatric patients, may conceal CNS manifestations. The increased threshold for CNS toxicity in infants as compared to adults and the equal sensitivity to bupivacaine cardiotoxicity may explain why cardiac signs may not be preceded by any sign of CNS toxicity. Also, because of their higher heart rate, newborns and infants are thought to be more prone than adults to the frequency dependent blockade of sodium channel produced by tertiary amine agents such as bupivacaine. Cardiac complications require urgent and appropriate therapeutic measures including oxygenation, ventilation and cardiac massage if appropriate. In infants, cardiac output almost exclusively depends on heart rate and increasing the rate might be essential especially in the presence of high degree intraventricular block (and also during episodes of torsades de pointes). On the other hand, it must be remembered that increasing heart rate also increases the phasic (frequency-dependent) block. Prolonged cardiac massage has proved to be efficacious in adults (4). In fact, bupivacaine wash-out from the heart seems to be rapid when coronary perfusion is maintained at least in the isolated rabbit preparation. Despite its arrhythmogenic potential, epinephrine appears to be the only useful drug, but requires careful titration using boluses of 0.01 µg/kg, in order to avoid ventricular tachycardia or fibrillation.

The use of a lipid emulsion ("Lipid Rescue") totally transformed the treatment of both neurologic and cardiac toxicity of LA. Since the first publication of the use of Intralipid® in rats (5), lipid emulsions have been successfully used in humans (6). They act by binding LA molecules and therefore they rapidly decrease the plasma concentration of anesthetics.

Allergy

Allergy to LA is rare and amide agents may exhibit anti-allergenic properties. Most often "allergic" reactions reported by patients during dental surgery may be attributed to epinephrine. In fact, allergy concerns almost exclusively esters because these agents have para-aminobenzoic acid as a metabolite. Solutions with epinephrine contain metabisulfite, which may

induce adverse reactions. However, some rare cases of proven allergy to amide agents have been published.

Methemoglobinemia

In neonates and infants, methemoglobinemia may develop several hours after the administration of prilocaine, benzocaine and, occasionally, lidocaine. In patients prone to methemoglobinemia, O-toluidine, which is a normal metabolite of prilocaine, accumulates. This powerful oxidizing agent may accumulate in erythrocytes especially in neonates and infants in whom the erythrocyte content of methemoglobin reductase is lower than in adults. Patients become cyanotic when methemoglobin exceeds 20-30% of the total hemoglobin content, when dyspnea, tachycardia, headache, vertigo and hypoxia occur. Death, though rare, can occur when the concentration exceeds 70%. Treatment of methemoglobinemia consists of i.v. methylene blue (1 to 7 mg/kg) in order to convert methemoglobin to hemoglobin. Therefore, prilocaine is contraindicated in infants less than 6-9 months and care should be taken in young children for whom dosage should be limited to 3-4 mg/kg. EMLA® cream contains prilocaine. However, in the absence of predisposing factors such as hemoglobinopathies, glucose-6-phosphate dehydrogenase deficiency, exposure to aniline dyes and oxidants (sulfonamides, nitrites, nitrates, antimalarials, trimethoprim-sulfamethoxazole or inhaled nitric oxide), the use of EMLA® cream in normal amounts (2.5 g, i.e., half a small tube) is usually safe, even in neonates.

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JOINT SESSION: MORBIDITY AND MEDICOLEGAL ASPECTS OF REGIONAL ANAESTHESIA AND ANALGESIA: SYSTEMIC LOCAL ANESTHETIC TOXICITY

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Overview: Instances of severe LAST are rare but this makes us all the more vulnerable since we are therefore less practiced in identifying it and have fewer opportunities to manage it than we do other more common complications of anesthetic care. Moreover, it is a complication that is clearly tied to the anesthesiologist since most times they hold the syringe in their hand and therefore can be viewed as more liable - exceptions are discussed below. The rarity of LAST can result in a letting our guard down, for instance, in using less-than-standard levels of monitoring during peripheral nerve blocks. Statements like, "I've been practicing for 20 years and never use ECG for an arm block", expose a failure to understand probabilities and increase the likelihood that the response to a rare event like LAST will be delayed, possibly to the patient's detriment. It is important, even when addressing rare events to consider how best to reduce further the likelihood of an event and a bad outcome.

Reducing Risk: The ASA Standards for Basic Anesthetic Monitoring (<http://www.asahq.org/For-Members/Standards-Guidelines-and-Statements.aspx>; effective July 1, 2011) require use of exactly the same monitors for regional anesthesia as for general anesthesia. Combining thoughtful consideration of the right block and drug, with proper incremental dosing, and monitoring the

patient for changes in ECG, heart rate, blood pressure and mental status, will increase the chance of identifying and interrupting intravascular injection as early as possible.

Three common issues can undercut the efficacy of monitoring as a key safety measure. First, in patients with low cardiac output and slow circulation time, the standard 'between-injections' interval must be prolonged to avoid stacking doses. That is, when the interval is shorter than the time it takes an entrained dose of local anesthetic to reach the heart then observing signs of toxicity will be delayed, thereby increasing the chances of multiple injections reaching the blood stream before a diagnosis is made. Next, there are specific, sensitive subpopulations of patients such as those with ischemic heart disease, conduction defect, low cardiac output or cardiomyopathy that are more susceptible to LAST at any given blood concentration of local anesthetic. Therefore it is wise to identify these patients preoperatively and consider either adjusting the local anesthetic dose down in or avoiding peripheral nerve block altogether in these patients. Obviously, this concern does not apply to subarachnoid blocks that use small doses of local anesthetic. However, this approach requires counterintuitive thinking since the sickest patients might be those in whom we are most inclined to use regional anesthesia when peripheral nerve block requiring large doses of local anesthetic might actually be a poor choice. Intravascular injection or entrapment of several hundred milligrams of ropivacaine, for instance, could create a rapid and fixed toxic effect that can be difficult to treat, whereas hypotension caused by inhalational anesthetic is usually gradual in onset, relatively easy to treat and the drug readily eliminated by pulmonary ventilation. Oversedation of the adult patient can also be problematic for detecting LAST during nerve block placement since it can remove input from one of the most important monitors of a patient's well-being: the patient.

Although not proven conclusively, it is the opinion of many practicing regionalists that ultrasound guidance will reduce the risk of LAST compared with other methods of needle placement. It is certainly logical that seeing the needle, the large vascular structures and spread of drug should help detect gross intravascular injection. However, it is clear that ultrasound guidance cannot entirely prevent LAST as slow subsequent absorption is not detected, nor is the risk to a sensitive patient lowered.

The risk of LAST can also be reduced by having a plan of action should an event occur. This requires having the necessary equipment and instructions available and a clinical staff that has been briefed or trained in treating LAST. Simulations are a useful training tool. Instructions are available at the ASRA and AAGBI websites. The ASRA version takes the form of a checklist since this method has been shown to improve resuscitation in LAST simulations. Further information is available at the educational website: www.lipidrescue.org.

It is important to recognize that anesthesiologists are not the only care providers that use local anesthetics. Clearly each of us has seen a surgical colleague, intensivist, radiologist, emergency room or other doctor blithely use doses of local anesthetic that seem unsafe - often with no apparent concern for toxicity. Moreover, many of our non-anesthesia colleagues are entirely unaware of the current recommendations for treating LAST. It is important as educators to continue teaching our anesthesia trainees. However, it is equally important to begin spreading the word among our other colleagues that using local anesthetics carries very real risks and that reducing this risk is possible if they take the time to learn the current standards of care for managing LAST.

Finally, data show that should an adverse event occur, risk is even further reduced by being open with the patient and family about the occurrence even to the point of admitting fault if such is the case. Most cases of LAST do not reflect poor care. However, this is exactly the message conveyed (among others) when the physician is reluctant to share information about the cause and patient's clinical course. It is important to note that clearly documented adherence to standards of monitoring, dosing, preparedness and treatment all contribute to reducing further the physician's liability when severe LAST occurs. We can never completely eliminate this risk, but with thoughtful preparation we can certainly reduce it and minimize the personal and professional consequences when it does occur.

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WHAT DO PATIENTS WANT TO KNOW AND HOW SHOULD WE DELIVER PATIENT INFORMATION?

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Healthcare services are under constant financial pressure to deliver patient care more efficiently. This drive for efficiency has led to increases

in the numbers of patients being treated in the day care setting. In parallel with these changes is an expectation to produce and demonstrate a high level of patient satisfaction. Patient satisfaction is achieved through meeting or exceeding patients' expectations [1-2].

Patients are often significantly anxious prior to surgery [3-5]. High patient anxiety can lead to adverse responses such as dysrhythmias and hypertension [6] and can lead to refusal of elective surgery.

Clearly, one of the key factors in achieving high levels of patient satisfaction is effective communication and delivery of information. Pre-operative education reduces anxiety, complication rates, hospital length-of-stay, analgesic consumption and can increase patient satisfaction [7-12] (although some investigators have found patient satisfaction may also be similar in patients not receiving media information [13]).

Patients often ask for information about anxiety-related issues, for example postoperative pain and other postoperative symptoms [14]. Patients also express dissatisfaction when they are provided with too little information, with patients commonly wishing for more information and believing that they received less information than their surgeons felt they were providing [15, 16].

Written information can successfully provide information pre-operatively to patients [17], but this effect will obviously depend on the patients' reading ability. Video-based information can decrease patient anxiety levels [10,18-20], but this effect is not consistent across all studies [21, 22].

Effective information delivery is not as easy as one might think. Patients will often not fully understand or remember information that has been provided to them [23, 24]. For example, 93% of cataract surgery patients could not remember even basic information about their procedure or possible complications prior to surgery [25], and only 4% of a group of patients undergoing cataract surgery remembered more than two complications the day after surgery [26]. These issues can lead to increased levels of patient dissatisfaction [27]. Ways of improving information delivery might include making more specific statements, rather than providing general information, and information can also be delivered verbally or in written form and even repeated, to improve patient recall [28].

We are now living in an information age; the public can access information easily via the media and internet, and often expect to receive a high level of information from healthcare services. Healthcare professionals are also encouraged to provide information concerning risks and complications about procedures as part of the informed consent process. The challenge is to provide this information, along with useful education without unduly increasing patients' anxiety. This is of course particularly relevant to patients who are undergoing their surgery under a regional anaesthetic. Information has sensitized patients to experience increased pain [29, 30]. This may have been due to increased pre-operative anxiety levels, which can lead to higher reported pain levels following surgery, but properly delivered information can also reduce peri-operative anxiety [31, 32].

Information can be considered as procedural (i.e. describing the actual procedure and event sequence), sensory (describing what the patient is likely to feel and experience) or behavioural instruction (describing behaviours the patient should adopt to encourage recovery) [33]. A combination of procedural and sensory information will produce the strongest and reproducible benefit [34].

Information delivery in healthcare is not as simple as 'give all patients as much information as possible'. Patients differ in the amount of information they wish to receive before treatment. Miller suggested that patients could be considered as monitors or blunders. Monitors desire a high level of information to reduce their insecurity, and are able to concentrate on what is known and safe. In contrast, blunders prefer less information and apply a cognitive coping style of avoidance, and prefer to be more distracted than involved in the process [35]. In one study, 26% of cataract patients explicitly said they did not wish to receive pre-operative information, and 28% found such information anxiety provoking [25].

I believe the challenge to us, as regional anaesthetists, is to make a judgement as to where in the spectrum our pre-operative patients lie, so that we may tailor the amount of information we provide to them, and deliver it in such a style as to not cause undue distress; on the contrary, we wish to allay anxiety in the pre-operative consultation. Instruments have been developed to measure this need for information; including Miller's Behavioural Style Scale [35] and the Krantz Opinion Survey [36]. When patients are provided with information according to their preference, their psychological and physical outcomes improve [37-40]. This would suggest that healthcare professionals need to become 'smarter' in the way they deliver information

to patients by tailoring the amount of information and style of delivery, according to the patients' personality type, in order to produce the best outcome.

The evidence for what types of information are the most effective is sparse. One problem with interpreting the type and style of delivery is that they are both important, i.e. a poor video or face-to-face interview may well fare worse than excellent written information, even though written information may be a weaker way of transferring information.

Falagas et al found information was delivered more effectively between doctors and patients when a good relationship existed between them, and concluded that this should assist the process of obtaining informed consent [41]. Sjoling et al found that pre-operative interviews with patients prior to total knee arthroplasty produced a more rapid decline in postoperative pain, reduced pre-operative state anxiety and increased satisfaction with pain management [42]. Mayande et al used guided imagery to increase patients' feelings of being able to cope with the stress of undergoing abdominal surgery, and found that the study patients required less analgesia and had a reduced length of hospital stay [43].

Audiovisual information reduces pre- and postoperative anxiety and can be particularly useful to those with reading and comprehension difficulties or both [44]. Pagers used an informational video before cataract surgery to significantly increase patients' understanding of and satisfaction with surgery, as well as decrease their anxiety. These effects were independent of patients' previous experience with cataract surgery, and despite the fact that these patients generally thought they had already received enough information about what to expect from the surgery [45].

We also used information videos in patients undergoing upper and lower limb surgery under regional anaesthesia. We found the videos, which depicted a pre-operative visit and explanation as well as a 'patient journey' through the theatre, significantly reduced pre-operative and postoperative patient anxiety [46].

The demand for information by patients and the need to produce high levels of patient satisfaction and improved outcomes in a difficult economic climate, mean that as regional anaesthetists, we need to provide appropriate and timely pre-operative information. Audiovisual information reduces pre- and postoperative anxiety and can be particularly useful to those with reading and comprehension difficulties. Informational films are an efficient and convenient way to inform patients and reduce their anxiety. Films can be shown in the pre-operative assessment clinic, thus allowing time for reflection before admission, which may improve the efficacy of the received information.

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JOINT SESSION: MORBIDITY AND MEDICOLEGAL ASPECTS OF REGIONAL ANAESTHESIA AND ANALGESIA: WHAT DO THE PATIENTS WANT TO KNOW AND HOW BEST TO DELIVER PATIENT INFORMATION

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While severe complications related to regional anesthesia are rare, minor complications in the aggregate are common (e.g., urinary retention after spinal). Openness in discussing possible complications before surgery is rational but must be calibrated to a patient's expectations and interests. The message must be delivered accurately but not the same way to every patient. An experienced anesthesiologist weighs at first visit, and quickly, the personal attributes of every patient including what they might want to know

about anesthetic options and risk, and the appropriate degree of clinical detail. Each patient is quite different in this regard. My practice at the Veterans Hospital in Chicago comprises a population of elderly patients who are generally very grateful for their care, not prone to questioning authority and usually happy to leave major decisions entirely to the physician. They often appear annoyed if I present the many sides of a clinical decision and usually just prefer, "What ever you want to do, Doc". My colleagues in the Bay Area might expect an entirely different attitude from the educated, affluent parent of a pediatric surgical patient, particularly if they are prone to suspect authority generally and medical professionals in particular. In addition to coming to preoperative evaluation clinic with a printout from a public awareness website, they will likely want to know every aspect of the procedure from how the skin is prepped to the type of gel used with the ultrasound probe. The physician's read of these disparate patients will define how they present the risks of regional anesthesia.

It is ironic to me that major concerns of patients and anesthesiologists seem not to overlap very much. Perhaps the main concern of many patients is the possibility of awareness under general anesthesia. They do not care very much about the quality and extent of monitoring, venous (and especially central) access, means of establishing an airway, methods of ventilation and replacing blood loss or correcting coagulation, blood sugar, electrolyte or other laboratory abnormalities. Certainly turnaround and throughput are not usually on their agenda except as it affects their time in the holding area. One area of overlap however, is concern about post operative pain control and I believe most patients are very interested to hear the doctor's plan to lessen their pain. This is an issue that has direct relevance to the choice of regional anesthetic since regional anesthesia can provide both intraoperative and post-operative analgesia through strategies that provide long-acting relief, i.e., catheter techniques.

One of the best ways to prepare patients is answering their questions at the preoperative evaluation and providing a means for them to search FAQ in public awareness forums on the internet. There are several very good sites to refer patients. The ASA site is a very good general example: <http://www.lifelinetomodernmedicine.com/>. For topics specific to regional anesthesia ASRA also sponsors a very good site: <http://www.asra.com/patient-info.php>. There is a subheading that specifically addresses the risks of regional anesthesia. The key factors in building a good site are defining the core message, and the target audience. In addition to standard sites in the web, social media such as Facebook, Twitter, and Youtube can also be used to disseminate information and improve public awareness of anesthetic risk and other important anesthesia-related topics.

Interestingly, physicians in other specialties such as Emergency Medicine are now performing nerve blocks and therefore assume the risks without necessarily having the necessary education or background to prevent, identify or manage them. Several patient deaths related to regional anesthesia or trigger point injections have resulted in large judgments against the non-anesthesiologists performing the procedures, in many cases without proper monitors or available resuscitation equipment. It is doubtful that such practitioners are open to the message that regional anesthesia should be under the lone purview of anesthesiologists. However, we should provide that message to our patients. Regional anesthesia is safe when practiced appropriately with awareness of the risks and how to detect and treat them.

Finally, it is important to touch on the topic of full disclosure, or medical transparency. Revealing the events that led up to a complication will improve patient trust and thereby reduce physician liability. I think this type of openness is an absolute criterion of professionalism and something we should emphasize in teaching our trainees. Moreover, studies of the transparency policy implemented at the University of Michigan in 2001 show that full disclosure of errors to the patient and their family did not lead to more malpractice claims but paradoxically decreased claims for compensation, time to resolution and overall lower liability costs. Perhaps the most important benefit to sharing such information is that what we can learn about improving our practice and as a result patient safety.

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NEUROPATHIC PAIN IN CANCER SURVIVORS, PREVALENCE AND ASSESSMENT

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Both acute and chronic pain has been well documented as one of the most frequent and distressing symptoms in cancer, and have been shown to

adversely affect quality of life. [1] [2] In a recent systematic review of 52 studies, 2 pooled **prevalence rates for cancer pain** were reported for four subgroups of patients: (1) in studies that included **patients after curative treatment 33%** (95% CI 21% to 46%); (2) in studies that included patients on cancer treatment 59% (CI 44% to 73%); (3) in studies in patients with advanced or metastatic disease, 64% (CI 58% to 69%); and (4) studies in patients at all stages of the disease, 53% (CI 43% to 63%). Across all of the studies evaluated, approximately 33% of the patients reported moderate to severe pain.[3]

Cancer pain is a complex multifactorial phenomenon. The overall concept of cancer pain does not suffice to classify or describe the different pain characteristics that are due to different tumour related, etiologic, patho-physiologic, anatomic, treatment-related and temporal factors. Psychological and patient-related factors strongly influence the individual pain experience. Up-to-date there is no clear standardised approach or taxonomy used for assessing neuropathic pain in patients with cancer, and little consensus exist concerning definitions, framework, format and content related to two related yet distinct concepts; **pain assessment and pain classification** in relation to cancer.

It is recommended that **pain intensity** should be assessed by a simple 11-point NRS, whereas well validated instruments such as the Brief Pain Inventory (BPI) or the McGill Short Form questionnaire are recommended for a more comprehensive, multidimensional pain assessment. Despite recommendations, pain is still not routinely measured in cancer clinical practice. This may reflect the fact that most tools are too long and cumbersome for patients and clinicians to use.[4] And yet there is a continuous flow of new instruments, and only a minority is developed according to standardized development procedures.[5]

Neuropathic pain (NP), is pain arising as a direct consequence of a lesion or disease affecting the somatosensory system.[6] **NP pain in cancer (NCP)** is commonly presented in cancer patients and is considered a well-established entity for more than 20 years.[7] ; can occur if the nervous system itself is damaged, by tumour infiltration of nerves, tumour-associated toxins, therapy-related toxins, or surgical damage. It is characterized by spontaneous and provoked pain, by positive symptoms such as paresthesias and dysesthesias, and by negative signs (sensory deficits) reflecting the neural damage.[8] Despite the fact that the exact prevalence of NCP remains unknown, available data demonstrate that a neuropathic component is present in approximately, 1/3 of cancer patients, usually mixed with nociceptive components, or, occasionally, as a single autonomous entity. Thus although as much as 9% of cancer patients have solely NP, many have a mixed pain syndrome.[9] [10]

Diagnostic criteria to identify NP are proposed by the Neuropathic Pain Special Interest Group (NeuPSIG) of the International Association for the Study of Pain. A detailed history and clinical examination are fundamental to a correct diagnosis. A grading system of definite, probable, and possible NP pain has been proposed by a group of experts for clinical and research purposes, in recognition that there is no gold standard and is based on pain distribution, causality, clinical examination and diagnostic tests. (ref. Nr 6)

Screening tools and questionnaires are useful in indicating probable NP. Several scales have been developed to evaluate various symptoms associated with NP pain, including the Leeds Assessment of Neuropathic Pain, Neuropathic pain questionnaire, the Pain Neurotoxicity Questionnaire, and Pain Detect. They include patient self-reported data, as well as various components of a physical examination. The common denominators across these questionnaires are set of descriptors (sensations of pins and needles, heat or burning, impaired temperature sensitivity, numbness, and electric shock-like sensations; whether or not the pain becomes worse with touch, and whether the joints are painful). [11] [12] Electrophysiological techniques, quantitative sensory testing, skin and nerve biopsies, and magnetic resonance imaging can be useful to detect lesions of the central or peripheral nervous system.

The main advantage of screening tools is to identify potential patients with NP, particularly by non-specialists (grade A). However, these tools fail to identify 10-20% of patients with clinician diagnosed NP, showing that they cannot replace careful clinical judgment. DN4 reports only about half the cancer NP cases diagnosed by clinicians. There are a few reports validating the questionnaires in various groups of patients with cancer. [13]

In a recent systematic review, by M. I. Bennett et al, on the **Prevalence and aetiology of NP pain in cancer patients** including 19 studies in 11,063 patients, they found that 6569 (59.4%) had nociceptive pain, 2102 (19%) had neuropathic pain, 2227 (20.1%) had mixed-mechanism pain, and 165 (1.5%) were classified as having pain due to unknown or other causes. Therefore the prevalence of NP ranged from a conservative estimate of 19% (9.4% to

28.4%, CI 95%) to a liberal estimate of 39.1% (28.9% to 49.5%) of all patients with cancer pain. It must be stressed though that only 14 studies (64%) clearly stated the use of confirmatory testing as part of the diagnostic criteria consistent with the current grading system for NP pain, and only 8 fully met the NeuPSIG diagnostic criteria. A standardised approach to clinical assessment is essential if neuropathic mechanisms are to be identified with certainty, for appropriate treatment to be initiated, and for data to be comparable across studies.[14]

Cancer survival is significantly increased all over Europe. [15] In the US, 10.5 million subjects are cancer survivors. Sixty-four percent of adult cancer patients diagnosed during 1995-2001 reached their 5-year survival. [16] [17] Once an explosive disease that lead to a quick demise, cancer has now become a chronic disease, characterized by a high prevalence of disturbing and persistent physical symptoms and multitude of psychosocial and economic issues that diminish their quality of life, with pain being one of the most disturbing and devastating one. [18]

According to the definition of the National Cancer Institute Office of Cancer Survivorship, an individual is considered a cancer survivor from the time of cancer diagnosis, through the balance of his or her life.[19] In an editorial in *Annals of Oncology*, [20] it is stated that there is a need to strictly define the population to be studied and distinguish the patients with active disease (persons living with cancer) from the disease and treatment-free patients from at least 5 years (cancer survivors), as cancer survivorship has 3 distinct phases: acute, extended, and permanent. The **acute phase** starts at the time of diagnosis and lasts until initial treatment is completed; the **extended phase** begins with completion of initial treatment resulting in partial or complete remission and is characterized by regular follow-up with or without maintenance or intermittent therapy; the **permanent survival phase** follows the extended phase during which patients have a very low likelihood of recurrence of their primary cancer but might be at some risk of developing associated cancers or cancers secondary to their initial anticancer therapy. (ref. 19)

On the light of the quite broad definition and the heterogeneity of the cancer survivors population it is inevitable that research is not focused yet, although a few reports exist on the quality of life and other parameters of the cancer survivors life, but not many on pain and especially on neuropathic pain as an aspect of quality of life.

Chronic pain in cancer survivors is caused by residual tissue damage from the cancer, and/or the cancer therapy: surgery, chemotherapy, steroids, hormones, and radiation. Cancer survivors may also have chronic pain from cancer related conditions such as postherpetic neuralgia and non associated chronic conditions such as collagen vascular diseases, degenerative arthritis, and diabetic neuropathy.

Studies on the **prevalence of pain in cancer survivors** are scarce. Cancer survivors experiencing chronic pain constitute about 40% of all patients' visits to Pain and Palliative Care Program at a NCI-designated, Comprehensive Cancer Center. [21]

The research on **pain and neuropathy** conducted among cancer survivors is of varying quality. A vast amount of literature addresses cancer pain symptoms, but long-term pain and neuropathy among disease-free survivors has received far less attention, despite evidence that pain can be severe compromising recovery and the quality of life. [22] Few cross-sectional or prospective longitudinal studies document the incidence, time course, and problems associated with the long-term effects of pain and neurologic impairment.[23] Data from surveillance studies are limited, making it difficult to estimate the prevalence and incidence of long-term pain and neuropathies among cancer survivors, as well as their susceptibility to developing these conditions.[24] [25] Most of the research has been conducted among survivors of breast,[26] lung,[27] head and neck,[28] [29] and colorectal cancers. [30] [31]

Neuropathic Pain in Breast Cancer Survivors

Chronic pain after surgical treatment, mastectomy or lumpectomy with axillary node dissection chemotherapy, and radiation, mostly referred to as postmastectomy pain syndrome (PMPS), is a common finding in breast cancer survivors. It can develop shortly after surgery or up to several months after surgery, and can persist for years.[32] [33] It is localized in the axilla, medial upper arm, breast and/or chest wall, and its timing is consistent with the IASP definition of chronic pain. [34] An alternative term, intercostobrachial neuralgia, has been proposed. [35]

The characteristics of this pain are described diversely as lancinating pain, paresthesia, dysesthesia, hyperalgesia or allodynia, edema, muscle weakness, and skin irritations, indicating that the symptoms are related to nerve injury or dysfunction. Additionally sensitization processes may occur in the peripheral

and central nociceptive system, leading to primary and secondary hyperalgesia. Using the grading proposed by Treede et al, we may consider PMPS as possible neuropathic pain.[36]

The prevalence of PMPS is variable on basis of definition, treatment, and anatomical localization of the pain measure. Studies measuring PMPS report prevalence around 25%, whereas studies with a wider definition report prevalence around 50%. A substantial variation in prevalence of the phantom breast, ranging from about 10% to 66%, was also reported. Risk factors for PMPS are unclear, but recent data suggest that it may be more common among younger women (ages 30 to 49 years) and women who are overweighted. [37] [38]

A large nationwide study showed a prevalence of chronic pain of 25% for patients treated with mastectomy without adjuvant therapy, and 60% for patients treated with breast conserving therapy, axillary lymphnode dissection (ALND), and radiation field including the periclavicular lymphnodes, demonstrating the importance of the type of treatment which patients receive. [39]

Furthermore, pain intensity has not been well examined and varies according to treatment, measurement method, whether measurement was taken at rest or during movement, and anatomical location.[40] In a prospective study 174 women were examined. Six months after the operation the incidence of pain syndrome was 52%. Younger women (< 40 years) and those who were submitted to axillary lymph node dissection (with more than 15 lymph nodes excised) have shown a significantly increased risk of pain syndrome after surgery, defined by the presence of one of the following complications: intercostobrachial pain (hyperaesthesia perception related to tactile stimulus at the internal area of the arm or axillary homolateral to treatment); neuroma (report of pain in the surgical scar when submitting to local percussion test); and phantom breast pain (reported by a patient who underwent mastectomy describing an unpleasant sensation of breast presence as pin-prick, burning or torsion), (relative risk (RR) = 5.23 95% (CI): 1.11-24.64) and (RR = 2.01 95% CI: 1.08-3.75). [41]

The validity of ID Pain as a screening tool for NP in 240 breast cancer survivors was evaluated using the Self-Report Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS) and a reported diagnosis of NP as criterion measures. Receiver Operating Curve analysis demonstrated that ID Pain has a predictive validity of 0.72 and 0.70 for diagnosis of NP as made by clinicians and the S-LANSS, respectively. 45% of the sample reported pain in the past week. Of those reporting pain, 33% reported that they had been diagnosed by their health care provider for NP, 39% had a positive ID Pain (≥ 2) score and 19% had a positive S-LANSS score. The most commonly endorsed ID Pain item was "hot/burning" ($n = 48$), followed by feeling "numb" ($n = 47$) and "pins and needles" ($n = 45$). Total ID Pain score was significantly associated with a clinical diagnosis of NP ($r = 0.41$; $P < 0.001$) and the S-LANSS total score ($r = 0.54$; $P < 0.001$). An ID Pain score of ≥ 2 corresponded with the likelihood of NP in this sample, consistent with the original ID Pain development study. This study provides evidence for ID Pain as a valid screening measure of NP for breast cancer survivors. [42]

Post-Thoracotomy pain

Chronic pain is a common complication after thoracic surgery. Little is known about the underlying cause of chronic post-thoracotomy pain, often suggested to be intercostals nerve damage during surgery leading to neuropathic pain. [43] Previous studies have shown chronic pain in 40% to 80% of patients after thoracotomy[44] and in 20% to 40% after video-assisted thoracic surgery (VATS).[45]

Symptoms of NP pain are present in 35% to 83% of the patients with chronic pain after thoracic surgery.

A questionnaire designed specifically for the study, including questions on neuropathic symptoms was sent to 1152 patients who had undergone thoracic surgery between 7 months and 7 years ago. 948 people were included in the study, 600 responded (63%). Prevalence of chronic pain was 57% at 7-12 months, 36% at 4-5 years and 21% at 6-7 years. **The prevalence of each neuropathic symptom was between 35 and 83%.** The presence of a neuropathic symptom was associated with significantly more severe pain, more analgesia use and pain more likely to limit daily activity.[46] Patients undergoing thoracotomy with bilobectomy or pneumonectomy had a significantly greater risk of developing chronic pain than patients undergoing a thoracotomy with lobectomy or wedge excision, suggesting a significant role of visceral nociceptive components.[47]

The prevalence of the neuropathic component in chronic pain after thoracic surgery was investigated in 243 patients who underwent a video-assisted thoracoscopy (VATS) or thoracotomy by mail. Mean time since surgery was 23 months. Patients retrospectively received a questionnaire with the validated Dutch version of the Pain DETECT Questionnaire. The prevalence of

chronic pain was 40% after thoracotomy and 47% after VATS. Definite chronic neuropathic pain was present in 23%. **Thus, chronic pain after thoracic surgery has both neuropathic and non-neuropathic components and is only half neuropathic.** [48]

Chronic pain syndromes that result from the treatment of cancer

After **Radiation therapy** delayed painful brachial and lumbosacral plexopathies have been described, with the overall prevalence ranging from 2% to 5%. [49] Brachial plexopathies occur most commonly in those patients with breast cancer, followed by lung cancer and lymphoma. [50] The onset is typically delayed from 6 months to as long as 30 years after radiotherapy, with peak onset from 2 to 4 years. In a case series of 33 women who developed brachial plexopathy after treatment with radiotherapy for breast cancer, symptoms began from 6 months to 20 years after therapy. [51] Particularly devastating symptoms are paresthesias (100%), hypoesthesia (74%), weakness (58%), and pain (47%). [52]

In patients treated by contemporary radiation techniques for **head-and-neck cancer (HNC)**, the brachial plexus frequently receives doses in excess of historically recommended limits. Clinically significant peripheral neuropathies believed to be associated with radiation-induced injury of the brachial plexus. In a prospective study, 330 patients who had previously completed radiation therapy for HNC (median time from completion of radiation therapy 56 months), disease-free at the time of screening were prospectively screened using a standardized instrument for symptoms of neuropathy. Forty patients (12%) reported neuropathic symptoms, with the most common being ipsilateral pain (50%), numbness/tingling (40%), motor weakness, and/or muscle atrophy (25%). [53]

In a prospective study, investigators identified pain in 56% of patients with HNC at diagnosis, and found mixed nociceptive and neuropathic pain in 93% of those with pain. The LANSS scale is a simple and suitable screening test for neuropathic pain in patients with HNC pain, (sensitivity 79%; specificity 100%), although some modifications might improve it. [54]

Chemotherapy-induced painful peripheral neuropathies (CIPN) are increasing in frequency as more neurotoxic agents are introduced to treat cancer. Patients describe symmetrical, distal painful neuropathy in a "stocking and glove" distribution, usually in the feet/toes and fingers/hands/. Unfortunately, few studies systematically evaluate CIPN in a prospective manner. Further complicating our ability to clearly define the CIPN experience from existing data is the absence of a universally-accepted valid, reliable instrument, that might be used in both clinical and research settings. [55] Although clinically some of the symptoms much the NP pain criteria, these syndromes have not been investigated accordingly.

Well-designed cross-sectional and longitudinal studies would elucidate much about the incidence and prevalence of treatment-induced pain and neuropathies.

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PATHOPHYSIOLOGY OF NEUROPATHIC PAIN IN CANCER SURVIVORS

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Earlier diagnosis and advances in the management of cancer increases the survival rate of patients. Cancer behaves more and more like a chronic disease. Many patients still suffer persistent and often disturbing physical symptoms besides a multitude of psychosocial and economic issues all diminishing the quality of their life.¹ It is still unclear what is the exact prevalence and incidence of pain in cancer survivors. In a comprehensive cancer centre, including a pain and palliative care department, about 40 % of all patient contacts of cancer survivors concern pain problems.² Pain in cancer survivors can be divided in 3 types of pain: nociceptive or somatic pain, which is often well localized, sharp and aggravated by activity or position change; visceral pain generated by stimulation of nociceptors in the capsules or walls of hollow or solid organs by the tumour or metastasis and finally neuropathic pain resulting from injury to the peripheral and/or central nervous system. Patients describe the neuropathic pain in terms as 'itching, hypersensitive, pins and needles, electric shock, burning.... The neuropathic pain is often localized to specific dermatomes, nerve root distribution, or peripheral, distal extremities. Neuropathic pain can arise both spontaneous and evoked by a stimulus. Assessment of the underlying ethology and pain mechanism is of major importance to allow appropriate treatment selection.³

Neuropathic pain is generated by abnormal activity in the primary and secondary afferent neurons induced by direct injury and/or overstimulation by excitatory amines from intense nociceptive pain. In the painful area, an increase in inflammatory mediators following tissue injury decreases the nociceptor threshold and enhances the responsiveness of specific nociceptors, which is called peripheral sensitization. When peripheral sensitization resolves the area of allodynia or hyperalgesia reduces to the dermatome of the most affected nerves. Additionally, damaged primary and secondary afferent neurons may also develop spontaneous activity, which results in over reactivity of the damaged neurons and pain generation without stimulus. Changes in the dorsal root ganglia and the dorsal horn provoke an increased synaptic activity on a central level, called central sensitization.²

Types of neuropathic pain in cancer survivors

Nerve damage can be caused by tumour compression or invasion resulting in tumour related neuropathic pain. The largest group of neuropathic pain in cancer survivors is caused by the previous oncological treatment. Neuropathic pain syndromes that were existent prior to the diagnosis of cancer will most likely continue to exist. Cancer survivors may have diabetes or a herpes zoster infection, both pathologies are known to cause neuropathic pain in non-cancer patients and the chance for a cancer survivor to acquire neuropathic pain are comparable.

Chemotherapy induced neuropathic pain

Chemotherapeutic agents are frequently neurotoxic and induce peripheral neuropathies. The severity of this neuropathy depends on the type of chemotherapeutic agent, the cumulative dose, and the treatment duration of these agents. Patients with pre-existing nerve disorders are more vulnerable for the development of this chemotherapy induced neuropathic pain. Patients may experience acute, painful paraesthesia's or late, persistent, dysesthetic pain in the distal extremities. The acute neuropathies become chronic in 15 to 50 % of the cases.

Surgery induced neuropathic pain

Post-surgical pain is rather common. It has been described after thoracotomy, breast surgery, modified-radical neck dissection, limb amputations, nephrectomy, and inguinal lymph node dissection. Incidence figures of 13% to 24% have been reported for phantom breast pain and 30% to 80% for phantom limb pain. Phantom pain is caused by peripheral and central factors. The increased activity in the peripheral nociceptors induces central sensitization. Low threshold afferents may become functionally connected to ascending spinal projection neurons that carry nociceptive information. Inhibitory interneurons may be destroyed by rapid discharge from injured tissue leading to a hyperexcitable spinal cord. Peripheral nerve injury can lead to degeneration of C-fibre terminals in lamina II, which may induce sprouting of A-fibre terminal into this area where they are normally not represented.⁴

Radiation therapy induced neuropathic pain

Several types of pain have been reported after radiation therapy. Radiation-induced brachial plexopathy may become prominent from 6 months to 30 years after a course of radiotherapy that included the plexus⁵⁻⁷. This type

of delayed plexopathy is usually progressive. The underlying mechanism is not completely understood. It seems to be related to the fact that the radiotherapy reduces the plexus ability to withstand a second injury, which in turn may lead to progressive fibrosis, this is also called the "double crush" phenomenon.⁸

Lumbo-sacral plexopathy induced by radiation therapy typically present with progressive unilateral or bilateral distal weakness potentially associated with pain.

Chronic radiation myelopathy is described as an injury to the spinal cord. Pain commonly precedes the development of autonomic and motor dysfunction.⁹

Patients who received radiation therapy of the pelvis for cancer of the rectum, prostate, bladder, and uterus may develop the pelvic pain syndrome secondary to chronic radiation enteritis, proctitis, cystitis, insufficiency fractures and neural damage that may present as burning perineum syndrome.²

How to diagnose neuropathic pain?

A careful diagnostic work-up will help identifying the etiology of the type of pain.

Medical history and specific signs, alongside with the neuroanatomical pain distribution and sensory abnormalities will give an indication for the diagnosis of peripheral or central neuropathic pain.

Some technical examinations such as laser evoked potential recording, quantitative sensorial testing and potentially skin biopsies can selectively assess nociceptive pathways and become more and more reliable methods used in the assessment of neuropathic pain.

The commonly used diagnostic tools for assessing neuropathic pain in non-cancer patients are also valuable tools for the identification of the neuropathic component of pain in cancer survivors.¹⁰

Conclusions: The number of cancer survivors is increasing progressively. In parallel specific problems related to the preceding treatments and disease can proceed, such as neuropathic pain. In cancer survivors, even more than in non-cancer patients the pain perception may be influenced by the patient's previous experience and the psychological factors. Attention should be paid to establishing a clear diagnosis in order to select the most appropriate treatment.

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MANAGEMENT OF NEUROPATHIC PAIN IN CANCER SURVIVORS

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Pain is prevalent in patients with cancer and considerably undermines their quality of life, thereby making the development of a comprehensive pain management approach essential.

Neuropathic pain (NP) is commonly encountered in cancer patients and is considered a well-established entity for more than 20 years. Approximately, 1/3 of cancer patients experience NP, usually mixed with nociceptive components, but, also, as a single, autonomous entity. As advances in cancer identification/therapy prolong life expectancy, physicians' efforts target in quality of life improvisation. Cancer pain usually results from mixed mechanisms. An absolute distinction between cancer and non-cancer related NP is perhaps artificial. NCP pathophysiology basically remains similar to non-cancer NP, with common cross-referencing between the two conditions. Research on NCP determined distinct differences in the signature of neuroreceptors/transmitters' alterations, unique damage and interruption of neuronal function and may yet elucidate pain induction or maintenance differences. NCP possesses unique characteristics and exhibits an incomparable molecular signature. However, therapy similarities to non-cancer related neuropathies, may explain the ability of drugs (e.g. gabapentinoids) in treating cancer pain, indicating possible neuropathic components.

Metastatic spread of cancer to bone is one of the most important causes of NCP and painful muscle spasm, whereas breakthrough pain (defined as transitory flare of pain occurring on a background of relatively well-controlled baseline pain) may be prevalent, due to numerous aetiological factors (bone metastases, triggering pain on movement). Infiltration and injury of sensory neurons that innervate the bone marrow cause pain. Alterations in normal bone turn over occur, with loss of mechanisms that normally regulate the balance between osteoclast and osteoblast activity. With advanced disease, the bone loses mechanical strength and is subject to osteolysis, pathological fracture, and microfractures. Mechanical distortion of the periosteum may be a major source of pain.

NCP can also arise as a consequence of cancer-directed therapy, such as surgery, radiotherapy and chemotherapy (treatment-related therapy). Treatment adverse effects include joint pain following chemotherapy and hormonal therapy or/and painful mucositis due to radiotherapy and chemotherapy with certain agents. Drugs such as paclitaxel, vincristine, cisplatin and bortezomib have been widely reported to produce sensory neuropathies. Radiotherapy can induce injury, leading to microvascular insufficiency and fibrotic changes (radiation-induced fibrosis), affecting peripheral nerves and perineural tissues (e.g. brachial plexus fibrosis) and causing chronic NP that begins months to years following treatment. Chemotherapy induced NP(CINP) has been widely reported in controlled and uncontrolled studies. On one hand, more patients experience the excellent outcomes of chemotherapy, with prolonged survival. On the other hand, increasing numbers of patients are unable to complete full treatment because of CIPN development. Long-term pain management is therefore a challenging treatment aspect for neurologists, oncologists and pain specialists.

CIPN incidence is rising due to increased number of neurotoxic agents and because patients live longer, receiving multiple chemotherapy drugs.. CIPN symptoms are often under-recognized, in part because of difficulties in diagnosis, in addition to patients' underreporting. CIPN is documented frequently with vincristine, taxanes and platinum-based agents.

New approaches are desperately demanding in controlling cancer pain. Neuropathic Cancer Pain (NCP) frequently becomes severe as disease advances, requiring miscellaneous types of analgesics, at different time-points. The intrinsic difficulties in performing randomized controlled trials in cancer pain have traditionally justified the acceptance of drugs already known to be effective in benign neuropathic pain for the management of malignancy-related neuropathic pain despite the lack of relevant high quality data. Review of available literature reveals that the management of neuropathic cancer pain has changed dramatically in the past few years thanks to the improved perception of the problem, new therapeutic approaches and novel drugs. Current therapeutic strategies depend on pharmacotherapy, mainly with the inclusion of adjuvants. At present, variable agents are used to treat NCP, but despite the advances in pathophysiology understanding, management is still suboptimal. Intractable NCP remains an important epidemiological, clinical and economical burden worldwide, posing significant societal impacts.

Specific guidelines on the pharmacological treatment of NCP have been suggested by the European Federation of Neurological Societies (EFNS) Task Force. This Task Force concluded that there is a level A of evidence for the efficacy of gabapentin (one study), a level B for TCAs and tramadol and inefficacy of valproate.

In the following pages, non-opioid and opioid drugs that are recommended by the WHO for cancer pain therapy, as well as various classes of adjuvant analgesic drugs for NCP treatment will be presented.

Non-Opioid Analgesic Drugs

Non-opioids, such as NSAIDs, acetaminophen and COX-2 inhibitors, have limited usefulness in the management of NCP. However, some patients do report relief, so a trial may be indicated. Many patients have concomitant neuropathic pain and nociceptive pain, which may respond to non-opioids.

Opioid Analgesics

The role of opioids has been re-evaluated during NCP therapy. Controlled-release oxycodone has been applied, because it is safe, well-tolerated and effective, although it is unlikely that opioids will replace antidepressants and antiepileptic drugs for NCP therapy. However, co-administration of oxycodone and paracetamol resulted in a low-dose synergic combination in different pain types. It has been reported that such a combination can be useful in cancer-related pain, including those situations that are complicated by a neuropathic component.

Morphine combined with gabapentin achieved better analgesia, at lower doses of each drug, than either as a single agent, with constipation, sedation and dry mouth as the most frequent adverse effects.

Clinically, opioids provide effective relief of cancer pain, although occasionally high doses must be administered, to suppress "breakthrough" pain or pain from nerve involvement. The most common adverse effects of opioids are constipation, sedation, drowsiness and nausea.

Recently, according to a systematic review of 35 years, conducted by WHO (2005), due to its favourable analgesic properties and low cost, methadone has been recognized as an important player in the treatment of both nociceptive and neuropathic pain and has been characterized as an essential analgesic in cancer pain management.

Tramadol Hydrochloride

Tramadol is a norepinephrine and serotonin reuptake inhibitor (SNRI), centrally-acting analgesic, which has direct, but weak opioid action (metabolite with major μ -opioid agonist effect) and indirect monoaminergic action (like TCAs). It is also devoid of immunosuppressive activity. RCTs have yielded positive results from tramadol and tramadol/acetaminophen combination in PDN, PHN and various NP states. In all trials, tramadol, titrated to a maximum dosage of 400 mg/day significantly relieved pain, compared with placebo. Its beneficial effects on allodynia and quality of life are also reported.

The most frequent side-effects of tramadol include dizziness, nausea, constipation, somnolence and orthostatic hypotension.

Adjuvant Drugs (Adjuvants)

The widely-used adjuvants represent a major aspect in our NCP armamentarium. These include gabapentinoids (gabapentin, pregabalin), AEDs, antidepressants (TCAs, duloxetine, venlafaxine), corticosteroids, capsaicin 8% patch, bisphosphonates, NMDA-antagonists, cannabinoids and other substances.

An adjuvant analgesic is an agent, whose primary indication is other than pain, exerting analgesic effects in certain painful conditions. Not only are adjuvants important per se, but they also hold opioid-sparing effects.

Tricyclic Antidepressants (TCAs)

TCAs inhibit norepinephrine and serotonin reuptake, followed by augmentation of biogenic amines' activity. Their action includes sodium channels' modulation in the periphery and NMDA antagonism. As a result, TCAs enhance dorsal root inhibition and reduce peripheral sensitization.

TCAs are started with a low bedtime dose (10-25 mg), which is gradually increased or titrated weekly, every 3-7 days (by 10-25 mg/day), usually up to 150 mg, or until further dose increase is forbidden due to adverse effects. Although TCAs analgesic properties probably occur at lower dosages than those for an antidepressant effect, no systematic evidence supporting this assumption exists. Some data suggest a possible dose-response relationship. An adequate trial of a TCA should have duration of 6-8 weeks, with at least 1 to 2 weeks at the maximum tolerated dosage. For NP, dosing escalation to antidepressant blood levels is advised for 4-6 weeks.

Common side-effects of TCAs are sedation, anticholinergic consequences (dry mouth, constipation, postural hypotension and weight gain) [94]. In one large-scale study, TCAs long term administration was associated with a 2.2-fold greater relative risk of myocardial infarction and a 1.7-fold increase in overall mortality, compared with placebo.

Other Antidepressants (ADs): SSRIs, SNRIs (Venlafaxine, Duloxetine), NDRIs (Bupropion)

Selective Serotonin Reuptake Inhibitors (SSRIs) produce less side-effects and are better tolerated than TCAs. At present, in NCP treatment there is insufficient evidence to support the use of SSRIs.

Sustained release bupropion, a Norepinephrine and Dopamine Reuptake Inhibitor (NDRI) was more effective than placebo in patients with NP of peripheral and central origin. It has a low incidence of sexual dysfunction and is associated with weight loss. Side-effects include agitation and insomnia. For NP it is given at a dosage of 150 - 300 mg daily.

Venlafaxine, with a different chemical structure compared to TCAs and SSRIs, inhibits norepinephrine and serotonin reuptake (SNRI) at a dose $\geq$ 150 mg daily. Recent data support the use of venlafaxine in NP states (NNT=3.6). In a randomized, 3-period, crossover trial of venlafaxine and imipramine administered in patients with painful polyneuropathy, both antidepressants resulted in superior pain relief, compared with placebo, with no differences between them. In a placebo-controlled, crossover trial of 13 patients with chronic NCP following breast cancer therapy (surgery, chemotherapy, radiotherapy) the investigators did not find significant benefits of venlafaxine (18.75-187.5 mg/10weeks) vs placebo, regarding the primary end-point (daily pain diary ratings), although venlafaxine was associated with better results related with two secondary pain end-points (maximum intensity of every day pain at rest and in movement). They also reported similar percentages of adverse effects vs placebo.

Duloxetine, a newer dual uptake inhibitor, belongs to SNRIs, is FDA approved for PDN treatment, with early evidence of being efficacious. It has minimal or no effect on blood pressure and body weight, with few sexual adverse effects in studies published up to now. Duloxetine doses range between 60 and 120 mg/day, without any significant differences between the two doses, but with better effect versus placebo. Improvement should be noted in 1 to 2 weeks at 60 mg before increasing the dose, which should be considered prior to further dose elevation. Frequent adverse events observed were nausea, somnolence, dry mouth, constipation, diarrhoea, hyperhidrosis and dizziness, while discontinuation rates were 15-20%. Duloxetine induces little or no cardiovascular side effects, but rare cases of hepatotoxicity have been published.

The advantage of venlafaxine and duloxetine application in NCP treatment is that, apart from pain relief, they can serve a useful therapeutic role for clinical depression.

Antiepileptic Drugs (AEDs) - Gabapentinoids

Gabapentin is an AED, holding the broadest evidence for efficacy in NP treatment, due to central sensitization reduction. Loss of inhibitory regulation in the dorsal horn contributes to spontaneous firing of nociceptive pathways, through complex mechanisms. Levels of gamma-aminobutyric acid (GABA, a dorsal horn inhibitory transmitter) are reduced, and GABA receptors in dorsal horn neurons are down regulated. Gabapentin, an anti-convulsant structurally related to GABA and not acting on GABA receptors, is efficacious for the treatment of NP of various etiologies.

It has an FDA-approved indication for PHN in the United States and is licensed for the treatment of NP in the UK. Eight, at least, published double-blind, placebo-controlled, RCTs of gabapentin for chronic NP therapy exist in literature. These studies examined patients with PHN, PDN, mixed NP syndromes, phantom limb pain, Guillain-Barre syndrome and acute or chronic pain from spinal cord injury. Gabapentin at dosages up to 3600 mg/day significantly reduced pain versus placebo; improvement in sleep, mood, and quality of life were also reported in some. Confirmation from basic experimental studies, employing animal cancer pain models, as well as from clinical ones, concluded that gabapentin is effective in treating NCP. In a study investigating the efficacy and safety of gabapentin monotherapy in the management of CIPN, Gabapentin has also been studied in a multi-centre, randomized, double-blind, placebo-controlled trial, including 121 cancer patients with NCP. Patients had ineffective analgesia with opioids and they were started on gabapentin at a dose of 600-1800 mg/day. The authors concluded that gabapentin is effective in improving analgesia in NCP patients, already treated with opioids. Side effects of gabapentin include somnolence, dizziness and less commonly gastrointestinal symptoms and mild peripheral oedema. All these effects require close monitoring and dosage adjustment, but usually not drug discontinuation.

Pregabalin has been FDA approved for PHN and PDN and its action is similar to that of gabapentin, with a significantly greater affinity for the $\alpha_2\delta$ subunit of voltage-gated calcium channels versus gabapentin. Pain improvement is noted by the second day. It is not liver metabolized and as a result, important

pharmacokinetic drug-drug interactions do not occur, but the dosage must be adjusted for patients with renal dysfunction. Its side effects are mild to moderate (dizziness, somnolence, headache, dry mouth and peripheral oedema). During the first 3 days 150 mgr daily are prescribed, followed by 300 mgr daily for the next 4 days. From the beginning of the second week 600 mgr/day are usually prescribed to patients, whose creatinine clearance is more than 60 ml/min (max dose 300 mgr twice a day) Pregabalin discontinuation rates range from 0 (150 mgr/day) to 20% (600 mgr/day).

As far as the therapeutic role of pregabalin in NCP management, in a study presented last year during the 3rd International Congress on Neuropathic Pain, we examined the results of the addition of pregabalin, in cancer patients with a NP component. In this prospective, open label study, we included 102 cancer patients with definite NCP, resistant to a combination of paracetamol, codeine, NSAIDs and methylprednisolone. Patients were randomly divided into two groups (pregabalin versus opioids). In the first group pregabalin was added and titrated up to 600 mgr/day, until significant pain relief or poor tolerability where observed (whichever occurred first). In the second group, TTS fentanyl 25mcg/h was added and the dose was escalated by 25 mcg/h every 72 hours, up to a maximum dose of 125 mcg/h, until significant pain relief or problematic tolerability. We concluded that pregabalin prescription in NCP patients provided significant pain alleviation and minimized the need for rescue opioids, thus reducing opioid-induced adverse effects and tolerance. However, in another recent publication on the treatment of CINP, the authors concluded that, unfortunately, even when effective in other types of NP, anticonvulsants and antiepileptics have not yet proven effective for treating CINP symptoms.

Topical Antineuralgics: 5% Lidocaine Patch, 5% Lidocaine Gel

Topical lidocaine is available as a 5% patch or gel. The efficacy of lidocaine patch has been demonstrated only in patients with PHN and focal NP syndromes, expressed with allodynia, without controlled studies being conducted for other pain conditions. Anecdotal evidence of a beneficial effect in patients who have other NP types has been published. In our department, we have used the 5% lidocaine patch in 36 patients in an open, observational study, for the treatment of NP of diverse origin. The therapy had a 2-month to 4-year duration, resulting in good and very good analgesia in 50% of patients.

Lidocaine patches have been used in NCP where allodynia (sensitivity to light touch) exists. It has also been used for central NCP in a patient with metastatic epidural spinal cord compression, with promising results, offering new treatment options.

Topical Antineuralgics: Capsaicin 8% Patch

A high concentration capsaicin patch (8%), applied to the skin for 60 min in 402 patients, was found to be more effective in treating NP versus a low concentration patch. Adverse effects were primarily attributable to local capsaicin-related reactions at the application site. The patch has also been used for the treatment of painful HIV neuropathy. In our department, we have used the Capsaicin 8% patch in patients with CIPN in an open, observational study with good unpublished yet results.

NMDA Antagonists: Ketamine, Dextromethorphan, Amantadine

The N-Methyl-D-Aspartate (NMDA) receptors within the spinal cord play a significant role in the pathophysiology of chronic NP. NMDA receptor antagonists have been used in an attempt to abolish wind-up at the spinal cord level. The role of excitatory amino acids in hyperalgesia and the development of tolerance to opioids were early recognized. Ketamine and dextromethorphan are NMDA receptor antagonists, being explored for relieving NP. Ketamine is a potent analgesic at subanesthetic doses, by reducing hypersensitivity in the dorsal horn. Recently, it has been suggested that ketamine and amantadine reduce opioids resistant NCP.

Conclusions

In conclusion, NCP is a complex pain problem that is often refractory to treatment. Its pathophysiology may involve diverse aetiologies, which can vary with the evolution and progression of the disease. Present therapeutic strategies rely heavily upon pharmacotherapy. Combination of drugs, with completely different mechanisms of action is the optimal approach.

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PERIPHERAL NERVE STIMULATORS: DO THEY HAVE A FUTURE?

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Introduction: There is increasing debate over the role of nerve stimulation (NS) in the setting of ultrasound (US) guided peripheral nerve blocks (PNBs).¹ However, the discussions tend to be based on anecdotal clinical experience rather than on the merits of the two needle-nerve localization modalities, either individually or combined for optimal benefit. Critics of NS argue that the routine use of NS with US does not increase efficacy of the block.^{2,3} It has even been argued that US is equally ineffective in improving the success rate of all blocks.⁴ Such rhetoric distorts the central issue as the main benefit of NS in conjunction with US is not to increase the efficacy of PNBs but to enhance their safety.⁵ For instance, the use of US has not reduced the complication rate of nerve blocks and new cases of neurologic injury continue to be reported in the literature.^{6,7} Occurrence of an evoked motor response to NS at a low current intensity (e.g. < 0.5 mA) always indicates intimate needle-nerve relationship or an intraneural needle placement and therefore, requires needle repositioning or additional measures to avoid intraneural injection.⁸ Importantly, needle-nerve contact reported by the patient (paresthesia) continues to be predictive of post-block neurologic symptoms.⁶ While US can be and is used to monitor the needle-nerve relationship, errors in scanning techniques and interpretation of the images are common.⁹ In addition, NS can be extremely useful in confirming that the structure imaged is indeed a nerve when US does not yield adequate images or when artifacts that are difficult to recognize are present.^{10,11}

In this review, we focus on methods to simplify the use of current NS technology with US and forecast how future NS can be used in combination with US.

INCREASED COMPLEXITY WHEN COMBINING NS WITH US

One of the main misconceptions in combining NS with US is that many clinicians use NS as they would with any other non-US technique, rather than modifying NS for use with US. The traditional instrumentation with NS typically involves utilizing a current of higher intensity to establish a motor response and then advancing the needle toward the target nerve while decreasing the current intensity to maintain an evoked motor response of similar intensity.¹² Eventually, when the motor response is obtained at a sufficiently low current intensity (conventionally, between 0.2 and 0.5 mA), the needle is deemed sufficiently close to the target nerve, and the injection is made.⁵ However, when present, an evoked motor response at < 0.2 mA indicates an intraneural or intrafascicular needle placement, and should prompt repositioning of the needle before the injection is made.¹

A TECHNIQUE OF NS IN CONJUNCTION WITH US

When the needle and the nerve structure(s) of interest are seen during US guided nerve blocks, deliberately eliciting motor response is unnecessary. Rather, an evoked motor response to NS is the sole nerve localization strategy with NS guided blocks only. Therefore, when using NS to complement US, it is critically important to have a clear strategy so that the combination of the two add to the safety and *not* to the complexity of the block.

After the patient is placed in the appropriate position, with standard monitors attached and equipment ready, US is applied to the patient, and the desired image of the nerve and surrounding structures are obtained. The needle attached to the NS (0.5 mA, 0.1 ms) is then advanced under US guidance to the desired tissue plane. There are three specific scenarios that can occur during this process:

1. The needle is positioned in the desired tissue plane, and no evoked response is elicited. In this case, an initial injection is made while avoiding resistance to injection (< 15 psi). If the spread of the local anesthetic (LA) is deemed adequate, the remaining dose is injected.

There is no need to elicit a specific motor response.

2. During needle maneuvering, an evoked motor response is elicited unexpectedly. In this case, the operator should assure that the motor response is not present at < 0.2 mA. This can be accomplished either by:

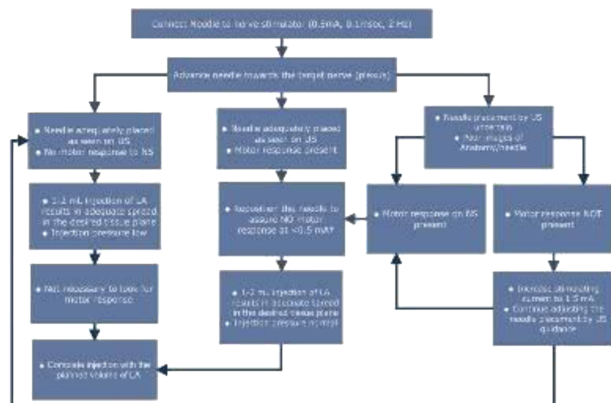
- Reducing the current 0.2 mA to confirm that the motor response is absent *or*
- Withdrawing the needle so that the motor response at 0.5 mA is terminated (favored as being simpler and faster).

Once it is confirmed that motor response is absent, an initial injection is made while avoiding resistance to injection (< 15 psi). If the spread of the LA is deemed adequate, the remaining dose is injected.

3. Images obtained during US are inadequate and/or the needle-nerve relationship cannot be assured. In this case, the operator can rely on NS to help localize the nerve, as illustrated in Figure 1.

Suggested Standard Monitoring For Nerve Blocks

Combined Monitoring: Ultrasound + Nerve Stimulation + Resistance to Injection



Legend: US = ultrasound; 0.5 mA = 0.5 milliamperes; 0.1 ms = 0.1 millisecond; 2 Hz = 2 Hertz; 0.5 mL = 0.5 milliliter; 0.2 mA = 0.2 milliamperes; 0.5 mA = 0.5 milliamperes; 15 psi = 15 pounds per square inch; 0.5 mA = 0.5 milliamperes; 0.1 ms = 0.1 millisecond; 2 Hz = 2 Hertz; 0.5 mL = 0.5 milliliter; 0.2 mA = 0.2 milliamperes; 0.5 mA = 0.5 milliamperes; 15 psi = 15 pounds per square inch.

Figure 1. Suggested Standard Monitoring For Nerve Blocks.¹³

RATIONALE

With adequate training, US can be used alone to determine needle placement for most superficial nerve blocks. Here, the main purpose of NS is to monitor for an overlooked needle-nerve contact or intraneural placement. However, where US imaging and anatomy prove challenging, NS with higher current intensity (e.g., > 1.5 mA) can be used to identify the nerve structures of interest. Therefore, a combined technique of NS with US offers additional information that can contribute to the safety of the procedure as well as identify nerve structure when this is difficult by US only. Combined NS and US techniques require additional equipment; extra personnel to manipulate the NS, and the practitioner must monitor motor response while simultaneously imaging with US, monitoring the patient, and manipulating the needle. The complexity of multitasking, however, is similar to other combinations of monitoring, such as standard ASA monitoring. Regardless, the ability of NS to detect needle-nerve contact and/or intraneural needle placement does add to patient safety, and therefore, in our opinion, NS should be used routinely with US guided PNBs. In the simplified protocol we described above, additional instrumentation to man the NS is negligible, as the protocol does not call for manipulating the current intensity.

FUTURE

It is our vision that the current NS technology will become more user-friendly, and monitoring will become more automated. For instance, current technology requires constant monitoring of the Liquid Crystal Diode (LCD) or Light Emitting Diode (LED) indicators on the NS box for setup, current delivery information, and to assure functionality of the device. Future designs may incorporate a remote indicator of current delivery, perhaps an LED display on the hub of the needle, or wirelessly displayed information on the US screen. Such designs would provide continuous monitoring of current delivery as well as immediate detection of disconnected circuit or other electrical problems (e.g. stimulator failure). Future technology may also incorporate nerve conduction and negative feedback-loop (which have been available for a long time) to provide additional information on the needle-nerve relationship without the operator having to interpret motor responses. In addition, incorporating the negative feedback loop would help detect needle-nerve contact even with the sensory nerves, without relying on the patient's feedback. Likewise, monitoring of impedance may add to the safety of PNBs.¹⁴ This can be accomplished without adding complexity by incorporating algorithms that can be displayed on the NS, hub of the needle, US screen or all three. Regardless, it is almost certain that these more advanced modes of electrical stimulation will simplify NS with US.

Summary: We believe that NS will continue to play a role in US guided PNBs. There is sufficient evidence that they are useful for nerve and intraneural needle localization during US guided nerve block procedures. We also believe that more advanced electrical NS will be introduced into clinical practice to simplify their incorporation with US. We anticipate that monitoring of evoked responses to NS will become more objective and that the intensity of monitoring requirements of the current technologies will be reduced.

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WHAT IS THE OPTIMAL CURRENT USED FOR NS-GUIDED BLOCKS

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Background and aims: Next to ultrasound, electrical nerve stimulation is considered a clinical standard for the performance of peripheral nerve blocks¹. To locate a target nerve, initially a higher output current is applied to guide the needle in the direction of the target nerve. After a motor response is elicited, the electrical current intensity and the needle position have to be adjusted to achieve a minimal but sustained motor response at a lower current¹ with a target range usually below 0.5mA. On one hand, a neuromuscular response obtained within a threshold current range of 0.3-0.5mA serves to indicate appropriate proximity to a target nerve and should therefore result in a successful nerve block¹. On the other hand, stimulation current threshold (SCT) intensities below 0.3 mA should alert us for intraneural needle location. Therefore, for nerve stimulator guided needle placement, one has to compromise with respect to an assumed low success rate (using high currents threshold) and an assumed increased risk of nerve damage (using low current threshold). However, in clinical practice appropriate current for a successful and safe nerve block have not been clearly defined¹.

Accordingly, we applied experimental studies in a pig model for regional anaesthesia to challenge several hypotheses: Study A². Low SCT of 0.01 mA - 0.3 mA lead to a higher probability of close needle to nerve placement (NNP) than high SCT in the range of 0.8 mA - 1.0 mA; Study B³. The aim was to determine the maximum output current that is associated with a high probability of close NNP, thus eventually leading to successful nerve blockade; Study C. The current intensity does reliably discern needle-nerve contact from intraneural needle placement; Study D. High current threshold (0.9-1.1mA) is not inferior to the common low current threshold (0.3-0.5mA) for nerve stimulation for axillary plexus blocks regarding the latency times and quality of anesthesia.

Methods: Study A²: A minimal motor response to the stimulation of femoral or brachial plexus nerves in 16 anesthetized pigs was triggered either by a minimal SCT of low (0.01-0.3mA) or high (0.8-1.0mA) current in a random order. After eliciting a motor response with a predetermined SCT, synthetic resin was injected via the needle. After post mortem dissection of the injection site the localization of the resin deposition was determined verifying the final position of the needle tip. Depending on the proximity of resin deposition to the nerve epineurium, the needle tip placement was considered either as a close or a distant NNP.

Study B³: As described in Study A needle placements applying electric nerve stimulation were performed in a pig model for regional anaesthesia. Primary outcome was the frequency of close NNP as assessed by resin injectates and subsequent anatomical evaluation. Following a statistical model (Continual Reassessment Method, CRM) the applied SCT were selected to limit the necessary number of punctures while providing guidance towards the highest SCT range.

Study C: In six anesthetized pigs, axillary brachial plexus and sciatic nerves were exposed surgically. An insulated stimulation needle connected to a nerve stimulator was placed either adjacent to nerve epineurium or intraneurally. As a control, further measurements were performed approx. 1mm distant to the nerve. Three arbitrary pulse duration settings were applied in a random fashion (0.1ms, 0.3ms or 1.0ms). With all stimulations, the initial current was 0.0mA. Subsequently, the current was increased until a minimal specific motor response was observed.

Study D: Two hundred and five patients scheduled for elective surgery were randomized to a low (0.3-0.5mA, n=103) or a high (0.9-1.1mA, n=102)

stimulation current threshold for axillary plexus block with 40 ml local anesthetic mixture (20 ml each of prilocaine 1% and ropivacaine 0.75%). The outcome measures were the time to readiness for surgery (secondary key endpoint) which is defined as the time from the start of block procedure to complete sensory block, the block performance time (key secondary endpoint) and thereafter the time to complete sensory block (primary endpoint). Non-inferiority was evaluated using the two-sided 95% bootstrap-CIs (100000 replications) for differences in means. Secondary endpoints were the number of patients who required IV supplementation (fentanyl) and the frequency of conversion to general anesthesia due to insufficient sensory block.

Results: Study A: A total number of 235 punctures were performed. Ninety-one punctures were carried out with low SCT and 92 with high SCT. Fifty-two punctures served as a control (1.8-2.0 mA). All injectates following both, high or low SCT were considered "close needle tip to nerve placement", whereas 27 of 52 injectates of the control group appeared distant to nerve epineurium.

Study B: Altogether 186 punctures were performed in 11 pigs. Within the range of 0.3-1.4mA no distant needle to nerve placements was found. In the range of 1.5 - 4.1mA 43 distant needle to nerve placements occurred. The range of 1.2 - 1.4mA was the highest interval which resulted in a close needle to nerve placement rate of $\geq 95\%$.

Study C: The minimal stimulating current (STC) required to elicit a motor response was recorded in a total of 900 needle position/current duration settings. There were no significant differences in the current intensity to elicit a motor response between extraneural [i.e. brachial plexus; median (25th -75th percentiles); 0.1ms, 0.12 mA (0.08-0.18); 0.3ms, 0.10 mA (0.06-0.12); 1.0ms, 0.06 mA (0.04-0.10)] and intraneural needle placement [median (25th -75th percentiles); 0.1 ms, 0.12mA (0.10-0.16); 0.3ms, 0.08mA (0.06-0.10); 1.0ms, 0.06mA (0.06-0.08)] or tested current durations. Control groups (1mm distant needle placement) needed significantly higher STCs than needle placement adjacent to nerve epineurium [i. e. brachial plexus; median (25th -75th percentiles); 0.1ms: 0.28mA (0.26-0.32); 0.3ms: 0.20mA (0.16-0.22); 1.0ms: 0.12mA (0.10-0.14)].

Study D: The mean time to readiness for surgery was 33.3 $\pm$ 15.6 min in the low current group and 38.1 $\pm$ 16.8 min in the high current group (95% CI, 0.4 to 9.2; p = 0.04). Performance time was significantly shorter in the high current threshold group (9.5 $\pm$ 4.7 vs. 11.9 $\pm$ 5.7 min; 95% CI, -4 to 1.1; p = 0.001). The mean times to complete sensory block revealed a significant difference in favor of the low current group (17.9 $\pm$ 12.1 vs. 22.8 $\pm$ 12.4 min; 95% CI, 1.1 to 8.6; p = 0.012). There were no significant differences between the low and high current group for the number of patients who required IV supplementation (10 vs. 8 patients, p = 0.81) and for the frequency of general anesthesia (4 vs. 9 patients, p = 0.25).

Conclusions: Study A and Study B have shown that in the range of 0.01-1.4mA all resin deposition was found adjacent to nerve epineurium. The application of minimal current intensities up to 1.4mA does obviously not lead to a reduction of epineural injectate contacts in pigs. These findings suggest that stimulation current thresholds up to 1.4mA result in equivalent needle tip localisation in pigs. Furthermore we have demonstrated in Study C that electrical nerve stimulation is not able to distinguish extraneural direct needle-nerve contact from intraneural needle placement. However, motor response with STC < 0.2 mA was present only with needle-nerve contact or intraneural needle placement, and therefore may have a role as a sensitive monitor of needle position. According to Study D, the application of an increased current threshold (0.9-1.1 mA) results in similar times to readiness for surgery. However, we failed to demonstrate non-inferiority. There were no significant differences concerning the quality of anesthesia. Further studies may focus on the question whether high current outputs avoid potentially dangerous needle adjustments and reduce nerve injury or vascular puncture.

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HEALTH TECHNOLOGY ASSESSMENT: COMPARISON OF ULTRASOUND AND ELECTRICAL NERVE STIMULATION FOR PERIPHERAL NERVE BLOCKS CONCERNING CLINICAL AND ECONOMIC OUTCOMES

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Introduction: The purpose of the health technology assessment was to investigate the pros and cons of ultrasound (US) compared to nerve stimulation (NS) guidance. This excerpt presents whether US increases

- (1) the success rate of sensory blockade
- (2) the success rate of surgical anesthesia
- (3) the success rate of postoperative analgesia and
- (4) the cost-effectiveness compared to NS.

The investigation was based on a systematic review of the literature comparing US and NS technique in randomized controlled trials (RCTs).

Methods: The success rate of sensory blockade (SR_{SB}) is defined as the fraction of patients with decreased or no sensation at a well-defined time point - typically 30 minutes - after injection of local analgesic. In the scientific literature SR_{SB} is typically used as a proxy marker of block quality or sometimes as a probe of readiness for surgery. Almost all authors have used an ordinal scale of measurement from no sensation to normal sensation with a variation of ranks from two to 101 when comparing US and NS guidance. The reference groups were either all randomized patients or just the patients where the endpoint of injection was obtained. The analgesic stimulus was simulated by stimulating the small-diameter Ad-fibres with either pinprick, ice, alcohol or pinching. No authors have stimulated the C pain fibres when comparing US and NS for SR_{SB}. The H₀ hypothesis and the power estimate were based on SR_{SB} in some trials (1-7), and on other outcomes in other trials (8-20). Some trials were not based on power estimates (21-23). Estimation of SR_{SB} was mostly performed observer blinded (2-4,6-8,10,11,13-19,24). In some trials SR_{SB} was estimated by unblinded independent observers (1,22) and in some by unblinded, dependent observers (5,9). Some authors did not describe the blinding of sensory blockade data sampling (20,21,23).

Success rate of surgical anesthesia (SR_{SA}) is defined as the fraction of patients with painfree surgical anesthesia solely with the primary peripheral nerve blockade without supplementary nerve blockade or intravenous analgesia or conversion to spinal or general anesthesia. The reference groups were either all randomized patients or just the patients where the endpoint of injection was obtained. The H₀ hypothesis and the power estimate was based on SR_{SA} in some trials (20,25) and on other outcomes in other trials (1-3,5,7-14,16-18,26).

Estimation of SR_{SA} was performed observer blinded in some studies (3,7,8,10,13,14,25) and in two studies by unblinded dependent observers (5,26). However, in most studies the blinding of surgical anesthesia data was not described (1,2,9,11,12,16-18,20,22).

Success rate of postoperative analgesia (SR_{POA}) is typically defined as sensory blockade at specified time points (4,5). In a lot of settings it is reasonable to use a proxy marker such as "sensory blockade" instead of analgesia *per se*, because other nerves than the target nerve are sometimes stimulated nociceptively in the surgical field.

A health economic evaluation is a comparative analysis of costs and consequences of two or more alternative health technologies. The purpose of a health economic evaluation is to serve as an input for decision-making. The most common types of health economic evaluations are cost-effectiveness analyses and cost-utility analyses.

The incremental cost-effectiveness ratio (ICER) can be employed as the primary outcome of a cost-effectiveness analysis. The ICER can be calculated as the difference in mean cost between US and NS divided by the mean difference in success rate. The ICER estimates the extra costs of obtaining one extra successful block with US compared to NS. It might be possible to base the ICER on other health-related outcomes. In the calculation of cost-effect ratio "cost" should enter the numerator and health-related outcome enters the denominator in accordance with standard guidelines for cost-effectiveness analysis. Only one cost-effectiveness study has both been based on a RCT

comparing US and NS and performed in strict accordance with the principles of health economic evaluations. These principles include the comparison of both costs and consequences of two (or more) alternatives, a systematic framework for identifying, measuring and value resource usage expressed as marginal value (i.e. opportunity cost), and the pursuit of efficiency by identifying interventions that offers the greatest health returns from scarce health care resources (27).

Results:

Bolus injection	Result	Evidence	Grade
SR(SB)	US = USNS > NS	1b	A
SR(SA)	US = USNS > NS	1b	A
Continuous infusion			
SR(SB)	US = USNS > NS	1b	A
SR(POA)	US > NS	1b	A
CE(ICER) p.o. analgesia	US > NS	1b	A

Level 1b means that the evidence is based on individual RCTs that are not sufficiently homogenous to qualify for the highest level of evidence 1a. Grade A requires that the recommendation is based on consistent level 1 RCT studies. US = ultrasound; NS = nerve stimulation; USNS = combined US and NS; CE = cost-effectiveness; ICER = incremental cost-effectiveness ratio; p.o. = postoperative; SR(SB) = success rate of sensory blockade; SR(SA) = success rate of surgical anesthesia; SR(POA) = success rate of postoperative analgesia; CE(ICER) = cost-effectiveness estimated as ICER.

[Table 1.]

Discussion: Some trials show a statistically significant difference in SR_{SB} in favor of ultrasound but the majority do not. However, all trials demonstrate a difference in SR_{SB} in favor of ultrasound. The majority of the trials were not powered to estimate a difference in SR_{SB}. The typical range of SR_{SB} with US was 90-100% and with NS 80-90%. No trials contradict the result of this review. The result is supported by previous reviews (28-32).

Most trials compare US and NS in the setting of surgical anesthesia. Only two studies have compared US and NS concerning postoperative analgesia (4,5). They both used continuous infusion of local analgesics via perineural catheters. No trials have compared the effect of US and NS guidance on postoperative analgesia with single injection of local analgesics. That is interesting considering the fact that most anesthesiologists use peripheral nerve blocks mainly for single-shot post-operative analgesia. The result that SR_{POA} is higher with US compared to NS guidance is not supported by the only other review analysing this topic (33). However, that review was published before the most recent trial comparing the SR_{POA} of US and NS (4).

The result that the SR_{SA} is higher with US compared to NS guidance is confirmed by some previous reviews (28,31,32,34,35). Other reviews conclude that the evidence does not point to higher SR_{SA} with US compared to NS (29,33,36,37).

One study has examined the cost-effectiveness of US compared to NS based on estimating the ICER as the difference in mean cost between US and NS divided by the mean difference in success rate between US and NS in a trial concerning popliteal sciatic perineural catheter infusion of local analgesic in order to alleviate pain after major foot and ankle surgery (27). The ICER was negative meaning that US is a dominant technology that leads to better clinical outcome as well as lower costs. This result depended mostly on the difference in success rates between the alternative techniques of US and NS in the setting of perineural catheter infusion of local analgesics. It is probably not be possible to extrapolate this result to single injection peripheral nerve blocks.

Conclusions: The success rate of ultrasound guidance is higher compared to nerve stimulation guidance for sensory blockade and surgical anesthesia.

The cost-effectiveness of ultrasound is better than nerve stimulation for postoperative analgesia based on perineural catheter infusion of local analgesics.

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SPINAL ANAESTHESIA IN A PATIENT WITH PRE-ECLAMPSIA: HOW FAR CAN WE GO?

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Severe pre-eclampsia is characterized by systolic blood pressure exceeding 160 mmHg and or diastolic blood pressure exceeding 110 mmHg

together with proteinuria ($>5\text{g}/24\text{h}$). Severe pre-eclampsia continues to challenge anesthetists worldwide. In the developed world, severe pre-eclampsia is less common but it remains an important cause of maternal mortality(1) Pre-eclamptic parturients have an increased risk for caesarean section (CS) due to the high incidence of intrauterine growth restriction, fetal distress and prematurity.

Unfortunately CS increases the risk of cardiopulmonary morbidity associated with pre-eclampsia. Divergent haemodynamic adaptation during the pregnancy may render pre-eclamptic parturients prone to cardiopulmonary complications during caesarean section(2). Pre-eclampsia has also been shown to be a significant risk factor for postoperative cardiac failure.

Since the first randomized trial comparing general and regional anaesthesia for CS in severe pre-eclampsia was performed in 1995(3), evidence has accumulated attesting to the safety of regional anesthesia supported by authoritative editorials (4-5). Because of hazards related to management of the difficult airway and to the hemodynamic consequences of laryngoscopy and tracheal intubation, general anesthesia is usually chosen only when regional techniques are contraindicated.

In 1998, an editorial recommended that epidural anesthesia is preferable to spinal anesthesia for cesarean delivery because of its slower onset of action and controllability, even if the patient has not received epidural analgesia in labor(6). Sympathetic blockade-induced hypotension may occur in up to 64-100% of pregnant women given spinal anesthesia for cesarean delivery, especially when hyperbaric solutions are used. Severely pre-eclamptic patients were previously believed to be at high risk of severe hypotension, with maternal and fetal consequences because of reduced plasma volume and because of the need to limit IV fluids to avoid iatrogenic pulmonary edema. Therefore spinal anesthesia was avoided in preference to an epidural technique. Subsequently, several retrospective and prospective studies showed that epidural and spinal anesthesia induce a similar incidence and severity of hypotension in severely pre-eclamptic parturients.(7) More recent studies have shown that spinal anesthesia is safe in pre-eclamptic parturients causing less hypotension and lower vasopressor requirements than during spinal anesthesia in healthy parturients with similar fetal weights(8).The possible explanation is that blood pressure (BP) is regulated via vascular tone by sympathetic and endothelial pathways. Sympathetic activity increases the vascular tone. Because sympathetic hyperactivity was shown in preeclampsia, this could contribute to hypertension. The sympathetic outflow to vessels may be altered by spinal anesthesia in both pre-eclamptic and healthy parturients. Concerning the endothelial pathway, the endothelium regulates the vascular tone via endothelium-related vasodilator systems that are altered in preeclampsia, decreasing the physiologic role of endothelial-dependent relaxation of small resistance vessels. In addition, preeclampsia is characterized by an increased production of numerous circulating factors with a potent pressor effect on the one hand and by an increased sensitivity of blood vessels to pressor drugs because of endothelial damage on the other hand. These two phenomena contribute to the widespread vasoconstriction observed in preeclampsia, are not altered by spinal anesthesia and could maintain a high vascular tone that, finally, contributes to limit the decrease in blood pressure (BP) during spinal anesthesia in pre-eclamptic patients with smaller doses of pressor drugs.

Furthermore, owing to its simplicity, reliability and rapidity, spinal anesthesia may be considered as an alternative to GA for emergency cesarean delivery in preeclamptic women who have been adequately prepared with an judicious amount of IV preload. In an observational study (1)describing the maternal hemodynamic response to spinal anesthesia for CS in 15 patients with severe pre-eclampsia, spinal anesthesia was associated with hemodynamic stability and the requirement for phenylephrine as the first choice vasopressor was low. Transient profound hypotension associated with tachycardia and an increase in cardiac output (CO) was only registered at the time of oxytocin infusion and these data suggest that consideration should be given to administering this drug by slow intravenous infusion. A correct fluid administration during the CS is an important factor for haemodynamics during SA in preeclamptic patients. Sympathetic blockade induced by regional anesthesia disposes the parturient to hypotension and exposes the fetus to the risk of hypoxaemia especially in cases of intrauterine growth restriction. The effects of hypotension may be intensified by the low cardiac output often found in women with preeclampsia. Employing the method of the whole body impedance cardiography, in the only study of maternal cardiac output changes associated with spinal anesthesia for CS in pre-eclampsia, data were reported (2.). Haemodynamic reactions to fluid preloading, spinal anesthesia, delivery and disappearance of anesthesia, expressed as percent changes of haemodynamic parameters between the successive points of anal-

ysis, were compared between two groups of preeclamptic and healthy parturients. Authors found pre-eclampsia to be a state of low cardiac output and high systemic vascular resistance. Volume preload administration (with hydroxyethyl starch (6%) 10 ml/kg over 15-30 minutes and thereafter 10ml/kg/ hour during the operation), attenuated the vasospastic and hypovolemic features of the condition re-establishing cardiac output (CO) at the level of normal parturients and reducing systemic vascular resistance (SVR). At the moment of delivery, preeclamptic parturients were not able to increase stroke volume (SV) thus differing from healthy parturients. The unchanged and even diminishing SV could be due to diastolic dysfunction of the left ventricle in preeclampsia to adapt to sudden volume load at the moment of delivery exposing the parturient to the risk of pulmonary edema. The conclusion of this study must be considered speculative in view of the small numbers reported and therefore further noninvasive cardiac output studies on spinal anesthesia for CS in severe preeclampsia would be beneficial in defining optimal clinical management of these often critically ill patients.

A preliminary work (1) employing lithium calibration of a pulse power algorithm during CS for severe preeclampsia suggests that CO is well maintained during spinal anesthesia and that phenylephrine boluses, although restoring blood pressure, do not increase maternal cardiac output. Slow administration of 2,5 UI of oxytocin did not affect CO and BP. In conclusion, in the absence of contraindications to regional anesthesia, and if an epidural catheter has not been placed for labor analgesia, current evidence strongly supports the use of single shot spinal anesthesia for CS in pre-eclampsia, employing similar doses to those used in healthy parturients (9-10) Noninvasive blood pressure monitoring is adequate in uncomplicated cases. However clinicians should carefully assess preoperative fluid and pharmacological management of the patient and tailor the anesthetic accordingly. In severe cases, when blood pressure is difficult to control preoperatively, epidural or low dosage CSE may be preferable also because the postoperative epidural infusion can provide analgesic and possible haemodynamic benefits during the postoperative period.

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SPINAL ANAESTHESIA FAILURE AFTER LOCAL ANAESTHETIC INJECTION

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Sub-arachnoid or spinal anaesthesia (SA) is a commonly performed anaesthetic technique for surgery of the lower limb, lower abdomen and pelvis. In a national postal survey conducted in the UK, Sandby-Thomas et al reported that SA was the technique of choice used by anaesthetists when managing patients presenting for surgery of a fractured neck of femur¹. Compared to other regional anaesthesia techniques (i.e. peripheral nerve block and epidural anaesthesia), the success rate of SA is generally considered to be very high. This has been attributed to the procedure having a definitive end-point i.e. free aspiration of cerebrospinal fluid (CSF) through the needle prior to the injection of the local anaesthetic (LA) into the sub-arachnoid space.

Incidence of spinal anaesthesia failure

In the literature, the published incidence of SA failure varies between 0.5% and 17%. However, it is difficult to directly compare data because the definition of failure differs between studies. In a retrospective study of 100 patients, Levy et al found that SA was inadequate for completion of the surgical procedure (i.e. general anaesthesia required) in 17 patients². This study showed significantly more SA failures in patients in whom the anaesthetist failed to freely aspirate CSF prior to injecting the LA solution. Munhall et al reported in a prospective study, a 4% failure rate among 200 patients, with a technical factor involved in only 25% of the failures³. The remaining 75% of failures were considered as errors in judgement (e.g. inappropriate choice of local anaesthetic (with/without vasoconstrictor) relative to the duration of surgery, LA dosage, LA baricity, patient position and inter-space used for SA relative to the site of surgery and sub-optimal technique). Similar results were found with SA performed for Caesarean section^{4,5}. Inadequate anaesthesia, with a low incidence of failure, was also reported even after LA injection into the sub-arachnoid space. Recently, SA failure after injection of bupivacaine was reported as being the most frequent adverse drug reaction involving LA according to the data in the French Pharmacovigilance system⁶. Manchikanti et al reported, in a retrospective study, a 3% SA failure rate among 329 patients in whom a free flow of CSF was obtained before the injection of the LA⁷. In a prospective, multi-centre study including more than 1200 patients, Fuzier et al reported an incidence of failed SA in 3.2%, leading to general anaesthesia in 85% of those cases⁸. In this study, the number of puncture attempts (≥ 3), the absence of the use of an adjuvant drug combined with the local anaesthetic, and age (< 40 years) were identified as risk factors for failure.

What are the main causes of spinal anaesthesia failures?

Technical problem (i.e. inability to enter the sub-arachnoid space) is considered to be the main cause of SA failure. Variability in the underlying anatomy of the lumbar spine may contribute to this due to the presence (documented or presumed) of arthrosis and/or scoliosis. Obesity also increases the risk of spinal failure⁴. In the context of these clinical scenarios further investigation is warranted into the use of ultrasound to facilitate the performance of successful SA. Perhaps, more interesting is the failure of SA encountered after injection of LA into the CSF. There are few data available in the literature, many of them being published as case reports. However, even though the incidence seems to be very low, SA failure in this context has been occasionally encountered by all anaesthetists even when, apparently, an optimal procedure has been performed. It seems that reaching the CSF with a needle and injecting LA through it is not sufficient to predict spinal anaesthesia success. Anatomical variations, problems with batches of the LA and alterations in the baricity of LA are among the most frequent hypotheses proposed during discussions of these cases⁹⁻¹³. Maldistribution of the LA or variability in the anatomy of the lumbar sub-arachnoid space may explain some SA failures. Many factors affect the intra-thecal spread of injected local anaesthetics, even though the influence of most of them remains small and unpredictable¹⁴. In a cadaveric study, fibrous or membranous structures were identified within the sub-arachnoid space in 16 of 26 subjects, and these structures may possibly be associated with the variation in the spread of LA¹⁵. Some SA failures were related to uncommon anatomical characteristics of the lumbar spinal canal¹⁶. Magnetic resonance imaging (MRI) was helpful for the diagnosis of such failure. In one case report, syringomyelia was diagnosed by MRI after an unexplained SA failure occurred¹⁷. Inadequate CSF concentration of LA is a common reason for SA failure. Sacral restriction or dilution of local anaesthetics may lead to inadequate CSF concentration of LA. A large CSF volume in the lumbo-sacral

region was proposed to explain SA failure in a 37-year-old healthy woman¹⁸. In an MRI study, Carpenter et al demonstrated that the volume of CSF correlated well with sensory block extent and duration of surgical anaesthesia and they considered CSF volume to be the primary determinant of these features of SA¹⁹. However, a recent study found a wide range of LA concentrations in the lumbar CSF of patients with SA failures²⁰. Some anatomical variations of the dura mater and associated structures have been proposed to explain some SA failures. Dural ectasia, diagnosed by MRI, was proposed to explain an inadequate spread of intra-thecal local anaesthetics in a patient with Marfan's syndrome²¹. Injection of LA into a variety of extradural cysts, including dermoid, arachnoid or Tarlov's cysts has also been described. Tarlov's cysts are dilations of the meninges that may arise de novo or following trauma or surgery²². They are usually asymptomatic and occur most commonly in the lumbo-sacral nerve roots. They have an estimated incidence of 4.5-9% of the adult population, and becoming more commonly diagnosed with the development of MRI technology¹¹. When performing SA in the presence of these cysts, the fluid observed within the syringe during aspiration is not CSF and consequently LA injection results in SA failure. Such causes of SA failure are very difficult to predict in routine practice. The appearance of CSF at the needle hub is usually the confirmatory sign which denotes that the sub-arachnoid space has been entered by the needle tip. Some needles (e.g. "atraumatic" or pencil-point designs), have the luminal orifice which is sited just proximal to the tip of the needle and this orifice has a linear dimension which is much longer than the bevel of a Quincke needle. Whilst using pencil-point needles it has been postulated that this longer orifice may straddle the dura mater allowing for free aspiration of CSF. However, during injection of LA only a proportion of the injectate reaches the CSF whilst some is deposited in the epidural/subdural space, resulting in inadequate SA²³⁻²⁵. The type of needle (Whitacre, Quincke, Sprotte) was mentioned as a risk factor leading to failure in some studies²⁶, but no difference was encountered in others studies^{8,27}. Among the other risk factors, patient position⁴ or baricity of LA solution¹² has been proposed to explain some SA failures. Kinsella et al. noted a higher incidence of failures when SA was performed with the patient in the sitting position when compared to the lateral position⁴. However, the sitting position is most commonly chosen by anaesthetists when performing SA in the context of obesity or other anticipated technical difficulties. This may explain the Kinsella's results. Patient position, puncture level, type of puncture, needle size, generic or brand-name drug, LA concentration, and LA dose were not associated with an increase of the incidence of SA failure in others studies⁸. Injection of an altered LA has also been implicated in SA failure. Several cases of SA failure occurring in one centre during a short period of time were reported after injection of LA with the same batch number^{9,10,13}. However, the reply from the manufacturer was that the LA solution complied with the specifications for the product. In a report describing five patients with failed SA, the authors suggested that some patients might have a "physiologic resistance" to LA²⁸. The resistance of LA has also been suggested after SA failure performed in a 34-year-old woman presented for Caesarean section²⁹. Interaction between LA and CSF is an interesting hypothesis, but further investigations are necessary to confirm it. Finally, several different isoforms of the voltage-gate Na⁺ channel exist. Some mutations in the gene of a specific isoform might induce some resistance to LA. This hypothesis needs to be explored further and confirmed in the future.

Conclusion: Spinal anaesthesia failure is not a rare complication. Whilst technical failures remain the most common explanation, penetration of the sub-arachnoid space by the spinal needle and the free aspiration of CSF and injection of LA are not sufficient to predict the success of this technique. Maldistribution of LA or variability in the anatomy of the lumbar sub-arachnoid space constitute different explanations for these SA failures. Resistance to LA remains a hypothesis that merits further investigation.

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DISCOGENIC PAIN: INTERVENTIONAL PROCEDURES AT DISK LEVEL

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Introduction: Despite its high incidence, the diagnosis of discogenic pain often remains imprecise secondary to its non-specific clinical features. Typical features include persistent, nociceptive low back, groin and/or leg pain that worsens with axial loading and improves with recumbency. These features alone, however, are frequently insufficient to establish an accurate diagnosis and comprehensive treatment plan for patients with such complaints. This has led many practitioners to employ provocative discography in conjunction with magnetic resonance imaging (MRI) studies as a means of validating their clinical diagnosis of discogenic pain. Although MRI images are helpful in visualizing such pathology as disk degeneration and desiccation, high-intensity zones and loss of disk height, the results commonly correlate poorly with clinical findings, leaving open the critical question of causality. To date, provocative discography is the only available method of linking the anatomic abnormalities seen on MRI with clinically observed pain (1-12). Provocative discography:

Arguably the most reliable tool currently available for the diagnosis of discogenic pain is the technique of discography. It elucidates the architecture of suspected symptomatic intervertebral discs, and can often confirm the clinical suspicion of a discogenic pain. The first discography results were published by Lindblom in 1948 (1-3), and the diagnostic procedure became popular in 1960's (4-6). This was followed by a series of discography studies, further supporting the diagnostic value and validity of the procedure (7). The validity and reliability of these claims, however, has often since been questioned (8-12). If performed by experienced discographers, using modern methods and in psychologically normal patients, the false positive rate of lumbar discography remains low (11-12). Discography presently remains the most reliable tool to directly relate a radiographic image to the patient's pain (12-15).

Specific indications for discography include: Assessment of patients in whom surgery has failed, to determine whether pseudoarthrosis or a symptomatic disk in a posteriorly viewed segment could be the source of pain; Assessment of disks prior to fusion to determine whether the disks of the proposed fusion segment are symptomatic and whether the disks adjacent to this segment can support a fusion; Persistent, severe symptoms when other diagnostic tests have failed to clearly confirm a suspected disk as a source of the pain; Evaluation of abnormal disks or recurrent pain from a previously operated disk or lateral disk herniation; Assessment of candidates for minimally invasive surgery who have a confirmed disk herniation.

From a technical standpoint, discography requires introduction of a needle into the center of the disc under the guidance of fluoroscopy with injection of contrast into the disc (Figure 1 and 2). The volume of contrast injected, opening and peak pressures, as well as the patient's responses including pain location, severity and quality are documented. In terms of location, quality and severity, if the patient experiences similar pain as their baseline pain, it is termed "concordant" pain. "Non-concordant" pain means the pain is dissimilar from the baseline symptoms.

Discography is thought to provoke pain by the following mechanisms: The injection may increase pressure at the end plates, or pressure may be transferred to the vertebral body throughout the end plate, resulting in an increase in intravertebral pressure (15-19). This theory is supported by studies reporting disk injection resulting in end-plate deflection and increased specimen height (17,18). The injection may result in some biochemical or neurochemical stimulation that causes pain. The presence of pain on injection of a seemingly normal disk may be due to transfer of pressure from the injection to

an abnormal, symptomatic adjacent disk, thus eliciting a positive pain response (18). The injection of contrast material into the disk may increase intradiscal pressure. In an abnormal disk, stretching of the annular fibers of the disk may stimulate nerve endings (16).

During the discography, the disc morphology, i.e., disc height, location of annular tear and any contrast leakage are documented. In the last decade, investigators have also begun to study opening pressure of the disc, pressure at onset of pain, peak pressure and plateau pressure (12). According to Derby (12), the pressure at which the pain is experienced, may be used to divide discs into four different pathologic categories:

- 1) Normal disc has no pain;
- 2) Chemically sensitive discs have pain at a pressure less than 15 psi above opening pressure;
- 3) Mechanically sensitive discs have pain provoked at pressure between 15 and 50 psi above the opening pressure;
- 4) Indeterminate discs experience pain between 51 and 90 psi above opening pressure.

Importantly, one or two asymptomatic discs with normal morphology should be evaluated by discography and used as a control to increase the reliability of data. Internal disc disruption can be graded in five levels according to the modified Dallas Classification:

- 1) Grade 0 = normal disc;
- 2) Grade 1 = contrast spreads radially, fissure extends to the inner third of the annulus fibrosus;
- 3) Grade 2 = contrast extends to the middle third of the annulus fibrosus;
- 4) Grade 3 = contrast extends into the outer third of the annulus fibrosus, to an extent of less than 30 degrees of disc circumference;
- 5) Grade 4 = a grade 3 tear that dissects the outer third of annulus fibrosus for more than 30 degrees;
- 6) Grade 5 = A tear involving the full thickness of the annulus with extra-annular leakage (14).

Since its conception, the clinical value of discography has been the focus of ongoing debate. The majority of recent studies, however, appear to strongly favor the use of discography for clinical diagnosis and guidance for therapeutic decision-making (12, 20–25).

The results of laser disc decompression (LDD) for lumbar disc herniation were evaluated by Ohnmeiss et al (20). One-year success rate of LDD for the patients with contained disc herniation confirmed by CT discography was 70.7%, while success rate for those without CT discography confirmation or with extravasation of contrast was only 44%. A well-defined collection of contrast in a protruded or herniated disc with positive pain provocation has been reported as a good predictor for success of chemonucleolysis (26, 27). These studies demonstrate the importance of pain reproduction during discography for predicting procedure success.

The utility of discography for spine fusion has also been studied by Colhoun et al (28), who found that patients with both positive discographic image and pain provocation had an 88% rate of surgical success. This represented a significant difference from the group with a positive image but no symptomatic pain reproduction, in which the success rate was only 52%.

Derby et al (12) reported that pressure-controlled discography could predict outcome of different surgical techniques. In this study, 96 patients with discogenic pain confirmed by CT discography were randomized to undergo interbody fusion, combined fusion, intertransverse fusion or no surgery. The patients with low intradiscal pressure responsive (chemical) discs achieved significantly better long-term results with interbody and combined fusions than with intertransverse fusion. These results illustrate that precise categorization of positive discographic findings may greatly facilitate therapeutic decision-making.

Regarding complications of discography, there exist five reported cases of acute lumbar disk herniation precipitated by discography. New-onset or a persistent exacerbation of radicular symptoms may also emerge following provocative discography, meriting further investigation. Discitis has an incidence of approximately 2–3% when a single-needle technique is used. A double-needle approach reduces this risk to 0.7%, likely less when prophylactic antibiotics are used (1–19).

Annuloplasty: Once the diagnosis of discogenic pain has been suitably established, the next challenge involves instituting an effective therapy. Several of the most common current therapies involve careful heating of the annulus fibrosus. Historically, these modalities have been used despite a somewhat poorly understood relationship between the therapeutic effects

and the histologic changes observed (29–33). It is presently held that denervation of the tissue or destruction of the nociceptors, as well as alteration of the collagen fibers in the annulus producing denaturation and coalescence is the predominant mechanism of effect (30–33). Major advantages of these procedures generally include their minimally invasive approach, low cost, and relative simplicity versus surgical procedures such as lumbar fusion or disk replacement. Intradiscal Electrothermal Therapy (IDET; Smith and Nephews, London, UK), DiscTrode (Radionics Inc., Burlington, MA) and Intradiscal Biacuplasty (Baylis Medical Inc., Montreal, Canada) (Figure 1b–d) are several examples of approaches using heat to treat discogenic pain.

When considering indications for interventional approaches such as IDET annuloplasty, the most common criteria include discogenic low back pain, persistently present for more than 6 months. Further, this pain must remain despite comprehensive conservative treatment including physical therapy, a directed exercise program and at least one fluoroscopically guided epidural corticosteroid injection. Saal and Saal initially prescribed additional criteria for IDET that included: normal neurological examination, negative straight leg raise, absence of any inflammatory arthritides or nonspinal conditions that may mimic lumbar pain, and absence of prior surgery at the symptomatic intervertebral disk level (34–36). Further, no neural compressive lesions should be seen on MRI, and provocative discography should reproduce concordant pain at low pressurization at one or more - but no more than three - intervertebral disk levels. This criteria set was one of several variations used in subsequent studies evaluating the efficacy of IDET (for review, see Appleby et al. 2006 ;37). When comparing the studies, variation in patient selection, as well as heating techniques, are thought to account for differences seen in clinical results (37–46).

Overall, the average pain score improvement in 13 studies analyzed were between 1.5 to 5 VAS points. SF-36 physical function (PF) scores for evaluation of functional capacity improved from approximately 15 to 30 in four separate studies (37). Overall results of IDET appear to improve with several additional patient-selection criteria (40,46). Such criteria are evaluated in Pauza and colleagues' sham-controlled, prospective IDET study. Specifically, they restricted patients to: 1. Beck depression scale score of < 20; 2. Less than 20% disk height narrowing on lateral X-Ray; 3. No surgical interventions within previous 3 months of study enrollment (40). Although improvement was seen in both groups, greater improvements in mean pain and functionality scores were reported in patients who underwent IDET. Pauza and colleagues' use of provocative discography rather than MRI criteria for enrollment may have contributed to the negligible improvements seen in the IDET patients, as well as the high number needed to treat - five to achieve > 75% improvement in one patient (40). There was significantly less improvement in functional capacity and pain relief following IDET in a separate prospective study in which patients with any sign of disk degeneration on MRI at more than two lumbar levels were compared with patients who had one or two degenerated disks. In this particular study, patients were matched for the number of lumbar disk levels positive on discography (46). As single-level disease is less commonly present, it is reasonable to believe that Pauza and colleagues' patient selection realistically illustrates the expected results of the IDET procedure in the majority of patients presenting with discogenic pain (40,46). Overweight patients (47) and patients receiving workers' compensation benefits (45,48) represent additional patient subsets that are unlikely to benefit from IDET.

Using significantly different selection criteria than Pauza et.al, the recently published randomized, double-blinded, controlled IDET study by Freeman and colleagues reported no significant improvement between treatment and placebo in patients with discogenic pain (49). Importantly, selection criteria for this study did not include data regarding body mass index, depression scores, nor the number of disk levels that appeared degenerated on MRI. Further, more than half of the enrolled patients exhibited "marked functional disability" and were receiving workers compensation benefits at the time of their participation in the study. Freeman and colleagues also used patients belonging to groups previously referred as likely IDET failures (45,48,49).

IDET is not the only minimally invasive annuloplasty procedure. However, no differences in pain scores or improvement in functional capacity between the sham and the treated patient groups were seen in the randomized controlled trial using the original Sluijter radiofrequency (RF) technique in which the nucleus was heated to 70°C for 90 seconds (50). A disappointing performance was turned in by the novel annular probe termed "DiscTrode" as well, after treatment of patients with discogenic pain reported only modest improvements in pain scores and functional capacity (51). This technology proved to be less effective in improving functional capacity

and VAS scores versus IDET when strict patient selection criteria were employed (51).

Intradiscal biacuplasty is the latest minimally invasive posterior annulus heating technique. This technology employs bipolar RF electrodes and -based on improvement in pain scores and functional capacity in patients with discogenic pain - is likely the most promising of all currently available minimally invasive, disk-heating methods (51-55). This method works specifically by concentrating RF current between the ends of two straight probes. Deep, even heating over the larger area of the posterior annulus is achieved by internally cooling the electrodes (52) (Figure 3). Disks with large radial fissures, and at levels where placement of the IDET resistive coil may be technically difficult, (i.e. L5-S1), represent additional indications for trans-discal biacuplasty (55). Results from the randomized, sham prospective study will be available later this year and discussed during 2012 ESRA Meeting (Kapural et al).

Contained Disk Herniation-Minimally invasive decompression

A common cause of leg and back pain is the contained protrusion of the lumbar intervertebral disk. When contained, smaller protrusions are less likely than larger disk extrusions to spontaneously resorb (56) and often show less improvement from surgical discectomy (57). In an effort to speed functional recovery, yet provide similar efficacy as open surgical procedures, percutaneous discectomy and disk decompression have become attractive therapeutic alternatives for such lesions. One percutaneous method of central decompression, in particular, attempts to avoid extensive damage to the annulus by simply removing or degrading a portion of the nucleus pulposus at the center of the disk without removal of the actual herniated disk material (58,59). Although there are no clinical comparison studies or individual prospective controlled studies to confirm the data, reported success rates for these types of procedures ranges from 55% to 90% (58). The percutaneous techniques are also hoped to produce less pain following surgery, less nerve root scarring at the site of intervention, lower incidence of spinal instability and/or disc space collapse, less cost and a faster return to full function.

The three most recent techniques developed for the minimally invasive treatment of contained herniation of the nucleus pulposus are: Coblation technology (RF nuclear tissue vaporization) nucleoplasty; heated resistive coil catheter disk decompression; and a volume reduction/intradiscal decompression technique known as Dekompressor (Stryker).

Improvements in both functional capacity and pain relief were seen with nucleoplasty secondary to its ability to ablate and coagulate the nucleus pulposus, thereby decompressing the disk and thermally altering the disk tissue (60-62). A case series of 65 patients claimed a success rate of 80% and VAS pain score reduction from 7.7 to 3.3 at 1-year follow-up (60). VAS pain scores were reduced by 71% at 3 months and 59% at one year in another case series (61). Importantly, decompression is more effective in non-degenerated disks than in previously degenerated ones (62). In addition to this consideration, accepted indications include: radicular pain greater than axial pain for more than 6 months as well as failure of physical therapy and conservative treatments. Less favorable outcomes are seen in the setting of large disk protrusions, less than 50% of disk height maintained, and those with significant prolapse above and below the disk level, thus warranting careful review of all patients' MRI images. A patient with a contained disk protrusion of < 6mm whose annular integrity is documented by discography and who has consistent radicular symptoms confirmed by selective nerve root blocks represents the ideal candidate for annuloplasty or any percutaneous decompression (58,63). Some patients who have had either unsuccessful selective nerve root blocks or had simultaneous axial and radicular pain may require provocative discography but, in general, selective nerve root block is adequate to verify that the pain is originating from the selected disk.

Disk space infection, complete disk collapse preventing access to the intervertebral space, and comorbid conditions precluding the safe performance of the procedure represent contraindications to nucleoplasty. These procedures are also generally not of significant benefit in patients with scoliosis, progressive neurological deficits, significant canal stenosis, tumors, or with prior surgeries at the same intervertebral level (64).

The second technique, the percutaneous decompression (Dekompressor) technology, extracts nuclear disk material by an auger within a cannula that ends inside the nucleus. A significant change in intradiscal pressure follows the reduction of nuclear volume within the closed hydraulic space. It is imperative that the annular wall be intact for this technique in order to retract the bulging section, therefore provocative discography may occasionally be needed to confirm the affected level and to rule out any annular disruption. In

their case series, Alo and colleagues reported an 80% success rate with this technique (59).

The Decompression catheter (Smith and Nephew, London, UK) is a recently introduced electrothermal intervertebral disk decompression technique that utilizes thermal energy for focal decompression of contained herniated disks. In this technique, a 1.5cm resistive coil capable of developing localized heat in a section of the catheter is carefully positioned over the contained protrusion. This resistive coil is capable of significant heat production, and should therefore not be used in patients with < 50% disk height. In appropriate patients, the technology may be an effective approach to the treatment of patients who have both axial and radicular pain, but currently there exist no case series or in-depth clinical studies yet published to support this hypothesis.

Conclusions: Several new minimally invasive disk and vertebral repair techniques for pain control have been introduced recently, but sufficient clinical evidence of their efficacy and extent of application is still lacking overall. One thing that is clear, however, is that careful patient selection based on the present data significantly improves the success of these procedures.

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FIGURE 1. Anterior-posterior view of contrast distribution during the lumbar provocative discography. Note the rounded shape of the L3-4 and L4-5 intradiscal contrast spread, while it appears a significant contrast leak from the L5-S1 intervertebral disc.

FIGURE 2. Lateral fluoroscopic view of the intradiscal contrast spread during provocative discography. L3-4 and L4-5 discs were non-painful controls and L5-S1 had an obvious large contrast leak into the epidural space. Patient reported pain of 8 with pressurization of that particular disc at only 22 psi.

FIGURE 3. Anterior-posterior view of the intradiscal biacuplasty electrodes within the annulus of L5-S1 intervertebral disc. Notice the appropriate distance of the active tip of both electrodes from the end-plates and limited depth of the radiofrequency active tip (distal to radiopaque marker) just up to medial pedicle border.

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OPTIMIZED PERIOPERATIVE ANALGESIA REDUCES CHRONIC PHANTOM LIMB PAIN INTENSITY, PREVALENCE AND FREQUENCY: A PROSPECTIVE RANDOMIZED, CLINICAL TRIAL

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Background and aims: Persistent pain after amputation manifests as phantom limb pain (PLP), residual (stump) pain, or both, and is frequently a vexing clinical problem that is difficult to manage. PLP is reported by 50% to 80% of patients^{1,2}, can result in depression and sleep disorders and has been associated with serious long term health sequelae, including obesity, joint pain, low back pain and cardiovascular disease^{3,4}. The epidemiology and risk factors for PLP are not fully understood, but pain before limb amputation is associated with development and severity of chronic PLP^{5,6}. Several analgesic regimens, including oral gabapentin⁷, intravenous morphine, ketamine or lidocaine, nerve blocks and epidural analgesia^{8,9} have been used to control pain before amputation, in an attempt to prevent phantom pain, but results have been conflicting. This prospective randomized clinical trial (RCT) was conducted to investigate whether optimized perioperative analgesia aimed at control of pain before, during and/or after lower limb amputation can influence the intensity, prevalence and frequency of PLP at 1 and 6 months after amputation.

Methods:

Setting

This prospective, randomized, double blinded clinical trial was conducted at the University Hospital of Patras in Rion, Greece, between December 2003 and May 2008. The study was approved by the Institution Ethics Committee, and was registered at the trial registry at www.clinicaltrials.gov (ClinicalTrials.gov Identifier: NCT00443404). Written informed consent was obtained from all patients before they enrolled in the study. The study was financially supported by department funds, without any support from outside sources.

Patient Selection

Inclusion criteria included patients ages 18 - 85 years, scheduled for major (above or below the knee) amputation who had moderate to severe pain before amputation despite routine analgesic therapy. Patients undergoing repeat amputation, emergency amputation, foot or toe amputation, and patients with significant psychiatric disease, chronic pain not related to limb ischemia, history of substance abuse and patients unable to complete a pain questionnaire were excluded.

Pain Measurement

Pain intensity was evaluated using the Visual Analog Scale (VAS) and the three main measures of the McGill Pain Questionnaire (MPQ): the Pain Rating Index (PRI-R), the Number of Words Chosen (NWC) and Present Pain Intensity (PPI)¹⁰. Pain intensity data were collected every 8 hours for 48 hours before the amputation, and at 24 and 48 hours, 4 and 10 days, and 1 and 6 months after amputation. PLP intensity, as measured using the VAS and MPQ-PRI-R was designated as primary outcome, whereas all other PLP and residual limb pain measurements were designated as secondary outcomes.

Study Design and Interventions

Patients who enrolled in the study were randomly assigned to one of five groups. All patients had a lumbar epidural catheter [or subcutaneous catheter in the control group (Group 5) in order to maintain blinding] placed 48 hours before amputation, but use of the epidural catheter differed based on group assignment. Patients in Group 1 (Epi/Epi/Epi group) received epidural analgesia before and after surgery, and epidural anesthesia during surgery; Group 2 (PCA/Epi/Epi group) patients received IV patient-controlled analgesia (PCA) preoperatively, epidural anesthesia intraoperatively and epidural analgesia postoperatively. Group 3 (PCA/Epi/PCA) patients received IV PCA before and after surgery, and epidural anesthesia intraoperatively. Group 4 (PCA/GA/PCA) patients had IV PCA before and after surgery, and general anesthesia intraoperatively. Group 5 (control) patients received conventional analgesia (intramuscular meperidine 50 mg 4-6 times a day as needed, oral codeine/acetaminophen as needed, and IV acetaminophen 650 mg 2-3 times a day) before and after surgery, and general anesthesia intraoperatively. In total, 65 patients participated. All patients had an "epidural" infusion pump (delivering saline or analgesic depending on group assignment). Similarly, all patients (except for those in the control group) received IV PCA pumps (delivering saline or analgesic depending on group assignment). The epidural analgesic was a solution containing bupivacaine 2 mg/ml and fentanyl 2 mcg/ml administered at 4-8 ml/hour, whereas the IV PCA regimen consisted of fentanyl 25 mcg per dose with 20 minute lockout and no basal

infusion. Visual analog scale and McGill Pain Questionnaire pain scores were recorded perioperatively and at 1 and 6 months after the amputation.

Statistical analysis

Sample size calculation was conducted before starting the study and showed that 10 patients per groups would be adequate, using the following assumptions: ANOVA for 5 groups of patients, VAS pain score at 6 months as the primary outcome, power = 0.8, alpha = 0.05, and mean square standardized effect = 0.6. Subsequently, we decided to increase the sample size to 13 per group, to allow for patient attrition and possible data errors or protocol violations. ANOVA was used to compare differences between groups for normally distributed variables, whereas the Kruskal-Wallis test was used to compare variables that were not normally distributed. P values indicating statistical significance were adjusted for multiple comparisons using the Bonferroni correction method. Data analysis was conducted using "per protocol" analysis initially; subsequently, analysis was also conducted based on the "intention-to-treat" principle, and both analyses yielded similar results.

Results: Of 107 eligible patients, 42 were excluded before randomization, and 65 patients were randomized. Two patients were excluded from the study after randomization (one patient had a different procedure, and the other patient died before the amputation). The five groups did not differ with regards to age, sex, presence of diabetes or cardiovascular disease and level of amputation. However, patients in the control group had significantly lower median VAS pain scores (70) compared to all four intervention groups (median 80-92) before the analgesic protocol started.

Six months after amputation, PLP VAS scores were significantly different between groups ($p = 0.001$). Post-hoc comparisons between all intervention groups and the control group showed that median (minimum-maximum) PLP VAS scores and significance (p value) for the difference between each intervention group vs. control were 20 (0-58) for the control group, 0 (0-20) for the Epi/Epi/Epi group ($P = 0.001$ vs. control), 0 (0-42) for the PCA/Epi/Epi group ($P = 0.014$ vs. control), 20 (0-40) for the PCA/Epi/PCA group ($P = 0.532$ vs. control) and 0 (0-30) for the PCA/GA/PCA group ($P = 0.008$ vs. control).

Similarly, six months after the amputation MPQ-PRIR scores differed significantly between the intervention groups and the control group ($p = 0.001$). Post-hoc comparisons showed that, at 6 months, median (minimum-maximum) MPQ-PRIR PLP scores and significance (p value) for the difference between each intervention group vs. control were 7 (0-15) in the control group, 0 (0-7) in the Epi/Epi/Epi group ($P = 0.001$ vs. control), 0 (0-9) in the PCA/Epi/Epi group ($P = 0.003$ vs. control), 6 (0-11) in the PCA/Epi/PCA group ($P = 0.208$ vs. control) and 0 (0-9) in the PCA/GA/PCA group ($P = 0.003$ vs. control).

With regards to prevalence, 6 months after the amputation PLP was present in 1 of 13 patients in the Epi/Epi/Epi group, 4 of 13 patients in the PCA/Epi/Epi group, 7 of 13 patients in the PCA/Epi/PCA group and 3 of 13 patients in the PCA/GA/PCA group, compared to 9 of 12 patients in the control group. Overall, the prevalence of PLP at 6 months after amputation was 15 of 52 patients (28.8%) in the intervention group vs. 9 of 12 patients (75%) in the control group, and the observed difference was highly significant ($p = 0.004$). Interestingly, in contrast to earlier publications, residual limb pain in this study was insignificant in all patients 6 months after the amputation.

Conclusions: Phantom Limb Pain remains a significant clinical problem that can adversely affect the health and quality of life of affected individuals

1. The effectiveness of available options for the management of existing phantom pain is limited and not very well documented.
2. Poor pain control before amputation remains the rule, rather than the exception, and pain before limb amputation is associated with phantom limb pain frequency and intensity.
3. Analgesic interventions aimed at optimizing perioperative analgesia for patients undergoing amputation may result in reduced phantom pain frequency and intensity, but published studies have produced conflicting results.
4. Results of this RCT published in "Anesthesiology" in May 2011 suggest that optimized epidural analgesia or intravenous PCA, starting 48 h preoperatively and continuing for 48 h postoperatively, decreases PLP at 6 months¹¹. However, because this was a small study, more data from larger RCTs are needed to validate these findings.

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LOCAL ANAESTHETICS: REAPPRAISAL OF THEIR ROLE IN REGIONAL ANAESTHESIA AND PAIN MANAGEMENT. NEUROPROTECTION

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Introduction: Even nowadays, the treatment of ischaemic brain disease still remains a challenge for all clinical anaesthesiologists. Yet, there is no clinical evidence that any commonly used agent in the perioperative period affords significant neuroprotection against ischaemic injury. However, a large volume of experimental data confirms that among all anaesthetic agents, Local Anaesthetics (LAs) do hold at least some short term neuroprotective properties, in vitro as well as in vivo, in both animals and humans.

Traditionally, Local Anaesthetics (LAs) are used clinically for anaesthesia and analgesia purposes, either following surgery, or during the management of other acute and chronic pain conditions. The use of LAs has long been focused not only on the treatment of pain, but also of cardiac arrhythmias. According to classical knowledge, in both these settings, their efficacy - action is mainly based on Sodium (Na⁺) Channels' Blockade. However, during the last decades, results of multiple publications suggest that LAs are able to interfere with other receptors. LAs not only block Na⁺ Channels, but also Calcium (Ca²⁺) and Potassium (K⁺) Channels, Transient Receptor Potential Vanniloid - 1 and NMDA receptors, as well as other ligand - gated receptors. In addition, they also disrupt the coupling between certain G proteins and their associated receptors.

Through such interference, LAs exert potent antinociceptive, antihyperalgesic, anti-inflammatory, antithrombotic, antibacterial and potential neuroprotective actions, leading to their administration in different settings, including postoperative ileus, neuroprotection, decompression sickness, cerebral air embolism, cancer recurrence and various types of inflammation.

Aim of the Lecture - Presentation: The aim of this lecture is to provide an overview of recent progress regarding LAs neuroprotective properties, in terms of new indications and limitations of their application. The lecture will commence with a brief summary of the main changes in brain metabolism,

triggered by ischaemic / anoxic injury and neuronal death and will then continue with a review of the most important experimental and clinical data, showing that LAs exhibit neuroprotective properties both in vitro and in vivo. Finally, the clinical relevance of these findings and their prospects for the future will be discussed.

Hypoxia, Anoxia, Ischaemia and Neuronal Death: Pathophysiology:

Considerable progress has currently been made in the understanding of the consequences of brain anoxia / ischaemia on nerve tissue metabolism and consequent neuronal viability. Impairment of blood and / or oxygen supply to the brain reduces ATP production and affects energy - dependent processes, such as function of the Na⁺ / K⁺ / ATPase transporter. Activation of ATP - dependent K⁺ channels, as well as of Ca²⁺ - activated K⁺ channels is interrupted, leading to initial neuronal hyperpolarization and electrical silence, immediately after ischaemia onset. Neuronal K⁺ transport loss results in its extracellular accumulation and in a subsequent slow neuronal cell depolarization. Once a threshold is reached, depolarization leads to the complete loss of membrane potential, with massive intracellular Na⁺ and Ca²⁺ entry. The release of excitotoxic amounts of glutamate from nerve terminals is triggered, activating both NMDA and AMPA receptors. This enhances Na⁺ and Ca²⁺ entry, in addition to K⁺ extrusion from the neurons through the glutamate receptor - coupled cationic channels.

During ischaemia, cytosolic Ca²⁺ concentration increases markedly, because of both NMDA receptors and voltage - gated Ca²⁺ Channels activation, but also due to the blockade of the Na⁺ / Ca²⁺ transporter and the release of Ca²⁺ from intracellular stores. The increase in cytosolic Ca²⁺ plays a prominent role in the development of ischaemic injury and of neuronal death by necrosis and / or apoptosis, through production of free radicals, DNA damage and proteolysis. Necrosis consists of cell disintegration, with a spreading tendency towards adjacent neurons, with simultaneous activation of glial cells and of immune system (acute inflammatory response). Apoptosis is a physiological process for eliminating unnecessary neurons, mostly during embryonic development, although during cerebral ischaemia, apoptosis is triggered as an actively programmed cell death. In contrast to necrosis, it does not damage adjacent neurons. Its initiation is attributed to cytochrome C release from mitochondria, producing ATP when oxygen is available and leading to activation of caspases and programmed cell death. Apoptosis is absolutely controlled and tightly regulated by both anti - apoptotic factors (bcl - 2) and pro - apoptotic ones (bax, bad), with tyrosine phosphorylation, triggered by growth factors (NGF, BDNF), also playing a major role in neuronal apoptosis inhibition.

Neuroprotection - Terminology

The term neuroprotection refers to the application of prophylactic interventions, prior or simultaneously with the hypoxic/ischaemic insult, aiming in enhancing neuronal «strength» and in improving neuronal cells survival rates (pretreatment). The term has been «extended» in order to include all interventions taking place after brain ischaemic/anoxic injury, targeting in the prevention of later - ultimate cellular damage (resuscitation). Every phase - step in the ischaemic cascade represents a potential target for pharmacological intervention. Currently, no pharmacological agent is considered a definite protective measure, in a way that it recommended as an absolute indication for neuroprotection. However, many drugs do deserve careful and specific - detailed attendance, with LAs being one of the most important categories.

Neuroprotective Effects of Local Anaesthetics (LAs)

The first step in the ischaemic cascade is Na⁺ influx. As a result, prevention or reduction of such a consequence offers to clinicians a potential mechanism for neuroprotection. The ability of LAs to block the hypoxia - induced alterations in Na⁺ influx, rather than blocking propagation of action potential, predicts their neuroprotective effects. This exciting area for systemic local anesthetic use - potential neuronal cells protection is significantly related to the seriousness of neurologic sequelae and relative paucity of therapeutic interventions, thus creating an important field of research, especially when taking into account the risk of many patients who undergo both cardiac and neurological surgery each year.

The neuroprotective effect of lidocaine (the LA that has been mostly studied) is reinforced by in vitro and in vivo, experimental and clinical studies in both animals and humans. Lidocaine blocks the voltage - gated Na⁺ channels, decreases energy demands, maintains ions homeostasis and finally protects the brain against ischaemic damage. Lidocaine is considered a very promising agent in the field of neuroprotection because a) it is a local anaesthetic (familiar to all clinicians and easy in pharmacological «manipulation»), b) it acts in the early stages of the ischaemic «cascade», thus interrupting the following sequelae of all pathophysiological interactions, especially when administered

prophylactically and, finally c) its actions have been described at doses that have been applied in various clinical situations.

In vitro studies results conclude that lidocaine limits ischaemic injury in rat hippocampal slices, subjected to 10 min anoxia and that low concentrations of lidocaine and tetrodotoxin improve recovery of CA1 pyramidal cells, through reduction of Na⁺ influx and initiation of depolarization. Higher concentrations can partially restore ATP production and may also block the increase of intracellular Na⁺ accumulation and depolarization induced by hypoxia, but do not block neuronal activity during normoxic conditions. In addition, a clinical antiarrhythmic dose of lidocaine (4 mgr / kg) increased the number of surviving CA1 pyramidal neurons and preserved cognitive function, following transient global ischaemia in rats, indicating that lidocaine is a good candidate for clinical brain protection.

Several in vivo experimental studies on rats have shown the neuroprotective effects of lidocaine at antiarrhythmic doses. Lei et al reported that low - dose lidocaine, infused 30 min before focal cerebral ischaemia led to a significantly reduced infarct size, improved neurologic outcome and resulted in less post - ischemic weight loss. A more recent study by the same group of investigators has also shown that a similar antiarrhythmic dose of lidocaine, also given 30 min before onset of ischaemia, attenuated neuronal apoptotic cell death in the penumbra and showed a similar reduction in infarct size. Even though these studies involved pre - ischaemic administration of lidocaine, Lei et al have also shown that lidocaine has neuroprotective effects when administered 45 min after the ischaemic event, by improving evoked potentials values. Although the size of the infarct was not significantly reduced in the lidocaine - treated rats in this study, they reported an increase in the number of surviving neurons in both the ischaemic penumbra and the ischaemic core, an improvement in the neurological outcome, and an increase in post - ischaemic body weight. Similarly, Cao et al reported that both pre - insult and post - insult administration of lidocaine attenuated cell death, either before or after 10 min of oxygen glucose deprivation in the rat hippocampus.

Additionally, lidocaine significantly inhibits the Acid Sensing Ion Channel Currents (ASIC currents) in mouse cortical neurons by up to 90% approximately. The inhibition is reversible and dose - dependent. The effect is rapid and does not depend on pH. In Chinese hamster ovary cells, expressing different ASIC subunits, lidocaine inhibits the ASIC1a current without affecting the ASIC2a current.

Furthermore, based on the assumption that excitotoxic neuronal injury from ischemia may be reduced by local anesthetics and according to the results of an experimental study examining the neuroprotective effects of intrathecally administered bupivacaine and hypothermia in a rat model of transient spinal cord ischemia, it is collectively suggested that intrathecal bupivacaine does not provide neuroprotection during normothermic transient spinal cord ischemia in rats, although it enhances the neuroprotective effects of hypothermia. In this study, after reperfusion, the motor and sensory deficit scores of the normothermia (NT) group were significantly higher than those of the hypothermia (HT) and bupivacaine - hypothermia (BHT) ones. Significant differences were evident in the motor and sensory deficit scores between the HT and BHT groups at 24 h. Neuronal cell death and immunoreactivity of HSP70 were frequently observed in the NT and BT groups, but not in the HT and BHT groups.

Based on the above, one may understand that an antiarrhythmic dose of lidocaine, given before, during or after transient focal cerebral ischemia, significantly reduces infarct size and improves neurological outcome. Blocking apoptotic cell death in the penumbra involving cytochrome C release and caspase 3 activation may also play a role in these effects.

At a clinical level, several studies have previously shown that antiarrhythmic or even lower doses of lidocaine demonstrate neuroprotective effects in humans. These potential properties are of great importance, since the severity of perioperative neurologic sequelae and the relatively limited therapeutic interventions that are available make this an important area of research. Post-operative neurocognitive decline is detected in more than 50% of patients post cardiac surgery, being still present 6 months later in 30%.

Interestingly, lidocaine possesses neuroprotective effects in cardiac surgical patients. Mitchell et al found a better outcome in patients undergoing mitral and aortic valve surgery, while Wang et al observed improved early cognitive recovery in CABG patients. Cognitive decline is associated with the occurrence of silent brain infarcts. There is thus both experimental and clinical evidence to suggest that lidocaine may be neuroprotective in cardiac surgical patients. In a prospective, randomized double - blind, placebo - controlled study, Mathew et al investigated whether a continuous intravenous infusion of lidocaine (bolus 1mg/kg, followed by 1mg/min for the next 48h)

would reduce postoperative cognitive dysfunction after cardiac surgery, using cardiopulmonary bypass (CPB). The authors concluded that lidocaine did not reduce the incidence of cognitive dysfunction, but in non-diabetic patients a secondary analysis did show a neuroprotective effect, which was still present 1 year after surgery. This study suggests that not all, but certain patients may benefit from such treatment.

Additionally, since neuroprotection in the setting of severe head injury (SHI) remains an unsettled problem some scientists have tested a combination of high-dose magnesium and low-dose lidocaine, infused over 3 days, in 32 consecutive patients admitted to the emergency department of a large tertiary referral centre, during a pilot study to assess safety. This combination appeared indicated to protect both gray and white matter from secondary injury following SHI. No toxicity was observed, mortality was lower than published statistics and these results seem to open the stage to a controlled randomized study.

In the majority of experimental and clinical studies, lidocaine was administered systematically. Now the question that arises is if LAs administered through other routes still exert protective effects on neuronal cells. There is accumulating evidence that intrathecal LAs (for spinal anaesthesia) may themselves be neurotoxic - although occasionally protective, and that lidocaine is more neurotoxic compared to others, with ropivacaine being the least toxic one and levobupivacaine presenting a more favourable profile over the racemate.

In an *in vitro* experiment, primary cultures of mouse cortical cells, containing both neurons and astrocytes, were exposed to 100 μ M NMDA for 10 min for the induction of excitotoxic neuronal death. This treatment killed 70 - 80% of the neuronal population, as assessed 24 h after the excitotoxic pulse. In this particular model, both levobupivacaine and bupivacaine were neuroprotective against NMDA toxicity. However, neuroprotection by levobupivacaine was seen at lower concentrations (with respect to bupivacaine) and was maintained at concentrations of 3 mM, which are much higher than the plasma security threshold for the drug *in vivo*. In contrast, no protection against NMDA toxicity was detected when 3 mM concentrations of bupivacaine were applied to the cultures. These data show a better neurotoxic profile of levobupivacaine as compared to racemic bupivacaine, and are indicative of a safer profile of levobupivacaine in clinical practice.

Neither the clinical implications nor the cellular mechanisms of LA neurotoxicity have been fully elucidated, but accumulating evidence strongly suggests that lidocaine has a narrow therapeutic index with clinical implications for both spinal anaesthesia and attempts to use LAs as neuroprotective agents, by decreasing neuronal metabolism. The direct neurotoxicity of LAs that will be discussed here is distinct from the global CNS toxicity seen with inadvertent intravascular overdose, and from other causes of neurologic injury after spinal anesthesia, such as mechanical needle trauma and epidural hematoma.

LAs induce multiple derangements in neuronal homeostasis, depending on the dose and exposure time. Toxicity is not mediated by the desired pharmacological effect of LAs, Na⁺ blockade, since an equipotent dose of tetrodotoxin, a structurally unrelated Na⁺ blocker, is not neurotoxic. Generally, lidocaine is more toxic than equipotent bupivacaine; other comparisons are either incomplete or indefinite. It is not known if there is a single proximal insult leading to all others, or whether there are multiple insults leading to multiple mechanisms of neuronal death or injury, in case LA neurotoxicity is a consolidated fact. It is tempting to hypothesize that higher doses cause neuronal death or long-lasting injury by a mechanism distinct from transient injury associated with TNS at lower doses, but this is not established. LAs increase cytoplasmic calcium. The biphasic calcium response involves release from internal stores, including the endoplasmic reticulum, as well as influx of calcium across the plasma membrane for higher concentrations. LAs also cause a rapid decrease in mitochondrial membrane potential which is initially reversible and not due solely to uncoupling. A direct effect of LAs on membrane permeability has been shown. Very low concentrations of lidocaine reversibly inhibit axonal transport. Tetracaine induced multiple members of the mitogen-activated protein kinase family in PC12 neurons, but some kinases were harmful and some were protective.

As it has already been mentioned, lidocaine is cerebroprotective in human as well as animal studies, at plasma concentrations well below the ED50 for Na⁺ channel block that are not toxic in the models reviewed above. The mechanism is not clear. The ability of such low concentrations of lidocaine to provide spinal neuroprotection has not been tested. Three of four animal studies using much higher CSF concentrations of LA to provide dense spinal anesthesia have reported spinal cord neuroprotection in various ischemic models. In the nonprotective study, the tip of the spinal catheter was placed

at the cauda equina and there was evidence of injury (elevated glutamate) in some animals. In the protective studies, the catheter was placed at L2-5 or higher, which probably provided better mixing of LA with CSF. Further study is required before spinal anesthesia can be recommended as neuroprotection. The neurotoxicity of LAs suggests particular caution when considering spinal LA as prophylactic neuroprotection in a situation where bad outcomes are not frequent.

As experience with dose-response and mechanism of the action of a particular compound expands, it is evident that multiple mechanisms may exist for any given agent when the full dose-response curve is explored. It is highly likely that critical, limiting steps in any given mechanistic pathway may become overwhelmed with increasing exposure, signaling the emergence of new modalities of toxic tissue injury at these higher doses. Therefore, dose-dependent transitions in the principal mechanism of toxicity may occur and could have significant impact on the interpretation of data sets for risk assessment. The principle explored is that each saturable or inducible process that occurs as part of the overall chemical disposition and/or biological response represents a potential point of departure from linearity in the dose-response relationship. Saturable and/or inducible processes that contribute to the pharmacokinetic characteristics include absorption, distribution (protein binding, active transporters), elimination, and chemical transformation (activation and detoxification). Pharmacodynamic examples include receptor interactions (affinity constants, finite receptor numbers, and multiple receptor types), repair/reversal (DNA repair, receptor reactivation, protein synthesis, and cell replacement), and altered homeostasis (induction, metabolic switch, cell proliferation, and apoptosis). Using the effects of increasing doses of cocaine on PC12 cells in culture, recent data demonstrate that the mechanism of cell death switches from apoptosis to necrosis as the dose is increased. This example serves to document that dose-dependent transitions in mechanism can occur and to provide an opportunity for discussing the potential impact of this phenomenon on the risk assessment process.

Conclusions

To date, large trials attempting to demonstrate pharmacological neuroprotection with perioperative LAs administration have produced disappointingly small reductions in morbidity and mortality and experimental data produce ambiguous results and inconsistent conclusions. The reasons for this may include lack of convincing experimental data, underpowered clinical trials, heterogeneity of patients, timing of drug administration, and the difficulty in getting the local anaesthetic agent to the ischaemic zone.

However, systemic administration of LAs may protect against brain ischaemia in some clinical situations. During cardiac surgery, lidocaine may protect against the neurocognitive sequelae of micro embolization, especially in high-risk perioperative situations. In addition, LAs may interfere with neuroprotective measures of spinal cord ischaemia during major cardiovascular or orthopaedic procedures. Their neuroprotective effects when administered via alternative routes still remains unexplored and necessitates elucidation. It is fascinating that more than decades after the introduction of LAs for perioperative analgesia, we may still discover new properties and anticipate new applications of this class of drugs. Various types of inflammation including neuroprotection, may be positively influenced by the application of LAs. These issues are without doubt the challenges of the coming years.

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ADJUVANTS IN LOCAL ANAESTHETICS FOR PERIPHERAL NERVE BLOCKS: WHAT IS NEW?

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Single shot administration of local anaesthetics either peripherally or by the neuraxial route results in anaesthesia/analgesia of limited duration. For a number of decades, anaesthetists have tried to prolong the effect of local anaesthetics by combining them with varying adjuvant compounds. In discussing the use of such adjuvants in regional anaesthesia it is important to consider how the quality of the block is measured or determined.

What is the optimal way of testing the block quality?

In many publications aiming to determine the optimal solution mixture for single shot peripheral nerve block, quality and duration of anaesthesia in differing dermatomes has often been assessed using absence of pin-prick or cold sensation. But are pin-prick and cold the correct way to test a block? In fact, pin-prick tests high threshold mechanoreceptors (also activated by pain, pressure and stretch) and cold sensation tests A-δ fibres. These techniques for testing the extent of a PNB have two clear advantages viz. they are easy and quick to perform. However, they have important disadvantages too viz. measurement variability, subjectivity and non-selectivity, as they do not test all of those fibres involved in pain impulse transmission. Both A-δ and unmyelinated C fibres are the most important small afferent fibres in the transmission of pain signals. The lack of a quantitative method for the assessment of a peripheral nerve block, as well as the aforementioned problems associated with traditional testing directed our attention to Quantitative Sensory Testing (QST) as applied in chronic pain diagnostics. QST is a psycho-physical testing method already applied for many decades in multiple domains in medicine. In the last 10 years specific QST protocols have been developed for application in a variety of acute and chronic pain syndromes, in order to provide a more objective way of measuring abnormalities in the functioning of cutaneous afferent small fibres. QST involving the application of thermal stimuli such as cold (CS) and warm sensation (WS), cold-induced pain (CP) and heat induced pain (HP) provides reproducible and semi-objective investigation of

the small A- δ and C polymodal nociceptors responsible for pain transmission to the spinal cord. QST also allows us to adequately compare the effects of differing substances on peripheral nerve conduction. Its implementation in daily anaesthetic practice has, however, been tempered by rather complicated methodological protocols and by the fact that the technique is inherently time-consuming.

The increasing use of ultrasound in regional anaesthesia has demanded greater objectivity in testing peripheral nerve blocks. Many studies emphasize the multiple advantages of ultrasound in regional anaesthesia: shorter block onset, better control of anaesthetic solution spread, use of smaller volumes obtaining more selective blocks and minimal effective volumes for specific surgical procedures. But practically speaking, how small a volume of local anaesthetic can be effectively used? Do we have to use adjuvants to compensate for the dose reduction? Lower volumes means lower doses of local anaesthetics, but how should adjuvants be administered? Should the dose also be reduced or should the dose per kilogram bodyweight remain the same? Clearly, higher concentrations of adjuvant agents in lower local anaesthetic volumes carry the potential for neurotoxicity.

Commonly used adjuvant substances

In the past, several adjuvant substances have been added to local anaesthetic solutions either to improve the quality or prolong the duration of neuraxial and peripheral nerve blocks, as well as Bier's blocks. Most compounds have been used 'off-label'. Dose-finding studies as well as toxicology studies assessing their histological effects on peripheral nerves are lacking. Adjuvants that have been successfully used for neuraxial analgesia have also been tried in peripheral nerve blockade regardless of the presence of appropriate receptors at the injection site.

EPINEPHRINE

Epinephrine-containing local anaesthetic solutions have been on the market for some time. At first it was considered that epinephrine was an innocuous additive, providing vasoconstriction thus conserving more local anaesthetic for the core effect. However, it was later discovered that epinephrine itself had anti-nociceptive effects. For several reasons, the use of epinephrine-containing solutions has progressively diminished over the past decade. Firstly, anaesthetists have been concerned about the deleterious effects of epinephrine on the peripheral vasculature resulting in compromised distal limb perfusion. Secondly, companies marketing the newer local anesthetics ropivacaine and levobupivacaine were not interested in producing solutions in combination with epinephrine because these agents had some intrinsic vasoconstrictive properties. Lastly, the preparation of fresh epinephrine-containing local anaesthetic solutions requires significant drug handling and dilution, which enhances the risk of errors and contamination.

In one of our studies (unpublished data), we applied Quantitative Sensory Testing (QST) with heat and cold discrimination, after ultrasound-guided interscalene block for shoulder arthroscopy, to test the duration of analgesia after injection of 15 mL or 5 mL of 3 different anaesthetic solutions around the C5 root: levobupivacaine, levobupivacaine with epinephrine and ropivacaine. The use of ultrasound gave us the opportunity of visualizing optimal spread of the anesthetic solution around the C5 root. Subjective end-points in the study were evaluation by VAS and the timing of first rescue analgesia.

Each anaesthetic solution significantly increased the thermal detection thresholds, with more pronounced effects on painful sensations. There was no significant difference between the solutions on block duration. These increases were clearly dose-dependent. Lower doses resulted in shorter blocks, as measured by a faster QST recovery and shorter time to rescue medication.

Therefore, in answer to Brummett and Williams [5] the addition of epinephrine to the long-acting levobupivacaine has no effect on duration of an interscalene block. Weber et al. came to the same conclusions with ropivacaine.

There are some concerns about the neurotoxicity of epinephrine. The decrease in blood flow in the intrinsic and extrinsic vascular structures of peripheral nerves may result in ischaemic injury [6], especially in patients with an existing neuropathy. In diabetic patients epinephrine seems to have little benefit and the reduction of neural blood flow due to vasoconstriction could be deleterious in an already compromised nerve, even if we take into account the number of diabetic patients who in the past decades had surgery under a PNB with epinephrine as an adjuvant, without evident exacerbation of their neuropathy. [7]

Why still use epinephrine? Epinephrine prolongs the duration of short-acting and intermediate-acting local anaesthetics and can help in detecting an intravascular injection (cave: beta-blockade) This is particularly helpful when needle tip and spread cannot be seen with US. [5]

CLONIDINE

Adding clonidine, an α -2 adrenoreceptor agonist, to local anaesthetics enhances the duration of a block. [8,9] In the various studies performed with clonidine, no quantitative testing has been performed and therefore it is difficult to assess the exact benefit of its combination with local anaesthetics. The addition of 100 to 150 μ g of clonidine is likely to enhance the duration of the block by approximately 100 minutes when used in combination with long-acting local anaesthetics. [9] The possible mechanisms are local vasoconstriction, blocking A- δ and C-fibers by increasing K⁺ conductance and intensifying local anaesthetic conduction block. [10]

Peri-neurally, clonidine seems to have an anti-inflammatory and anti-leukocyte effect. This may make it of interest in attenuating peripheral neuropathy. It has also been shown to prevent chronic pain in an animal model.[7]

Side effects such as sedation, bradycardia and hypotension, seems to appear only when higher doses are used. [9]

DEXMEDETOMIDINE

Only a few studies are available using the possible benefits of dexmedetomidine, a more selective α -2 adrenoreceptor agonist, on the duration of a PNB. It prolongs the duration of a block in a dose- and concentration-dependent way via peripherally mediated action and seems to be more potent than clonidine. [5,11] ,5]. The possible mechanisms of action are central analgesia, vasoconstriction and an anti-inflammatory effect, but there are probably other mechanisms explaining a synergistic effect with LA. At a dose of 1 μ g/kg in combination with bupivacaine, the time to first request of rescue analgesics is increased and pain scores are lowered following great palatine nerve block for cleft palate surgery in children.[12] Side-effects such as bradycardia and hypotension have been observed, as well as a possible cardioprotective effect. Further studies are necessary to determine safety and optimal dosing [5].

BUPRENORPHINE

It is widely accepted that opioids have no clinical effects on PNB [13], unlike the positive, non-toxic clinical effects when administered neuraxially. Buprenorphine is an opioid receptor μ -agonist and a κ -antagonist with therapeutic properties in chronic pain. Buprenorphine has an analgesic and an anti-hyperalgesic effect [14], without in vitro neurotoxicity. Its effect seems more pronounced on intermediate-acting local anaesthetics than on long-acting ones, but side-effects, especially nausea and vomiting, are very disturbing. [15]

DEXAMETHASONE

In chronic pain the use of corticosteroids is a common practice. The preservative-free dexamethasone, seems to be safer than methylprednisolone, where the preservatives polyethylene glycol and benzyl alcohol have been shown to be neurotoxic. Williams et al. reported that dexamethasone attenuates C-fiber responses. [7] As a corticosteroid, it is not in itself neurotoxic, but in combination with ropivacaine, it increases local anaesthetic-induced neurotoxicity in vitro. [8] Recent studies have reported varying results regarding the effects of dexamethasone on duration of peripheral nerve blocks. Castillo found no prolongation with aqueous bupivacaine in rat sciatic nerve blocks, except when used as on bupivacaine microspheres. [16] On the contrary Viera et al. compared a mixture of additives, bupivacaine, epinephrine and clonidine, with and without 8mg of dexamethasone. He and found a significant prolongation in the dexamethasone group.[17] One has to be cautious with corticosteroids in diabetic patients due to their hyperglycemic effect. Williams et al. suggest, even if its anti-inflammatory properties are desirable, more profound toxicological studies need to be done before dexamethasone can be used in daily practice.

SODIUM BICARBONATE

Whereas alkalization of local anaesthetic solutions can shorten the onset time of epidural analgesia, no such effect has been demonstrated for PNB. It seems to have no effect on block duration. [5]

TRAMADOL

Combining tramadol with long-acting local anaesthetic seems to have no value in increasing block duration when compared with systemic injection of tramadol. [18]

MIDAZOLAM

This benzodiazepine has been used intra-theically with an effect on GABA-receptors, but its potential benefit peri-neurally is unknown. In rabbits, lesions were observed when injected spinally. [7]

In in vitro testing, Williams et al identified the combination of midazolam and ropivacaine as being extremely toxic, as was the combination of midazolam or ketamine with lidocaine.[19]

Less neurotoxic was the combination of ropivacaine with high doses of either clonidine or dexamethasone. In vivo testing is also necessary, however [20]. In a recent study on isolated rat sciatic nerves, Yilmaz et al. tested clonidine, midazolam, buprenorphine and dexamethasone separately, in combination and each in combination with local anaesthetic. Separately, only midazolam, and clonidine to a lesser extent, attenuated compound action potential propagation. Combination with lidocaine had no prolonged effect in the isolated nerve. Their conclusion was that additives do not work directly on nerves, but rather via indirect mechanisms in the intact organism [21].

OTHERS

In Bier's block, nitroglycerin, neostigmine, potassium, ketamine, magnesium and muscle relaxants have all been added to the injected local anaesthetic mixture. The number of reports is limited however, and makes it difficult to draw conclusions. Prolongation or improvement in block quality is, despite statistical significance, mostly clinically irrelevant.

Conclusion: There is a need for an objective and quantitative testing method for assessing regional anaesthetic blocks. QST could be valuable for this purpose. Moreover, QST can detect lesions due to toxicity.

Until now, many additives have been injected peri-neurally sometimes in the absence of evidence for peripheral receptors at the injection site. There has been much speculation about the mechanisms of action of these additives.

Neurotoxicity and subsequent neurological damage is a serious complication of RA. Local anaesthetics themselves are capable of causing transient neurotoxicity. Can this neurotoxicity be enhanced by the addition of adjuvants? With few exceptions, extensive histological research on toxicity is lacking. What effect may be observed when local anaesthetic, with or without adjuvants, is used in patients with a pre-existing neuropathy? Recent studies on isolated neurones have shown ropivacaine, with and without adjuvants, to possess toxic effects. These observations emphasize the need for further investigations in this field using a reproducible testing method.[22]

Inadvertent intravascular injection of local anaesthetic is a major concern of all anaesthetists. Lipid emulsion seems to be the therapy in case of cardiac toxicity. [23] US has been shown to have a useful role in avoiding intravascular injection. Furthermore, as far as improving patient safety is concerned, ultrasound is a helpful tool in decreasing the dose of local anaesthetic needed and thus reduces the risk of toxicity. What about adjuvants used to prolong the block? Can these doses be reduced also? Are they safe when accidentally injected intravascularly or perhaps more importantly, intra-neurally?

Side effects, such as hypotension, bradycardia, nausea and vomiting are important for patient safety and satisfaction.

Combining drugs increases the risk of human errors.

Many adjuvants injected peri-neurally have not been tested for his purpose, have even not been approved for PNB and are in fact used 'off-label.' This demands extreme caution. [7]

Clonidine, up to 100 µg, seems to be the most effective additive in prolonging the duration of activity and seems to be a safe additive to use in combination with LA. As most studies have been performed with high volumes, the effect of concentration and reduced dose in smaller volumes of local anaesthetic remains to be studied.

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LOCAL ANESTHETICS AND CANCER RECURRENCE

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Recently published retrospective analysis of patients undergoing cancer surgery showed a possible benefit of perioperative continuous epidural infusions of local anesthetics. Long-term survival after colon cancer surgery¹ or cancer recurrence after radical prostatectomy for prostate cancer² were both significantly improved by epidural anesthesia, although there are other studies which reported no benefit³. The potential mechanisms by which local anesthetics might prove to be beneficial in this context are not yet known, but a common pathway with inflammation may be one of them.

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ALTERNATIVE EFFECTS AND SIGNALLING PATHWAYS OF LOCAL ANAESTHETICS

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Blockade of voltage-gated sodium channels, leading to inhibition of nerve impulse conduction, is probably the most important effect of local anaesthetics (LA) and is the major mechanism underlying their well-known antinociceptive and antiarrhythmic effects. However, LA affect other cellular systems as well. These interactions may contribute to antinociception and antiarrhythmic actions, but could also explain some other LA effects and side effects. Interestingly, several of these alternative target sites, for example muscarinic receptors are known to be much more sensitive to LA than are voltage-gated sodium channels. In this presentation I will highlight some actions of LA that are less well known to most anesthesiologists. Most important, I would like to focus on LA effects on coagulation and inflammation.

Local anaesthetics and coagulation

In 1977 Cooke et al.¹ reported that intravenous lidocaine (bolus and continuous infusion for 6 postoperative days leading to plasma levels between 1-5 mg/ml) prevents deep venous thrombosis (DVT) after elective hip surgery. Eleven of 14 patients (78%) in the untreated control group suffered from DVT within 6 days postoperatively, compared with 14% in the lidocaine-treated group. Significantly, between postoperative day 7 and 14 (after stopping the lidocaine infusion) 9 of 22 patients (41%), who were free of thrombosis during the therapy, developed DVT. Blood loss and transfusion requirements were similar in both groups, indicating that lidocaine is able to reduce the risk of thrombosis without increasing bleeding. Unfortunately no follow up was performed to assess differences in clinical outcome.

The mechanisms responsible for the observed antithrombotic effect by LA have been studied, but details remain unclear. Most in vitro studies have found that LA are able to inhibit platelet aggregation but only at concentrations 10 to 100-fold greater than those commonly obtained in plasma after intravenous or epidural administration. Bupivacaine, in clinically relevant concentrations (2.7 mg/ml) showed no or only slight effects on TEG variables. These findings are in agreement with the observation by Cooke et al.¹ that lidocaine had no effect on the level of coagulant factors, on platelets, on the quantity of circulating antithrombin III, or on fibrinolysis. The authors explained the clinically observed LA effect by inhibition of white cell activity (endothelial adhesion and transendothelial migration), preventing endothelial damage and thereby decreasing the incidence of thrombosis. Several caveats must be considered before rejecting platelet effects as the primary explanation of LA antithrombotic activity. First, to our knowledge all in vitro experiments were performed using incubation times of 2 to 60 min, compared with an LA exposure time of hours or days in the clinical setting (epidural anesthesia). Time-dependent inhibition by LA has been shown not only for coagulation-associated pathways like thromboxane A₂ signaling but also for platelet rich plasma.² Exposure to low concentrations of bupivacaine (1-10 mM) for 2 h resulted in significant changes in TEG parameters. Second, blood samples for in vitro experiments were drawn from healthy human donors. It is conceivable that the antithrombotic effect of LA is based on their ability to reverse the hypercoagulable postoperative state, which is most likely responsible for the increased incidence in thrombosis. Thus, one would not necessarily expect a significant effect on blood from donors with a normal coagulation status. This hypothesis is supported by the observation that LA do not increase bleeding. Finally, it might be possible that the LA effect is achieved by several actions on diverse

sites. If so, studying a single potential target, as usually done in in vitro studies, is unlikely to show significant effects. Whether the antithrombotic effect of LA is attributable to their anti-inflammatory action, as suggested by Cooke et al.¹ or whether it is an interaction of various effects, remains to be determined. In addition, the question of how long these compounds have to be administered to obtain maximal benefit needs to be addressed. However, LA are likely to be of benefit for patients at risk of thrombotic complications. Lack of effect on clinical bleeding makes them unique in this regard, and LA infusion should be considered in the perioperative setting for patients at risk for thrombosis who are not candidates for regional anesthesia. For example, for patients who decline epidural anesthesia for major orthopedic, abdominal or urologic surgery, or in whom placement of an epidural catheter is unsuccessful, we routinely consider IV lidocaine (1.5 mg/kg bolus, followed by 2 mg/min) administered during the procedure and for 1 h in the PACU. This technique will not only provide a degree of thromboprophylaxis, but in addition stabilize hemodynamics and reduce postoperative analgesic requirements. At these dosages, side effects are very rare.

Local anaesthetics and inflammation

One of the most interesting and best studied alternative effects of LA is their anti-inflammatory action, probably responsible, at least in part, for several important effects of these compounds (e.g., antinociception, as well as antithrombotic and neuroprotective actions). Although the inflammatory response is essential for structural and functional repair of injured tissue, over-stimulation of the pro-inflammatory cascade by products derived from inflammatory cells can aggravate tissue damage, as occur in several disease states. LA have been shown to interfere with almost all steps of the inflammatory cascade.³

- 1) At the site of infection, substances produced by bacteria, complement activation or cytokines are sensed by PMNs. This process is defined as chemoattraction. Blocking the release of these inflammatory mediators causes an anti-inflammatory effect, since recruitment of PMNs to the site of inflammation is inhibited. In vitro, various LA were shown to block release of these mediators concentration-dependently.
- 2) Histamine, complement factors such as C5a or C3a, IL-1, IL-8, TNF and platelet activating factor (PAF) are responsible for PMN rolling onto and attaching to endothelial cells, a process termed margination and adhesion. Excessive adhesion of PMNs to endothelium mediated by several adhesion molecules may induce endothelial injury. One of the most important adhesion molecules for firm adhesion of PMNs to endothelium is CD11/CD18. LA also decrease the ability of PMNs to adhere to surfaces. As a result a significant reduction of PMN accumulation at the site of inflammation can be expected. Indeed, ropivacaine or lidocaine treatment significantly reduces the upregulation of CD11/CD18. Consequently, lidocaine has been shown to reduce granulocyte adherence in vitro and in vivo.
- 3) PMNs migrate up the chemoattractant gradient to the site of injury (chemotaxis). Migration and accumulation of PMNs are key events during the inflammatory response. Using both in vitro and in vivo models, LA inhibitory effects on PMN migration and accumulation have been reported. Decrease in PMN accumulation at the site of injury by LA is most likely due to their inhibition of PMN migration and by interference with the critical steps of adhesion.
- 4) Pathogens are coated (opsonized) with specific serum proteins and PMNs are primed. Priming refers to a process whereby the response of PMNs to a subsequent activating stimulus is potentiated. Release of oxygen metabolites is markedly enhanced when activated PMNs have been primed previously. Importantly, the priming process has been shown to be a critical component of PMN-mediated tissue injury both in vitro and in vivo. LA has been shown to block the priming of PMNs by lysophosphatidic acid (LPA) and PAF with half-maximal inhibition concentrations (IC₅₀) of approximately 1 mM. NADPH-oxidase activity, Ca²⁺ and PKC, all likely to be involved in the priming process, have also been described to be inhibited by several LA. It is conceivable that inhibition of priming contributes to the anti-inflammatory action of LA, and in particular suppresses the deleterious effects of the uncontrolled, overactive response of inflammatory cells to a stimulating agent. This may also explain, as pointed out later in this section, why LA are able to decrease tissue damage without impairment of host defense.
- 5) Using NADPH-oxidase or myeloperoxidase enzyme complexes, PMNs produce reactive oxygen species such as O₂⁻, H₂O₂, OH, and HOCl. In vitro, lidocaine and bupivacaine have been shown to inhibit free radical generation concentration-dependently.

Local anesthetic effects on lung injury

Inflammatory cells and mediators such as cytokines, macrophages and PMNs play important roles in the pathogenesis of inflammatory lung injury. Beneficial effects of LA have been reported for three different types of inflammatory lung injury, namely hydrochloric acid (HCl)-, endotoxin- and hyperoxia-induced lung injury. In rabbits, pre- or early post-treatment with lidocaine (plasma concentrations of 1.2 - 2.5 mg/ml) attenuates the late phase of acid installation-induced lung injury. Not only PMN accumulation, free radical production, pulmonary edema and cytokine levels in bronchoalveolar fluid were reduced, but also lung function was improved, indicated by an increase in P_{aO_2} and attenuation of both decreased compliance and increased resistance. Summarized, most likely due to their anti-inflammatory action, LA have been shown to be beneficial for treatment of several types of inflammatory lung injury in various animal models. One of the main causes of morbidity and prolonged convalescence after major surgery was found to be postoperative ileus. LA also shortened the duration of postoperative ileus in patients undergoing major abdominal surgery. In this era of evidence based medicine, where measurable improvements in patient outcome becomes ever more the yardstick by which therapeutic interventions are measured, the study by Groudine et al.⁴ is of great importance. These authors demonstrated that in patients undergoing radical retropubic prostatectomy, systemic lidocaine administration during and shortly after the procedure (plasma concentration between 1.3-3.7 mg/ml) induces an earlier return of bowel function, reduces postoperative pain and, most impressively, decreases hospital stay. The return to normal bowel function in this regard might be explained in part by a direct excitatory effect on intestinal smooth muscle as a result of a blockade of inhibitory reflexes from the myenteric plexus. However, the effect on bowel function persists for 36 hours after the infusion was discontinued. Since anti-inflammatory effects of amide LA are prolonged and remain measurable even after serum levels have decreased this might be a more likely underlying mechanism for the observed effect, consistent with the observation that non-steroidal anti-inflammatory drugs are similar effective. These beneficial effects of LA on earlier return of bowel function, less postoperative pain and shorter length of hospital stay were confirmed by other authors^{5,6} as well and supported by a recent meta-analysis.⁷

Local anesthetics and increased risk of infection

Since LA impair PMN presence and function, concerns arose that LA might increase the susceptibility to infections. Although in theory an increased risk of infection might be expected, several investigations suggest that the remaining PMN function is sufficient to minimize the risk. Nonetheless, LA should be employed with caution in settings of gross bacterial contamination. However, their use in sterile inflammation appears to be beneficial. Antibacterial actions by LA reported *in vitro* and *in vivo* are obtained only at millimolar concentrations. Mechanisms underlying these antibacterial effects are not cleared in detail yet. Recent studies suggest bactericidal rather than bacteriostatic activity. Regarding bactericidal potency, starting with the most potent one, LA were ranked as follows: dibucaine - tetracaine - bupivacaine - prilocaine - lidocaine - procaine, whereby inhibitory properties are four times less for bupivacaine in comparison to dibucaine. Thus it might be conceivable for epidurally administered LA to contribute to the prevention of epidural infections by their antibacterial properties. LA furthermore exert antiviral activity when applied in high concentrations. Summarized the anti-inflammatory properties of LA in systemic concentrations might theoretically increase the risk of infections, as antibacterial and antiviral effects are only attained with the use of high LA concentrations. Yet, it seems to be of minor importance in studies accomplished, except for severe bacterial contamination. LA are known for inhibition of excessive inflammatory responses without significant impairment of the host's immune system. One of the hallmarks of the above mentioned findings described is the ability of LA to modulate excessive inflammatory responses without impairing the host defenses significantly. For the interested reader this topic has also been addressed in detail in a review article.³

Local anesthetics and airway reactivity

Another "alternative action" of LA is their effect on the airway system. LA are thought to be potent inhibitors of bronchial hyperresponsiveness. Bronchial hyperreactivity is increased during high fever, after smoking, after viral infections of the upper airway, and in the presence of left heart failure or COPD. Patients suffering from any of these conditions are at risk for developing bronchospasm after any form of airway irritation. Intravenous administration of LA to patients with bronchial hyperreactivity is recommended in standard textbooks and review articles to mitigate bronchoconstriction during tracheal intubation. Groeben et al. showed that both intravenous and inhalational administration of lidocaine significantly attenuated bronchial hyperreactivity; both were equally effective, but inhaled lidocaine produced lower

plasma concentrations (0.7 vs. 2.2 mg/ml). However, inhaled lidocaine had the disadvantage of causing transient bronchoconstriction, probably by stimulating irritant receptors within the airways during inhalation. The advantages of inhaled lidocaine, compared with intravenous lidocaine, are lower plasma concentrations and probably a longer-lasting effect because of prolonged absorption from the airway into the bloodstream. Although lidocaine inhalation initially induced bronchoconstriction in asthmatic patients, it subsequently attenuated responses to challenges with metacholine, hyperosmolar saline, distilled water, or exercise. Intravenous lidocaine (as well as oral mexiletine), in concentrations less than those necessary for cardiac protection against dysrhythmias, was shown not only to prevent histamine-induced bronchoconstriction in Basenji greyhounds (the standard animal model for asthma) and to block reflex airway hyperresponsiveness in asthmatic subjects, but also to avoid the risk of initial bronchoconstriction induced by the administration of aerosolized lidocaine. In a prospective placebo-controlled study, clinically relevant plasma concentrations of lidocaine and bupivacaine dose-dependently attenuated the hyperreactive response to a inhalational challenge with acetylcholine in human volunteers. Since beneficial effects of LA in patients with heightened reflex sensitivity resulting from asthma, respiratory tract infection, or cigarette-smoking, have been clearly demonstrated, the use of LA to prevent bronchial hyperreactivity in these patients is therefore justified. Groeben et al. recommend inhalation with 2 mg/kg lidocaine 4% for patients suffering from mild asthma. A regimen clearly showing local analgesia and attenuation of bronchial hyperreactivity and yet less airway irritation in comparison to different LA dosages. In a study with 20 glucocorticoid-dependent asthmatic patients, Hunt et al. reported that nebulized lidocaine also benefits patients with severe asthma, and possesses significant glucocorticoid sparing activity: 13 patients were able to discontinue oral prednisone treatment. In patients suffering from severe, steroid-dependent asthma, Tanaka et al. could demonstrate immunomodulatory effects on T-cells and classified lidocaine as an antiinflammatory substance. Remarkably, although the benefit of LA for preventing bronchoconstriction is well established, the mechanisms underlying these effects are not fully understood and sites of action are still debated. Thus, a generally accepted explanation is not available. Here, I will discuss the most likely LA targets in this setting. A first possibility is attenuation of bronchial smooth muscle tone. Recently, lidocaine was shown to inhibit muscarinic m1 and m3 receptors, expressed in *Xenopus* oocytes, in concentrations 100 to 1000-fold less than those required for blocking neuronal sodium channels.⁸ Both of these receptor types are involved in the efferent neural pathways that regulate airway caliber. M1 muscarinic receptors are found in ganglia within the airway wall and M3 muscarinic receptors are postjunctional in the airway smooth muscle. In contrast, direct depression of smooth muscle contraction by LA (due to a decrease in intracellular calcium concentrations or inhibition of increased calcium sensitivity of the contractile apparatus by affecting the activity of myosin-light-chain kinase (MLCK)) were shown only for LA concentrations greater than those obtained in plasma after intravenous or epidural administration. Interestingly, inhibition of MLCK might offer a possible explanation for LA effects on platelet function. Lind and Stossel reported that platelets contain muscle-like contractile proteins such as actin, myosin, tropomyosin, calmodulin and a MLCK. The myosin light chains in intact platelets are almost completely dephosphorylated when the cells are in a resting state, whereas stimulation with thrombin results in maximal phosphorylation of the myosin light chains. MLCK is responsible for this phosphorylation, and it is therefore conceivable that attenuation by LA of MLCK activity might lead to the clinically observed alteration of platelet function. A second potential explanation for LA effects on bronchoconstriction might be their modulatory actions on the inflammatory response. Although it was shown by Kai and Downes that concentrations necessary to achieve this effect were more than 100 times greater than used clinically, more recent reports have demonstrated potent anti-inflammatory effects by LA in clinically relevant concentrations, as described previously. Lidocaine is thought to act as an inhibitor of eosinophil-active cytokines. Eosinophils play an important role in the pathogenesis of allergic respiratory diseases, especially bronchial asthma. A number of cytokines, such as IL-3, IL-5 and granulocyte-macrophage colony stimulating factor (GM-CSF) augment eosinophil function and enhance their survival. Lidocaine inhibits eosinophil survival and is therefore thought to be an inhibitor of eosinophil-active cytokines. Third, depression of the central nervous system also suppresses airway responses. However, none of the studies in asthmatic subjects demonstrated CNS depression during administration of LA. Finally, LA might attenuate nerve conduction and reflex arcs involved in the mediation of bronchial hyperreactivity. Intravenous administration of LA has been shown to suppress or even completely block mechanically- and chemically-induced airway reflexes. Most of these reflexes (such as the expiratory

reflex, apnea, spasmodic panting, and cough reflexes) are mediated by the vagus nerve. Different sensitivity of these reflexes to inhibition by lidocaine together with the observation that these reflexes can be induced separately suggests that separate afferent neuronal pathways may be involved. Yet it should be mentioned that LA induced attenuation of reflex bronchoconstriction is not due to airway anaesthesia. Dyclonine, a topical, ketone-structure based LA exerting longer lasting and more intense local anaesthesia than lidocaine, in fact does not have any effects on histamine induced bronchoconstriction and even aggravates airway irritation, suggesting a different mechanism than the anaesthetic effect to be responsible for attenuation of bronchial hyperactivity by LA.⁹ In summary, at this time the most favored hypothesis of the mechanisms underlying the beneficial effect of LA on the airways is two-fold. After intravenous administration, inhibition of smooth muscle contraction by LA appears to occur predominantly by blocking neurally mediated reflex bronchoconstriction via the vagus nerve. After topical (inhalation) application, LA protect against bronchoconstriction by the same mechanism (after absorption of LA into the bloodstream). In addition, since concentrations of LA obtained locally are high, a direct effect on smooth muscle contraction must be considered. This combined effect might also explain why inhaled lidocaine exerted similar attenuation as did intravenous lidocaine, despite lower plasma concentrations.

Neuroprotective effects

During cerebral ischemia, decreased energy supplies result in inadequate active transport of ions, thereby depolarizing neuronal membranes. Several excitatory neurotransmitters are released in excessive amounts. The resulting Ca^{2+} influx into postsynaptic neurons activates detrimental enzymatic processes leading to irreversible neuronal damage. The excess release of, for example, glutamate during ischemia has been shown to be in part due to Ca^{2+} -independent reversal of the Na^{+} -co-transport system, an electrogenic Na^{+} -glutamate symporter, that leads to unidirectional flux of cytoplasmic glutamate. Blockade of Na^{+} -channels by tetrodotoxin (TTX) or by local anesthetics (lidocaine and procaine have been studied) reduces the Ca^{2+} -independent excitatory amino acid release, and it has been suggested that Na^{+} channel blockade may at least take part in the inhibition of the release of excitatory amino acid, thereby reducing glutamate toxicity. Terada et al. reported recently that intravenous or subarachnoid administration of lidocaine attenuates accumulation of glutamate in the hippocampal CA1 area and in the cerebral cortex during transient forebrain ischemia in rats. Although the well-known Na^{+} channel blocking properties of LA may reduce ischemia-induced neuronal damage, additional mechanisms may play a role in their cerebroprotective effects. Procaine has been shown to prevent increases in intracellular Ca^{2+} concentration, most likely by inhibiting ryanodine receptor-mediated Ca^{2+} release from the endoplasmic reticulum. The reduction of the intracellular Ca^{2+} concentration during the early stages of ischemia seems to play an important role in preventing the cascade eventually leading to neuronal damage; this might explain, at least in part, the neuroprotective effects of LA observed *in vivo* and *in vitro*. Other mechanisms may play a role as well. Wang et al. demonstrated substantial ischemic neuropathologic injury in dog brain after two hours of retrograde cerebral perfusion (RCP) and one hour of cardiopulmonary bypass (CPB). Lidocaine (plasma levels in the range of 5-12 mg/ml) infused before, during and after RCP significantly reduced the number of ischemic cells in cortex, hippocampus and thalamus. In addition, plasma glucose concentrations were decreased, possibly due to increased depth of anaesthesia and resultant decreased sympathetic activity. Low blood glucose concentrations are known to contribute to recovery from cerebral ischemia, and might explain some of the protective effects obtained with lidocaine. Lidocaine can reduce cerebral metabolism, an effect additive to that of hypothermia. The recovery of neurologic function in dogs after 90 min of hypothermic circulatory arrest and 7 days of survival was improved significantly by intravenous lidocaine (4 mg/kg before arrest and 2 mg/kg at the beginning of reperfusion). Moreover, pretreatment with lidocaine reduced cortical hypoperfusion and posttraumatic motor deficits following experimental fluid percussion injury in rats. In rats, reduced motor deficits were reported when lidocaine (2 mg/kg) was applied 30 min after experimental traumatic brain injury. Since pegorgotein, a superoxide anion scavenger, exerted the same beneficial effect, protection by lidocaine might be attributed at least in part to its anti-inflammatory action. Very interesting studies regarding neuroprotective effects of LA were published by Cottrell and Kass in the past years. The authors were able to show that lidocaine in low concentrations (10 μM , less than required for blockade of neuronal transmission) significantly reduced anoxic brain damage in hippocampal slices of rats. These *in vitro* results could be verified in several *in vivo*-studies. Rats, experiencing transient focal cerebral ischemia and reperfusion, presented two and seven days

after reperfusion with a reduced infarction size, an improved neurological outcome and less weight loss in comparison to rats only treated with placebo, when being infused with lidocaine (1.5 mg/kg as bolus, followed by 2 mg/kg for 90 minutes) 30 minutes prior to the ischemic event. Lidocaine-pretreatment of an ischemic incidence is only of limited use in the clinical practice as a matter of course. Therefore the authors studied to what extent a delayed administration of lidocaine (1.5 mg/kg as bolus, followed by 2 mg/kg for 165 minutes; 45 minutes after the ischemic event) is able to attenuate ischemic brain damage. Even though there was no significant reduction of infarction size in lidocaine treated rats after 24 hours and 7 days, respectively, the greater amount of intact neurons and less weight loss as well as the significant improvement of neurological outcome in the lidocaine-group was remarkable. To emphasize the importance of these LA induced neuroprotective effects in the clinical setting, two studies should be mentioned. Especially one published by Mitchell et al.¹⁰ that demonstrated significant neuroprotection by LA in patients undergoing cardiac surgery. 55 patients, waiting for correction of the left heart valve, a major surgical procedure associated with a high incidence of perioperative brain damage, received, randomized and double-blinded, either lidocaine - or placebo-infusion perioperatively. Neuropsychological tests 10 days, 10 weeks and 6 months after surgery revealed a significant improvement of cognitive function in patients of the lidocaine-group. A second study recently published could show similar protective LA effects in 118 randomized cardiac surgery patients. Lidocaine, given as a bolus of 1.5 mg/kg followed by an infusion of 4 mg/kg, significantly reduced the occurrence of cognitive dysfunction to 18.6 % vs. 40 % under placebo-treatment.

Other therapeutic effects

Local anesthetic effects on tinnitus

Lidocaine is also used for treatment of intractable tinnitus. In a prospective study in 50 patients with intractable tinnitus, intravenous treatment with lidocaine showed favorable results in 76%, especially in patients with bilateral tinnitus. Most relief is obtained when plasma levels are in the range of 1.5-2.5 mg/ml. The beneficial effect of LA-induced relief of tinnitus is explained by stabilization of the hair cell membrane and cochlear nerve fibers. Interestingly, intravenous procaine, which is more effective in the control of chronic pain than intravenous lidocaine, is less effective for tinnitus relief, suggesting that lidocaine exerts specific effects at one or more places in the ear and/or CNS to control tinnitus. Unfortunately, the beneficial effect of intravenous lidocaine is often only temporary, lasting from minutes to days. Therefore, a single-blinded clinical study using the oral amide of lidocaine, tocainide hydrochloride, was conducted. A dose of 600 mg of this drug was administered to 12 patients, four times a day. Of the 12 patients, 10 showed 80-98% relief from tinnitus. However, a double-blind dose ranging study involving 56 patients had to be discontinued because of nausea in 32% of patients receiving 600 mg four times a day. Nevertheless, follow up on several patients in these studies who experienced the advantages of tocainide hydrochloride, showed a 60-80% sustained reduction of the tinnitus.

Several other interesting alternative effects, which in part may be related to anti-inflammatory action of LA, should be mentioned but will not be discussed in detail. In a prospective randomized clinical study on 65 laboring parturients the addition of subarachnoid applied bupivacaine (2.5 mg) to fentanyl (25mg, subarachnoid applied) reduced the incidence of pruritus compared with those who received just fentanyl (except in the facial region) from 95% to 36.4%. In addition, this combination resulted in a rapid onset and prolonged duration of analgesia compared with either drug alone. The underlying mechanism may be either a prevention of alteration in neuronal activity at the brainstem level, by inhibition of neuronal transmission in the ventrolateral tracts of the spinal cord, or direct modulation of opioid receptors. Bupivacaine may inhibit m-receptor activation and increase the binding of opioids to k-receptors. Since stimulation of k-receptors has been shown to decrease the incidence of pruritus induced by m-agonists, this might at least in part explain decreased truncal pruritus. Intravenous lidocaine has been shown to be as effective as thiopental for rapid reduction of intraoperative intracranial hypertension, but with less cardiovascular depression. Thus, lidocaine may be of particular benefit to patients with both intracranial hypertension and marginal circulatory function. Lidocaine has been shown to be beneficial for patients with certain cluster or migraine headaches. In a prospective, randomized, double blind, placebo-controlled trial in 81 patients Maizels et al. demonstrated that 4% lidocaine intranasally caused in 55% of the patients at least a 50% reduction of headache within 15 min. and a significant improvement of nausea and photophobia. Unfortunately, 42% of the successfully treated patients showed relapse of headache within one hour after treatment. Whether intranasal lidocaine is a reasonable

proposition for acute treatment of migraine and if the results suggest that the sphenopalatine ganglion might be involved in migraine headache has to be determined in further studies.

Conclusion: I have summarized several interesting and potentially important “alternative” effects of LA, not explained by their well-known antinociceptive and antiarrhythmic actions. The most remarkable observation is that LA are able to prevent pathological changes such as hypercoagulability or excessive stimulation of the inflammatory system, without inducing increased bleeding or impairment of host defense. This sets them apart from drugs currently in use for treatment of such disorders, and points the way to potential therapeutic application. Indeed, we use intravenous LA infusions in patients who would benefit from epidural anesthesia/analgesia but are not candidates for the technique. I hope that this lecture will urge some listeners to investigate these effects in more detail, because much more research is needed on basic mechanisms. What does seem clear is that Na⁺ channel blockade plays only a limited, if any, role in these effects. Further research should determine which molecular determinants of the LA structure exert these effects and where the corresponding site of action is. This might eventually lead to development of new drugs, selective for treatment of these disorders, but without the “side effect” of Na⁺ channel blockade. In addition, LA ability to reduce bronchial reactivity is well recognized, even if the underlying mechanism is poorly understood. They also provide a considerable amount of neuroprotection. In combination with the hemodynamic stability provided, they are therefore of great usefulness in the practice of neuroanaesthesia. Finally, these versatile compounds have been employed with success in a variety of other clinical settings, including tinnitus, pruritus and migraine.

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LUMBOSACRAL RADICULAR PAIN DUE TO DISC HERNIATION

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Lumbosacral radicular (LSR) pain is characterized by low back pain irradiating into the leg. In patients under the age of 50 the most important cause of LSR pain is a disc herniation.¹ Disc herniation is commonly classified as contained or extruded herniation. Contained herniation can be defined as a herniation with a broad base, which is still limited within the posterior longitudinal ligament. Extruded herniation is a herniation that breaks through this ligament.² Radicular pain is thought to be caused by pressure exerted by the herniation on the dorsal root ganglion. The nucleus pulposus material that spills onto the dorsal root ganglion was demonstrated to induce an inflammatory reaction.³ The dermatomal distribution of pain provides an indication for the causative level.¹ Lumbosacral radicular pain has in 60% to 80% of the patients a favorable evolution. The pain spontaneously improves considerably or even disappears completely within 6 to 12 weeks.²

Diagnosis

Lumbosacral radicular pain is pain that may be experienced as sharp, piercing, throbbing or burning. Pain caused by a herniated disc classically increases by bending forward, sitting, coughing, or (excessive) stress on the lumbar discs and can be avoided by lying down or sometimes by walking.⁴

The most frequently used clinical test for LSR is the Lasègue or the straight leg raising test. The patient lies in supine position on the examination table and the examiner raises the leg. If radicular pain can be elicited under 60°, there is a large chance that a lumbar herniated disc is present. Though this test has a high sensitivity the specificity is low.

Magnetic resonance imaging is the preferred medical imaging method because of the better visualization of the soft tissue and the lower radiation dose compared to computed tomography.⁵ The specificity of CT-scan and MRI is very low, because disc herniation was found in 20% to 36% of asymptomatic patients. A resolution of the symptoms has been reported without concordant reduction of the hernia size.⁶⁻⁸

Confirmation of the level can be obtained by means of a selective segmental nerve block.² The involvement of the disc should, however, be confirmed by provocative discography, preferentially with manometric control.^{3,9} After placement of a hollow needle into the middle of the nucleus pulposus it is connected to a contrast delivery system which can measure the intradiscal pressure. The patient should experience concordant pain. The IASP and ISIS guidelines for defining discogenic pain are based on the outcome of manometric controlled provocative discography. When the concordant pain is produced at less than 15 psi above the opening pressure and stimulation of two adjacent levels is not painful, it is classified as “absolute discogenic pain”. When the concordant pain is produced at less than 15 psi above the opening pressure and stimulation of one adjacent level is not painful, it is classified as “highly probable discogenic pain”. When the concordant pain is produced at less than 50 psi above the opening pressure and stimulation of two adjacent levels is not painful, it is classified as “discogenic pain”. “Possible discogenic pain” is defined as elicitation of concordant pain at a pressure of less than 50 psi above the opening level and stimulation of one adjacent level is not painful but stimulation of another disc is painful at more than 50 psi above the opening pressure and the pain is discordant.

A prospective, match-cohort study showed that persons who underwent a discography showed significantly greater loss of disc height in the discography group compared to the control group at 10 years follow-up. Moreover, progression of disc degeneration was noted in 54% of the discography group compared to 14 % in the control group. More new disc herniations were observed in the discography group. They were disproportionally found on the side of the annular puncture.¹⁰ Therefore the authors recommend careful consideration of risk and benefit when using procedures that involve disc puncture for diagnostic and even for therapeutic reasons.

Treatment

Pharmacological

The natural evolution of the disease justifies a conservative approach. In the acute phase the use of Non-Steroidal Anti-Inflammatory Drugs or Cox-2 inhibitors may be considered because of their superior effect compared with placebo.^{11, 12}

In case of chronic radicular pain due to disc herniation, treatment should first try the pharmacological approach. Because of the neuropathic character of lumbosacral radicular pain the treatment guidelines for the pharmacological management of neuropathic pain can be followed.¹³ There is, however, little evidence specifically for the pharmacological treatment of lumbosacral radicular pain.

Epidural corticosteroid administration

The inflammatory compound of the lumbosacral radicular pain, potentially due to leakage of nucleus pulposus material onto the dorsal root ganglion can

be managed by epidural administration of corticosteroids, thus bringing these anti-inflammatory compound as close as possible to the inflamed nerve root.

Lumbar epidural drug administration can be performed by the interlaminar, the transforaminal or the caudal route. The evidence for interlaminar corticosteroid administration was assessed in several systematic reviews. The number needed to treat (NNT) for 50% pain reduction in the short term (1 day-3 months) was calculated to be 3, for the long-term (3 months to 1 year) however the NNT was 13.¹⁴ Two other systematic reviews also concludes that the effect of interlaminar epidural corticosteroid administration was of short duration.^{15, 16}

The transforaminal approach allows a more precise administration of the corticosteroid to the inflamed nerve root. Randomized controlled trials show mixed results.

Patients who were scheduled for surgery were randomly assigned to receive either local anesthetic alone or local anesthetic with corticosteroid transforaminal epidural injections. At follow-up (13 to 28 months) 20 out of the 28 patients in the local anesthetic with corticosteroid decided not to undergo surgery. This was the case for 9 out of the 27 patients who received local anesthetic alone.¹⁷ In a 5-years follow-up study it was shown that 81% of the patients who were not operated one year after the epidural infiltration did not require surgery within the 5 years follow-up.¹⁸ In patients with disc herniation the transforaminal epidural injection of corticosteroid was superior to trigger point injections.¹⁹ Patients with MRI proven disc herniation were randomly allocated to receive transforaminal epidural local anesthetic with corticosteroid or normal saline. At two weeks after treatment patients in the corticosteroid group were better than in the saline group. This was, however reversed after 3 to 6 months, because a rebound effect was observed in the corticosteroid group.²⁰ A sub analysis of the results of patients with a contained herniation and those with an extruded herniation showed that in the group with contained herniation corticosteroid injection provided superior results to placebo while in the group with extruded herniation the placebo group was better.²¹

The three different administration possibilities were compared in a randomized controlled trial as treatment for patients with radicular pain due to disc herniation. The transforaminal administration gave the better results.²²

In patients with MRI confirmed blind interlaminar corticosteroid injection was compared to radio-guided transforaminal injection. At 30 days the pain relief was significantly better in the transforaminal group. Six months after treatment patients' response to a mailed questionnaire showed better results for transforaminal injection concerning pain, daily activities, work and leisure activities and anxiety and depression, with a decline in the Roland-Morris score.²³

(Pulsed) radiofrequency treatment adjacent to the dorsal root ganglion

The effect of radiofrequency (RF) heat treatment adjacent to the lumbar dorsal root ganglion was compared to sham intervention in a well-designed randomized controlled trial. The superiority of RF treatment could not be demonstrated.²⁴

Pulsed radiofrequency treatment (PRF) is an alternative way of administering high frequency current where each active period is followed by a silent period, allowing the heat produced at the electrode tip to be washed out. In this way the temperature at the electrode tip stays beneath the neurodestructive level of 42°C.²⁵ PRF treatment adjacent to the lumbar DRG was studied in retrospective and prospective trials for the management of lumbosacral radicular pain. All studies showed an improvement of the painful condition.^{26, 27, 28, 29}

In one study the effect of PRF adjacent to the DRG was studied according to the etiology. In patients with disc herniation and spinal stenosis PRF treatment resulted in a significant pain reduction. Patients with the failed back surgery syndrome did, however, not experience improvement.²⁸

Percutaneous treatment

Intradiscal injections

Corticosteroids, local anesthetics, normal saline, glucosamine, chondroitin sulfate, hypertonic dextrose and demethylsulfoxide were injected intradiscally. The results are mixed and do not allow formulating guidelines regarding these treatment options.⁹

Annuloplasty

Annuloplasty uses heat application to the annulus fibrosus, thus inducing shrinkage and repair of small annular tears, that may be caused by small disc herniation. Besides the heat destroys newly formed nerves in the damaged disc zone.⁹ There are several ways to apply heat to the annulus.

Intradiscal electrothermal therapy (IDET)

IDET uses an thermocoil percutaneously inserted into the disc. The distal proportion of the catheter is heated. There are several publication on this

technique but the results are confusion. There is a positive RCT³⁰ and one negative RCT.³¹ The two systematic reviews also come to contradictory conclusions.^{32, 33} The mode of action of IDET is not elucidated yet and the disease characteristics that may best respond to this type of treatment need to be specified.

Biacuplasty

Biacuplasty uses two straight electrodes placed in the annulus. The RF current between those electrodes generates heat that spreads over a larger zone of the posterior annulus fibrosus. This technique was evaluated mainly in small sized pilot studies, that showed a positive outcome up to 12 months after the intervention.³⁴ The value of this technique needs to be confirmed certainly for the management of pain due to disc herniation.

Percutaneous disc decompression

Disc decompression often leads to rapid pain reduction. The percutaneous methods try to consolidate the benefits of disc decompression and a minimal invasive technique.

Laser discectomy

The laser light is absorbed by the affected tissue, which vaporizes at 100°C thus reducing the intradiscal pressure. If any disc material needs to be removed, endoscopic tools can be used.³

Nucleoplasty

The decompression uses "coblation" which relies on the application of a high energy plasma field with the help of bipolar RF probes. The plasma field breaks the molecular bonds whereby tissue can be evaporated at relatively low temperatures (40 to 70°C). The evidence for this technique was rated to be limited.³⁵

Percutaneous disc Dekompressor ā

The disc Dekompressor extracts nuclear disc material and thus changes the intradiscal pressure. It is imperative that the annular wall should be intact therefore this technique is indicated for the management of contained herniation. The prospective trials report high success rates (80%).³⁶ A European study illustrated that more benefit of the percutaneous disc Dekompressor technique can be expected in patients with posterolateral foraminal disc protrusions than those with posteromedian protrusions.³⁷

Conclusions: Lumbosacral radicular pain is probably the most frequently occurring form of neuropathic pain. In patients younger than 50 years the cause is frequently disc herniation. A conservative attitude with symptom management is indicated in the acute phase because in up to 60 % of the patients a spontaneous resolution of the problem is noted. When interventional treatment is considered effort will be done to identify the causative level. The use of diagnostic procedures will be balanced with the degree of invasiveness of the treatment intervention. A progressive approach using first the epidural corticosteroid administration and the PRF treatment is recommended. The annuloplasty and the nucleoplasty may be considered.

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3-D ULTRASONOGRAPHY FOR PERIPHERAL NERVE BLOCKS; THE FUTURE?

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The use of ultrasound imaging in regional anaesthesia has become widespread in clinical practice over the last ten years. The technique of free-hand needle-guidance, both in and out-of-plane with respect to the ultrasound beam has made the targeting of nerves and visualisation of local anaesthetic spread highly accurate. With these techniques has come an appreciation of the limitations involved during imaging and the sources of error when performing these techniques. Three-dimensional ultrasound imaging is now becoming available on smaller ultrasound machines, and here we will consider how this could be of use in regional anaesthesia.

Two-dimensional ultrasound imaging in anaesthesia

More than thirty years ago, La Grange¹ described the successful placement of 61 supraclavicular blocks with a 98% success rate and no complications using Doppler ultrasound to identify the subclavian artery. The evolution of handheld ultrasound devices over the last ten years has brought this technology into the hands of clinical anaesthetists. We have seen a huge interest and expansion the use of ultrasound-guided techniques in that time. The evidence base and utilisation of ultrasound to identify anatomy and guide needle placement during regional nerve blocks is now well established. Reduced requirements of local anaesthetic volume have been demonstrated as well as reduced block onset time, increased block duration, comfort and superiority over landmark and electrical stimulation approaches²⁻⁸. The technique has also been promoted as the gold standard for regional anaesthesia⁹ and recommended for both elective and emergency central venous cannulation¹⁰.

Ultrasound images are presented as a single two-dimensional (2-D) plane producing an image slice of approximately 1mm thickness of a variable and adjustable depth. Nerves and vessels may be viewed in short axis or long axis and needles guided towards them viewed in-plane or out-of-plane with respect to the ultrasound beam¹¹.

Safety issues when using ultrasound for needle-guidance

The evidence for safety of ultrasound-guidance during regional anaesthesia is limited. This situation is likely to continue, as the frequency of complications after peripheral nerve blocks is low regardless of the insertion technique employed. Ultrasound is extremely sensitive for detecting intra-neuronal injection of local anaesthetic¹² and the visual confirmation of spreading fluid during local anaesthetic injection means that the operator can immediately detect intravenous injection. The use of ultrasound also increases safety during central venous access, but complication rates may still be as high as five per cent¹³.

Complications incurred during ultrasound-guided needle techniques

The commonest errors made during ultrasound-guided needle insertion is overshoot, usually as a result of poor imaging of the inserted needle, this is in turn exacerbated by a poor probe handling technique. Puncture of vessels and nerves with injection of local anaesthetic have all been described when using ultrasound during regional anaesthesia¹⁴⁻¹⁶. Inexperience is probably the main causative factor in these errors; Sites¹⁷ found that novices commonly over-inserted needles during a simulated needle insertion task using ultrasound.

When imaging the needle out-of-plane with respect to the ultrasound beam (short axis), the operator will only see the needle tip. The most frequent error made is then imaging the needle shaft and misinterpreting this as the needle tip, which may then result in over-insertion. In contrast, when imaging the needle in-plane with respect to the ultrasound beam (long axis) the operator sees the whole needle shaft and tip. However during needle insertion, part of the needle may drift laterally outside of the ultrasound beam, and this incorrect line-up may mean that only the proximal portions of the shaft is visualised, and the distal portion which is then poorly seen is then at risk of over-insertion. The long axis approach is also made difficult when using a steep insertion angle, as the needle reflection deteriorates progressively as it slopes away from the perpendicular¹⁸.

A limitation of standard 2-D ultrasound imaging is that a short axis or long axis view can only be obtained interchangeably by rotating the ultrasound transducer through ninety degrees. This adjustment allows the operator to build more of a three dimensional mental image of the anatomy, nerve structure, local anaesthetic spread and any inserted catheter. Obtaining these images during a regional anaesthetic technique may prove difficult to the novice or expert. Imaging using three-dimensional ultrasound provides us with multiple planes of view and/or a representation of the whole imaged volume, and so may assist us in overcoming some of these issues.

Three and four-dimensional ultrasound imaging development

Two-dimensional ultrasound imaging was well established when Tom Brown developed his elaborate multiplanar scanner in 1973. The device produced a pair of stereoscopic images that the operator viewed through a prism stereoscope to construct a three-dimensional image. The device was not a commercial success and was discontinued, but the possibilities of three-dimensional (3-D) ultrasound had been discovered.

The development of 3-D ultrasound during the 1980's was driven mainly by cardiology and obstetrics and gynecology¹⁹. These early images were produced by manually scanning across a volume of interest and stacking the resulting image slices to form a 3-D volume. The positional information from the probe was made available to the analysing computer by having the scan head mounted on a mechanical arm. Advances in miniaturization, computer processor power, probe technology and also the software for image processing have led to improvements in image quality.

Three-dimensional ultrasound imaging has now become available on portable or 'hand-held' machines, which make the use of 3-D more feasible in the theatre environment. Although its application has been described in other specialties²⁰⁻²³ and during central venous access²⁹, there is little experience with 3-D ultrasound in regional anaesthesia. Three-dimensional ultrasound imaging has been used to visualise nerves and perform spatial mapping of the brachial plexus²⁴. Live 3-D, sometimes termed 'four-dimensional' (4-D) ultrasound, has facilitated successful placement of a popliteal and infraclavicular catheters²⁵ and aided needle-guidance during performance of a peripheral radial nerve block.²⁷

Three and four-dimensional image acquisition

A 3-D ultrasound image is created by the capture of a data set (by scanning a volume of interest) that is then displayed retrospectively as a static image. The quality of the resulting image depends, in part, upon the acquisition speed. A slow acquisition speed yields more scanned slices and more volume data points (but requires a static object) producing a superior image which is then displayed retrospectively. Faster acquisition speeds can produce

a continuously updating image of the newly acquired volume, creating the impression of a moving structure (but at the cost of a reduction in image quality). This 'live' imaging is variously termed live 3-D or 4-D imaging (where time is the fourth dimension). This can allow performance of needle-guidance in real-time. Three dimensional ultrasound machines will only achieve acquisition speeds of approximately four volumes per second during live imaging. This results in visible pauses between displayed frames and a rather jerky image. However others machines will operate at 16 volumes (or more) per second, and this give a much smoother on-screen picture²⁸.

Image capture

Three dimensional ultrasound probes may be standard linear array, mechanically steered array or matrix array. Standard linear probes need to be manually scanned over the area of interest; the machine will then assimilate the gathered frames into a 3-D image. Mechanically steered arrays work by mechanically oscillating the array within the probe back and forth through an arc, thus scanning in two planes. These types of transducers often produce high-frequency ultrasound and therefore high-resolution images. During 4-D (live) scanning, the display frame rate is approximately half that of current 2-D systems, resulting in a jerky on-screen image. Matrix arrays consist of rows of piezoelectric crystals that emit ultrasound in multiple planes. As the images are generated electronically, the scanning head does not move and the probes are smaller and lighter to use. The display frame rate is faster than a mechanically steered array transducer, which leads to a smoother displayed image. These probes were designed for echocardiography, and thus operate at lower frequencies (approximately 2-7 MHz), producing lower resolution images while allowing deeper penetration.

Multiplanar 3-D ultrasound imaging

Four-dimensional (live) multiplanar imaging produces up to three orthogonal (perpendicular) planes of view simultaneously (Fig 1). Transverse (X or short axis) and longitudinal (Y or long axis) views can be obtained using conventional 2-D ultrasound by rotating the probe through ninety degrees. A third view, unobtainable using conventional 2-D ultrasound, is effectively parallel to the transducer surface, thus the operator may effectively look down upon the area of interest. This view has been termed the Z-axis or coronal view, although it may not be a true anatomical coronal plane depending on where the probe is placed. The point of intersection of the three planes is often marked on each image by a marker dot on the display. The marker dot may be moved by the operator, allowing the creation of a target during needle-insertion²⁷.

Multiplanar imaging is the most similar to conventional 2-D imaging. Simultaneous short and long axis views of the imaged volume provide the operator with more information on the visualised structures, needle and injected fluid spread. The needle is seen approaching the target in short and long axis simultaneously. The Z-axis or coronal view presents an image 'through' the standard short and long axis planes at an adjustable depth. This means that if the needle is visualised in this view, but not in the other two

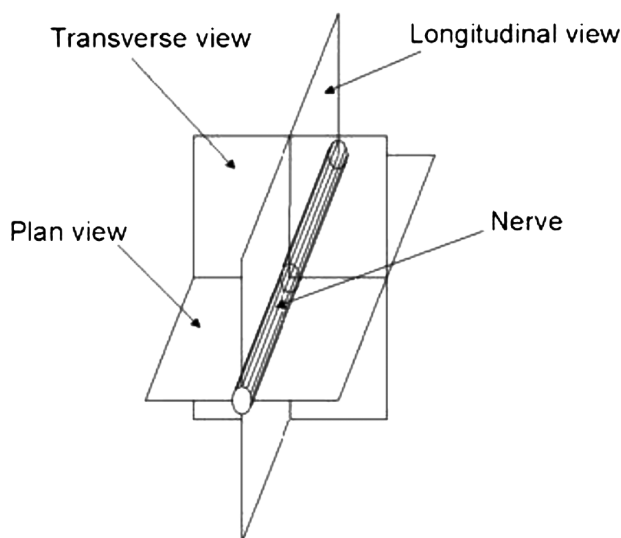


FIGURE 1: Orthogonal planes displayed during multiplanar imaging: plan view is the z-axis or coronal view.

standard views, it must have already crossed the central plane of the target (at the adjustable depth of the Z-axis) and has overshoot the target. This may then provide extra feedback to reduce the risk of needle overshoot.

Volumetric 3-D ultrasound imaging

The whole volume of interest can be reconstructed (rendered) and then displayed as a thick slice, cube or pyramid (depending on the transducer type). The volume can then be displayed in surface form or in a transparent manner. The visibility of structures (as with any ultrasound image) will depend on the acoustic impedance of those structures. Solid structures surrounded by fluid provide an excellent interface for ultrasound and high quality images of the surface of the structure can be produced. Obstetrics has taken advantage of this property to produce excellent 'commercial' images of the fetus in-utero. Some penetration of the fetus is also possible to demonstrate bone and vascular structures. Doppler flow imaging is possible during real time 3-D imaging. This ability to produce a rendered image originally evolved from computer graphics engineering, with many of the computer algorithms producing these images originating from the Disney film studio Pixar during production of animated films. Real time volumetric imaging (4-D) therefore potentially allows us to guide a needle to an exact point within a volume displayed in real-time.

Potential advantages of four-dimensional needle-guidance

To date the published experience with three-dimensional imaging for needle-guidance is limited to individual reports of use during vascular access and other specialties (previously referenced). The few case reports published thus far suggest potential for 3-D imaging during regional anaesthesia, but they also have highlighted the deficiencies in live image quality and with the available transducers. Improved spatial awareness during needle insertion may lead to lower complications during regional anaesthesia or vascular access. Better visualisation of fluid spread patterns could potentially increase block success rates or allow reduction in local anaesthetic volume requirements.

Summary: The use of ultrasound in anaesthesia in general, and regional anaesthesia in particular, is now widespread and has a large evidence base. Three-dimensional ultrasound imaging has been used in a number of specialties, but has thus far found few routine indications. Further developments in technology should see improvements in live image quality and enable the production of transducers more suited to our requirements. Ultrasound machines with three-dimensional capability will become smaller, more affordable and available. We should then see whether three-dimensional ultrasound has a place in the performance of regional anaesthesia.

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SPECTROSCOPIC INFORMATION OBTAINED WITH OPTICAL NEEDLE

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Background and aims: The techniques used for identification of the epidural space and especially peripheral nerves when performing central and peripheral nerve blocks have been developed and refined over decades. Identification of the epidural space is critical for safe and effective epidural anesthesia or treatment of acute lumbar radicular pain with epidural steroid injections. Accurate identification of peripheral nerves is critical to ensure safe and effective delivery of regional anesthesia during peripheral nerve blocks. Nerve stimulation is commonly used, but it is known to be unreliable. Even when it is performed in conjunction with ultrasound guidance, determining when the needle tip is at the nerve target region can be challenging. Due to uncertainty of needle tip position or catheter placement, there are still a substantial number of blocks that do not work for surgical anesthesia or postoperative pain relief. Furthermore the complications to needle tip displacement can lead to disastrous complications such as epidural bleeding or nerve damage and sequele. Optical reflectance spectroscopy is a technique based on the knowledge that tissues (such as fat, muscle, ligaments and blood) display different light absorption patterns. The technique provides information about nerves and blood vessels that is distinct from nerve stimulation and ultrasound images. With this sensing modality, light (typically in the visible and near-infrared wavelengths) is delivered to tissue, and the reflected light is spectrally resolved. A spectrum that is acquired from a surface that reflects light equally at all wavelengths exhibits uniform intensities. Spectra that are acquired from biological tissue do not exhibit uniform intensities due to the wavelength-dependencies of optical scattering and absorption. Whilst scattering tends to manifest as small changes in intensity with wavelength, absorption gives rise to significantly lower intensities in narrow wavelength ranges, which are termed "absorption peaks." Absorption peaks in the visible wavelength range derive in large part from hemoglobin. In particular, the deoxygenated form of hemoglobin has a prominent absorption peak at 557 nm and a smaller one just beyond the visible range at 757 nm; the oxygenated form, two prominent ones at 542 and 576 nm. The presence of lipids is responsible for absorption peaks centered at 930 and 1210 nm; the presence of water, for a prominent absorption peak at 1455 nm and additional ones at 976 and 1197 nm. Needles with optical fibers integrated into the cannula or stylet for acquiring spectroscopic measurements of tissues close to the tip have been demonstrated over 25 years ago, but designs optimized for anesthesiology and interventional pain management procedures have been demonstrated only recently. Following the development of the technique, optical reflectance spectroscopy has recently been tested as a mean to detect and identify what type of tissue is located in front of the needle tip in a series of experiments in vivo.

Methods:

Epidural space identification: Under general anesthesia, a Swedish Landrace swine was positioned on a fluoroscopy table in the left lateral decubitus position. Lateral and midline insertions to the epidural space were performed. The design of the optical spinal needle was derived from an 18 gauge spinal injection needle with a Quincke model tip. Three optical fibers (core diameter: 200 microns) were embedded in the needle shaft so that they terminated at the bevel surface. One fiber was located near the distal end of the bevel surface and delivered broadband light from a Tungsten-Halogen lamp which was scattered and absorbed by the tissue in front of the needle tip. The two other optical fibers were located at the proximal end of the bevel surface, at a distance of 2.4 mm from the distal fiber; they received light scattered within tissue and directed it to two spectrometers where it was spectrally resolved across the wavelength range of 500-1600 nm. The optical console, that comprised the lamp and the two spectrometers, was described in detail in a previous in vitro study.^(1,2) In each insertion, optical spectra were acquired at different insertion depths, and anatomical localization of the needle was provided by three-dimensional imaging with rotational C-arm computed tomography. During the image-guided insertions, spectra were not displayed to the practitioner performing the insertions to assure that the identification of the epidural space was determined anatomically using the XperCT images and was not affected by the spectroscopic information.

Optical spectra that included both visible and near-infrared wavelength ranges were processed to derive estimates of the blood and lipid volume fractions.

Brachial plexus identification: This study was conducted in two Swedish Landrace swines under general anesthesia. With the swine positioned on their backs with their front legs extended laterally, insertions were performed in the axilla.

The custom optical stylet was designed to be compatible with a commercially-available, 20-gauge radiofrequency needle cannula with a length of 100 mm and a vet point tip (bevel angle: 20 degrees). Two optical fibers with core diameters of 100 micrometers were integrated in the stylet body so that they terminated at the bevel surface, with the centers of the distal ends of the fibers separated by 1.0 mm. One fiber delivered broadband light to tissue at the tip of the stylet, and the other received light scattered by tissue and directed it to two spectrometers where it was spectrally resolved across the wavelength range of 500 to 1600 nm. The average maximum distance from the bevel surface that is reached by light depends on the optical properties of the tissue.

The electrical insulation coating on the needle cannula enabled nerve stimulation at the non-insulated tip with a stimulator stylet. In this study, a stimulator stylet could not be inserted into the cannula when the optical stylet was present. To allow for nerve stimulation and optical measurements to be performed concurrently, an alternative electrical connection was created by removing approximately 10 mm of the insulation coating from the proximal end of the cannula. The stimulator was connected to this conductive region by means of an alligator clip.

Ultrasound imaging with a linear array, 5-12 MHz probe (L12-5) was used to guide all insertions, with the needle visualized in-plane. Prior to insertions in each swine, a spectrum was acquired from a white reflectance standard to measure the wavelength-dependent sensitivity of the optical console to reflected light.

A total of 12 insertions to the brachial plexus were performed on the two swines (3 right-sided and 3 left-sided on each swine). With each insertion, the needle tip was directed to the surface of the brachial plexus at the axillary level. The entry points were distinct, so that the needle trajectories did not overlap. Spectra were acquired with the needle tip in skeletal muscle, in contact with muscle fascia, and at the nerve target. At all three locations, it was ensured that the needle tip, skeletal muscle, and the nerve were clearly visible with ultrasound. Close proximity to the nerve target was confirmed with stimulation (threshold: 0.3 mA).

For the acquisition of spectra during insertions to the brachial plexus, motion of the needle was paused, with the cannula and stylet held manually by the practitioner. Each spectrum was acquired with an exposure time of 0.5 seconds; 10 optical spectra were acquired at each location. Immediately after the acquisition of a spectrum from tissue, a background spectrum was acquired with the broadband light shuttered to measure ambient background light.

Insertion to the axillary artery: In a third swine in the brachial plexus study, an ultrasound-guided insertion into the right axillary artery was performed in place of insertions to the brachial plexus. Spectra were acquired with the needle tip at three different locations: in skeletal muscle, in contact with the arterial wall, and in the lumen of the axillary artery. Access to the arterial lumen was confirmed by rapid backflow of blood via the needle cannula after spectra were acquired and the stylet was removed. Two veins surrounding the artery were apparent prior to the needle insertion.

Spectral Analysis: Spectral analysis was performed off-line with custom software written in Matlab (Mathworks, Natick, U.S.A.). Three pre-processing steps were performed: subtraction of the background spectrum, intensity calibration with the spectrum acquired from the white reflectance standard, and normalization with respect to the mean intensities. Subsequently, two empirical parameters were calculated from each spectrum: a lipid parameter and a hemoglobin parameter. From each set of spectra acquired with the needle tip at one location in one insertion, mean lipid and hemoglobin parameters were calculated.

In the case of the lipid parameter, the spectrum values at two wavelengths, 1195 nm and 1210 nm, were utilized. At the latter wavelength, optical absorption of lipid is at a local maximum; at the former, the optical absorption of lipid is less pronounced, and it is equal to that of water. As a result, the difference between the spectrum values at these two wavelengths depends strongly on the volume fraction of lipids in tissue.

The hemoglobin parameter was calculated with two wavelengths, 545 nm and 797 nm. At the former wavelength, absorption of hemoglobin is much higher than it is at the latter; at both wavelengths, absorption is equal for both oxygenated and deoxygenated forms.

Both the lipid parameter and the hemoglobin parameter are dimensionless (i.e. they do not have associated units) and they are not a concentration

measurement; they may assume negative values in the case of low lipid or hemoglobin content respectively. An increase in either of the parameters is consistent with an increase in the content of fat or hemoglobin in the tissue from which the spectrum derives, provided that optical scattering is constant. **Statistical Analysis:** The lipid and hemoglobin parameters obtained from nerve target regions were compared to those obtained from skeletal muscle and muscle fascia using linear regression analysis. The regression model included tissue type (skeletal muscle, muscle fascia, or nerve target region) and swine as independent variables.

Results:

Epidural space identification: Across all epidural insertions, the mean hemoglobin fractions obtained from skeletal muscle were 1.9-fold to 20-fold higher than those obtained from the epidural space. Transitions of the needle tip from adjacent ligamentous tissues (the interspinous ligament and the ligamentum flavum) to the epidural space were associated with increases in the mean lipid fraction, which ranged from 1.6-fold to 3.0-fold.

Insertions to the brachial plexus: Ultrasound images provided excellent visualization of the needle and surrounding soft tissues. The target nerve, located adjacent to the axillary artery, had a granular appearance and was approximately 2 mm in diameter. Two veins adjacent to the artery were visible when they were not compressed by pressure from the ultrasound transducer. Superficial to the nerve, muscle fascia and skeletal muscle were apparent.

Optical spectra were displayed in linear units as the intensity of light received from tissue as a function of wavelength. In all insertions to the brachial plexus, pronounced lipid absorption peaks centered at 1210 nm were present in spectra acquired from the nerve target regions. Pronounced water absorption peaks centered at 1455 nm and less pronounced ones at 976 nm were present in all spectra. Pronounced hemoglobin absorption peaks in the range of 500 to 600 nm were also present in all spectra. Variation in the relative prominence of oxy-hemoglobin and deoxy-hemoglobin absorption peaks was observed, which manifested as two closely spaced absorption peaks at 542 and 574 nm when the former was more prominent and a single peak at 557 nm when the latter was more prominent.

In all insertions to the brachial plexus, a transition from skeletal muscle to the nerve target region was associated with an increase in the mean lipid parameter. Across the 12 insertions, the mean lipid parameter increased from -0.8 ± 0.3 (mean $\pm$ SE) in skeletal muscle, to 0.2 ± 0.2 at the surface of muscle fascia, to 2.7 ± 0.4 at the nerve target. The linear regression analysis indicated that the differences between lipid parameters obtained from the nerve targets and those obtained from skeletal muscle were statistically significant; the differences between lipid parameters obtained from the nerve targets and those obtained from muscle fascia were also statistically significant. Differences between the two swines were not significant.

Hemoglobin parameters were obtained with the needle tip in skeletal muscle, at the surface of muscle fascia, and at the nerve target. The mean hemoglobin parameter decreased as the needle tip transitioned from skeletal muscle to the nerve target in 10 of the 12 insertions. The linear regression analysis indicated that differences between hemoglobin parameters obtained from the nerve targets and those obtained from skeletal muscle were statistically significant.

Insertion to the axillary artery: During the insertion to the axillary artery, ultrasound imaging provided clear visualization of the needle when the tip was in skeletal muscle, in contact with the arterial wall, and in the arterial lumen. The axillary artery was approximately 1 cm below the surface. The veins were not clearly visible due to tissue compression by the ultrasound transducer. When spectra were acquired with the needle tip in contact with the arterial wall, the needle shaft was approximately perpendicular to the arterial midline axis, with the tip close to the depth midpoint of the wall. A similar geometry was maintained when spectra were acquired from the arterial lumen.

The transition of the needle tip from the arterial wall to the arterial lumen was associated with a greater than two-fold increase in the mean hemoglobin parameter. The hemoglobin parameters obtained from skeletal muscle were similar to those obtained from the arterial wall. With spectra acquired from skeletal muscle and from the arterial wall, the deoxy-hemoglobin absorption peaks at 557 and 757 nm were apparent. For spectra acquired from the arterial lumen, deoxy-hemoglobin absorption peaks were visually absent. Individual hemoglobin absorption peaks in the range of 500–600 nm could not be resolved; spectral intensities across this range were near-zero due to high absorption.

Conclusions: These studies demonstrated the feasibility of constructing both a needle and a needle stylet with integrated optical fibers for acquiring spectra that span the visible and NIR wavelength ranges. The stylet diameter

was sufficiently small to be compatible with a 20-gauge needle cannula. As such, only minor modifications would be required to make the stylet compatible with a wide range of needle cannulae used in peripheral nerve blocks, including ones that allow for electrical stimulation and ablation. The preliminary experiences of the practitioners during these studies suggested that the presence of optical fibers and the resulting non-uniformity of the bevel surface of the stylet did not significantly change the resistance from tissues encountered during insertions or the mechanical properties of the stylet/needle combination.

Spectroscopic detection of the epidural space employed quantitative and reproducible parameters. The prominent lipid absorption peaks that were observed in spectra acquired from the epidural space are consistent with cryomicrotome studies, which found a predominance of homogeneous fat in the posterior epidural compartment. This histological correlate could prove to be advantageous in terms of interpreting the optical spectra. With parameters that are based on reflectance at visible wavelengths, such as those developed in a previous study, histological correlates remain to be determined; moreover, one can expect that minor bleeding events could have a significant influence on their values. Optical identification of the epidural space with the lipid parameter may have limitations in certain clinical contexts, however, such as access to the epidural space in the cervical spine where there is a relative paucity of epidural fat, or with certain pathological conditions such as spinal stenosis that are frequently accompanied by local reductions in the amount of epidural fat. The relatively small distance in front of the needle sampled for the spectral data (estimated to be about 1.2 mm) may well allow use even when the dimensions of the epidural space are limited, however.

In the spectra acquired from the needle and the stylet demonstrated in these studies, absorption peaks that were consistent with the presence of lipids, water, and hemoglobins could clearly be identified. The prominent lipid absorption peaks in spectra acquired from nervous tissues likely had multiple morphological correlates. Intrafascicular structures such as myelin sheaths are known to be lipid-rich. Lipids can also be found in extrafascicular adipose cells contained within the epineurium, as well as extraneurally in the regions targeted during peripheral nerve blocks. In particular, more than 50% of the brachial plexus in the supraclavicular region is composed of fibrofatty connective tissue. The prominence of the lipid absorption peaks can be expected to depend on the concentrations of water, collagen, and elastin, given that these chromophores have optical absorption peaks that partially overlap.

Detection of nerves with optical reflectance spectroscopy may have limitations in certain clinical contexts. Many peripheral nerves such as the ilioinguinal nerve and nerves of the foot (e.g. the sural and the superficial peroneal nerves) are small compared with the large brachial nerves targeted in this study; it remains to be determined what optical contrast is associated with them and the surrounding fibrofatty connective tissues.

The absorption peaks in the visible wavelength range were indicative of the presence of hemoglobins. In the case of spectra acquired from skeletal muscle, there may have been additional contributions from myoglobins, which have very similar absorption spectra. During the course of the dissection, blood released from tissues migrated to some extent from one location to another. Caution must therefore be exercised when interpreting the prominence of hemoglobin absorption peaks.

An important topic that will be addressed in future studies is the correlation between optical spectra and the distance between the needle tip and the nerve surface. In the brachial plexus study, nerve stimulation and clear ultrasound visualization were utilized as two independent methods for identifying when the needle tip was in close proximity to the nerve surface. Taken together, these methods were presumed to be sufficient for the purposes of this study. Indeed, the target nerves were chosen to be very large and superficial, and there was no reason to suspect that the swine had muscle or neural damage prior to the insertions or that the insertions injured the target nerves. Neither method provided a highly accurate measurement of distance to the nerve surface, however. With ultrasound guidance, both the needle tip and the target nerve could be reliably identified, but precisely controlling variations of the distance between the needle tip and the surface of the target nerve in the presence of swine and practitioner motion was challenging. As a result, it was not possible to determine whether the bevel surface of the needle was in physical contact with the nerve surface or with the fibrofatty connective tissue immediately surrounding the nerve. Future studies are required to determine whether optical reflectance spectra allow for discrimination between extraneural and intraneural tissues and even between tissues within

a nerve. As intraneural injections, particularly intrafascicular ones, can result in neurologic injury, it might be possible to produce warnings that indicate when injections are potentially unsafe.

In summary the information obtained with this optical reflectance spectroscopy technique both with light fibres in the needle and the stylet about what type of tissue was immediately in front of the needle tip seems reliable, based on these in vivo experiments in swines. However, it remains to reproduce these results in humans, when the described prototype system is accepted for such clinical use and also to relate the spectroscopic findings to actual regional block success rate.

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SEDATION DURING SURGERY UNDER REGIONAL ANESTHESIA: WHICH DRUG IS BEST FOR MY PATIENT?

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Introduction: Anesthesia comprises four specific tasks: analgesia, muscle relaxation, amnesia, and hypnosis (sleep). Regional anesthesia routinely accomplishes the first two tasks, but does virtually nothing to accomplish the last two. It has been suggested that patients having surgery under regional anesthesia do not need sedatives or hypnotics. However, patients receiving regional anesthesia, and peripheral nerve blocks in particular, do experience discomfort. To resolve this issue, many anesthesiologists premedicate prior to block placement with intravenous sedation, hypnosis, or light general anesthesia because it contributes to increased patient comfort and satisfaction.

While having patients maintain verbal contact with their anesthesiologists and surgeons throughout peripheral nerve blocks and surgical procedures sounds like a worthy goal, it is not often practical. Often times, patient communication can be distracting to the surgeon who is concentrating on the technical aspects of the procedure. Additionally, the hectic environment of the operating room, the noise generated by various pneumatic and electric equipment, and the array of anesthesia monitors can hardly be perceived as a pleasant environment for a patient having surgery. It is for these reasons that anesthesiologists routinely use various sedatives and hypnotics to create an efficient environment for the surgeons, as well as to assure a pleasant, stress-free experience for the patients.

The specific goals of sedation for surgery under regional anesthesia may vary among practitioners, institutions and is often based on local practices. However, the overall goals can be summarized as: (1) Enhanced patient comfort, (2) Prevention of patient movement, (3) Avoidance of painful stimuli while maintaining a spontaneously ventilating and hemodynamically stable patient.

CHOICE OF SEDATIVE AGENTS

The commonly used agents for sedation include the centrally active drugs (such as the benzodiazepines), sedative doses of hypnotic agents, and short acting opioid analgesics. An understanding of the pharmacokinetic and pharmacodynamic effects of the commonly used sedative, anxiolytic and analgesic drugs is essential to achieving optimal surgical conditions and acceptable patient outcomes when using sedation-based techniques.

BENZODIAZEPINES

Benzodiazepines produce anxiolysis, as well as varying degrees of amnesia and sedation. Benzodiazepine-induced central nervous system depression

is dose-dependent and can vary from light sedation to deep unconsciousness. Diazepam (0.1 - 0.2 mg/kg IV), the prototypical drug, is characterized by a long elimination half-life of about 50 h, which may result in delayed recovery and possible postoperative re-sedation, due to active metabolites and enterohepatic recirculation. Its use as a sedative has been decreasing because of its poor ability to achieve the desired level and duration of sedation. Furthermore, the side-effects and elimination profile of diazepam are particularly variable with older patients, in whom loco-regional anesthetic techniques are frequently used.

Midazolam (0.05 - 0.1 mg/kg; 0.03 - 0.2 mg/kg/h) is probably the most popular benzodiazepine nowadays. It is water soluble and does not cause pain during intravenous injection. It is a more rapid-acting agent than diazepam with a relatively short elimination half-life of about 2 - 4 h. Resultantly, midazolam may allow a more predictable recovery after brief procedures, as compared to diazepam, but it can also result in less predictable or prolonged recovery in the elderly. Midazolam requires careful intravenous titration to achieve the desired sedative level, while minimizing side effects resulting from inadvertent over dosage. In many studies, midazolam demonstrated more rapid onset and more profound perioperative amnesia, anxiolysis and sedation than diazepam¹.

PROPOFOL

Propofol is commonly used in sub-hypnotic doses for conscious sedation in combination with loco-regional anesthesia, mainly because it is short acting, easily controllable and individually titratable². These pharmacokinetic properties result in a quick recovery either from the effects of a single bolus-dose or following a continuous infusion. Propofol's rapid onset and short duration of action ensure prompt responsiveness to changes in its infusion rate, with titration achieved by using a variable-rate infusion. Propofol has a low incidence of undesirable side-effects when used in sedative dosages³. Its use is rarely associated with excitatory phenomena or involuntary movements, and there is a low incidence of postoperative nausea and vomiting (PONV). Of particular importance, low-dose infusions of propofol are largely devoid of depressant effects on cardiovascular and respiratory functions.

MANUAL-CONTROLLED INFUSION OF PROPOFOL FOR CONSCIOUS SEDATION

Propofol is well investigated as a sedative agent in the field of regional anesthesia for various surgeries, including ophthalmic, orthopaedic, and urological surgery. In the most comprehensive trial conducted for conscious sedation with propofol, loading doses of 0.2 - 0.5 mg/kg and maintenance dosages of 0.5 - 4 mg/kg/h were recommended⁵. In randomized comparative studies (mean doses for maintenance: 1.7 - 3.5 mg/kg/h), propofol demonstrated a smaller amnesic effect for the early postoperative period than midazolam and was associated with a quicker recovery⁶. Propofol is particularly useful for ophthalmic procedures (0.8 - 3 mg/kg/h) not only because of its sedative properties, but also because of its ability to decrease intraocular pressure and its low incidence of PONV⁷.

TARGET-CONTROLLED INFUSION OF PROPOFOL FOR CONSCIOUS SEDATION

Target-controlled infusion (TCI) is a logical administration technique for intravenous anesthetic drugs. A TCI-system for propofol uses an open three-compartment pharmacokinetic model to predict the necessary initial bolus-dose and subsequent infusion rates needed to achieve and maintain a given predicted blood concentration of the drug. A TCI-system allows a more rapid adjustment of the propofol blood concentration according to individual needs compared to a manually-controlled infusion. Alteration of sedation level is easy to achieve with TCI as changes made to "deepen" or "lighten" the level of sedation enables patients to reach the desired sedation score within a few minutes. For conscious sedation with TCI, dosages of propofol at target concentrations of 0.4 - 1.0 (1.2) µg/ml are useful, and are based on the age of the patient as well as the co-administration of the premedication⁸.

OPIOID ANALGESICS: REMIFENTANIL

Although opioid analgesics can be used as the sole supplement to local anesthesia, they do not produce adequate sedation without the risk of respiratory depression. Consequently, opioids are typically used in combination with sedative drugs to supplement sedation and analgesia produced by regional anesthesia⁷. Fentanyl is perhaps the most widely used intravenous opioid for this purpose. However, in this review, we chose to focus on newer, short acting opioids such as fentanyl, morphine and its derivatives, which have been well-established in clinical practice.

Remifentanyl is the first representative of the esterase metabolized opioids. Its metabolism by esterases confers a short context-sensitive half-time

of about 3.5 min. Theoretically, remifentanyl allows a more precise intraoperative titration and has a more predictable onset and offset of effect than the older, traditional opioids. Moreover, remifentanyl does not accumulate even during prolonged infusion. Infusion rates of 0.025 - 0.1 µg/kg/min are recommended for conscious sedation, and are titrated to individual needs.⁹ When combined with propofol at lower dosages, remifentanyl can provide excellent analgesia for loco-regional anesthesia, and can enhance patient comfort during the surgical procedure.⁷ Regardless, the perils of respiratory depression from use of a potent, even short-acting opioid, remain. For instance, Mazanikov and colleagues studied patient-controlled sedation of a propofol and opioid mixture during endoscopic retrograde cholangiopancreatography, and recommended the combination of propofol and alfentanil because a remifentanyl - propofol mixture depressed spontaneous respiration more and produced nausea more frequently.¹⁰

ALPHA-2-AGONISTS: DEXMEDETOMIDINE

Dexmedetomidine is a short centrally-acting, selective alpha-2-agonist that acts as a sedative-anxiolytic. It is available as an intravenous infusion. It has an elimination half-life of 2 h, but an alpha-half-life of only 6 min.¹¹ It has many advantages over other types of sedative agents. It exhibits little inhibition of the respiratory drive unlike propofol, the benzodiazepines, or the opioids.^{12, 13} Sedation and recovery are achieved more quickly with propofol, however, unlike propofol and benzodiazepines, dexmedetomidine has analgesic properties, allowing it to have an opioid sparing effect.^{14,15} Dexmedetomidine can lead to decreased sympathetic outflow and increased cardiac vagal activity, which can consequently lead to decreased heart rate and cardiac output. These conditions ultimately lead to bradycardia and hypotension.¹³ Typical doses include 0.5-1 mcg/kg initial loading dose for 10 min followed by a maintenance dose of 0.4 - 0.7 mcg/kg/h titrated to desired sedation.

KETAMINE

Ketamine has a long-standing history of being used solely for sedation and analgesia. However, ketamine may cause undesired hypertension and tachycardia, increased secretions, and is associated with agitation, hallucinations, dysphoria, a sense of formication, and excessive uncontrolled patient movement.^{16, 17}

More recently and coinciding with the drug supply shortages, ketamine has been used in creative combinations with other sedative and hypnotic agents (particularly propofol). Various cocktails have been suggested for the purpose of intraoperative sedation and analgesia, while circumventing the associated hypertension, tachycardia, and negative patient experiences and movement. Ketamine has been combined with many drugs including opioids, midazolam, dexmedetomidine, and propofol.¹⁸⁻²⁰

Propofol and ketamine combinations, referred to some as "ketofol", have been the most studied in the literature. Earlier studies showed that they do in fact act in a synergistic manner. Ketamine helps prevent the hypotension resulting from propofol causes, while propofol decreases the risk of nausea and vomiting and the recovery agitation of ketamine.¹⁸ According to proponents, one of ketamine's biggest benefits is avoidance of opioids, that propofol when used alone requires.

ASSESSMENT OF SEDATION

The reliability of various clinical methods to assess the level of sedation is controversial. External factors, such as noise and light intensity, influence level of sedation as does inter-patient variability in response to the drugs. Various sedation scales have been proposed to standardize assessment and minimize interobserver variability.^{4, 5}

The bispectral index (BIS) is one of several technologies developed to monitor depth of anesthesia. These technologies are intended to replace or supplement the classical Guedel's system for determining depth of anesthesia. Titrating anesthetic agents to a specific BIS during general anesthesia in adults and children over 1 year of age allows the clinician to titrate the anesthetics to the needs of the patient, possibly resulting in a more rapid emergence from anesthesia. In addition, the BIS monitor is suggested as helpful in reducing the incidence of intraoperative awareness during surgery.²¹ Although widely used during general anesthesia, BIS monitoring has not been established as a reliable alternative to current clinical standards of sedation monitoring.²²⁻²⁵ To date, no single device can reliably substitute traditional scoring scales to assess level of sedation.²⁶

Summary: Several different classes of medications and a myriad of their combinations and dosing options are available to accomplish sedation during surgery under regional anesthesia. However, achieving an optimal balance between patient comfort, safety and favorable recovery profile still has elements of art and may be one of the more challenging aspects of success for loco-regional anesthesia.

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FASTING IN LABOUR AND BEFORE CS

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Background: NPO (*nil per os*) guidelines prior to elective surgery, including caesarean section, are well established, (1,2), Table 1. However, whether (or not) to eat and drink during labour continues to provoke debate? Given the duration of labour, particularly for nulliparae, all women should be allowed to drink clear fluids during labour (3). This will also obviate the need for intravenous (IV) cannulation in low risk women? The issue of eating during labour is more contentious and therefore the risks of eating during labour need to be clearly evaluated. Historically women were encouraged to eat light digestible food during labour (4). This changed after Mendelson published, in 1946, his paper on the risks associated with acid pulmonary aspiration in obstetrics (5). Today the incidence of pulmonary aspiration in obstetrics, and in particular at the time of induction of anaesthesia for emergency surgery during labour is vanishingly rare. This is illustrated in Fig 1 which shows the deaths rate from aspiration in the UK since the introduction of the Confidential Enquiries into Maternal Deaths in the (6).

Gastro-intestinal physiology during pregnancy.

Gastroesophageal reflux, resulting in heartburn, is a common complication of late pregnancy. Pregnancy compromises the integrity of the lower esophageal sphincter. A pregnant woman at term, requiring anaesthesia, should therefore be regarded as having an incompetent lower esophageal sphincter. These physiological changes return to their pre-pregnant level by 48 hours after delivery (7).

The rate of gastric emptying of both liquid and solid material is not significantly altered by pregnancy. In addition, it has also been demonstrated that, following an overnight fast, the emptying of 300ml water is not delayed in both obese and non-obese parturients (8). During labour parenteral opioids significantly delay gastric emptying, as do bolus doses of epidural and intrathecal opioids. Continuous epidural infusion of low-dose local anaesthetic with fentanyl does not appear to delay gastric emptying until the total dose of fentanyl exceeds 100mcg. Gastric emptying is normal by 18 hours post-partum (9).

Pre-operative fasting prior to elective caesarean section.

The purpose of fasting is to ensure a relatively empty stomach whilst at the same time minimising thirst and dehydration. Pre-operative fasting guidelines have been liberalised, for both pregnant and non-pregnant patients, in recent years. A Cochrane review compared peri-operative complications in groups who either had shortened or traditional pre-operative fasting regimens and noted that the volume or pH of gastric contents at the time of intubation did not differ significantly between the groups (10). In addition patients with pre-operative water intake had a smaller gastric volume of higher pH. Gastric emptying in parturients at term is not delayed and therefore pre-operative fasting times prior to elective caesarean section should be the same as for non-obstetric surgery, (Table 1).

Pharmacological prophylaxis.

There is no direct evidence to link the reduction in the incidence of pulmonary aspiration in obstetrics to the use of antacids, H₂-receptor antagonists or to proton pump inhibitors. Deaths from aspiration in obstetrics were already declining at the time of their introduction as a result of the more widespread use of regional anaesthesia. However logic would support the

concept that increasing gastric pH and decreasing gastric volume should help prevent aspiration or at least mitigate against an adverse outcome.

A meta-analysis comparing the ability of proton pump inhibitors and H₂ receptor to achieve therapeutic targets suggests that pre-medication with ranitidine is more effective than proton pump inhibitors in reducing the volume of gastric secretions (by an average of 0.22 ml/kg; 95% confidence interval 0.04-0.41) and increasing gastric pH (by an average of 0.85 pH units; 95% confidence interval -1.14 to -0.28) (11). Suitable pre-operative antacid regimens for both elective and emergency surgery are shown in Table 2.

Approximately 66% of all caesarean sections (CS) are performed as an emergency. Therefore women who are at risk of requiring an emergency CS during labour should given oral ranitidine 150mg at regular intervals (6-8 hourly) during labour. If the mother has not received oral ranitidine during labour intravenous (IV) ranitidine 50mg should be administered prior to surgery. If the surgery mandates a general anaesthetic 30ml of oral 0.3M sodium citrate should be administered shortly before induction of anaesthesia. This strategy will ensure that gastric pH is high at both intubation and extubation.

Further strategies for preventing pulmonary aspiration during obstetric surgery.

The ultimate aim is that aspiration syndromes should never occur. It is important therefore to identify risk and in obstetrics the risk of aspiration is greatest when emergency surgery is performed under general anaesthesia during labour. Therefore the single most effective strategy for the prevention of pulmonary aspiration is the avoidance of general anaesthesia. The ethos that regional anaesthesia is the optimal form of anaesthesia for parturients, with obvious exceptions, should be paramount on all delivery units.

The role of NPO policies in labour in the 21st Century.

The proponents of natural childbirth have long argued that denying women food during labour can cause an adverse obstetric outcome. This issue has been addressed in a randomised controlled trial in 2443 low risk nulliparae in labour who were assigned to an 'eating' or a 'water only' group. The study demonstrated that eating during labour did not improve obstetric outcome, i.e. the rate of spontaneous vaginal delivery was not increased, the duration of labour was not shorter and fetal outcomes (APGAR scores and NICU admissions) were not altered. Equally this study did not show that eating in labour is safe as the study was underpowered to demonstrate safety (12).

Current evidence suggests that the risk of aspiration is greatest if the woman is critically ill, obese or has a difficult airway; and such women should remain NPO (apart from water) during labour. The American Society of Anesthesiology (ASA) recommends that low risk women be allowed to consume moderate amounts of clear liquids during labour (3). Therefore women should be advised to alleviate thirst during labour by consuming ice chips and clear fluids (isotonic sports drinks, fruit juices, tea and coffee, etc). Women should be discouraged from eating *solid* food during labour as eating confers no benefit to obstetric outcome. Arguably however low risk women could be allowed to consume low residue foods (soups, yogurt, ice cream and etc) during labour, especially in view of the almost negligible incidence of deaths from aspiration. When deciding whether or not to allow women to eat during labour, the use of parenteral opioids, because of their profound delay on the rate of gastric emptying, must be considered. In addition, units who perform a significant volume of their emergency obstetric surgery under general anaesthesia should also probably not allow women to eat during labour.

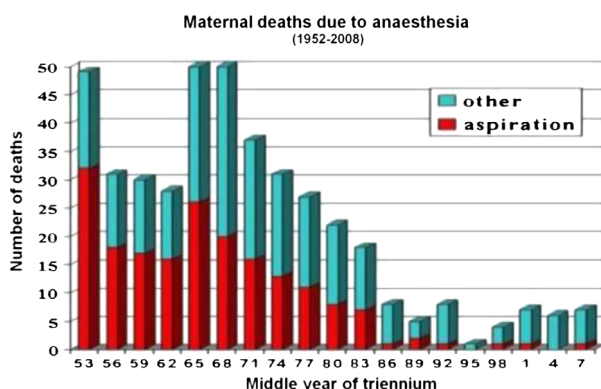
Maternal death from aspiration of regurgitated gastric content is now extremely rare, and its decline probably owes more to the widespread use of regional anaesthesia for operative obstetrics than to fasting policies. Thus, as there is no obstetric benefit to eating in labour, the decision to eat during labour becomes a risk/benefit analysis. For many women and their carers it is likely that this risk/benefit analysis will favour eating during labour?

TABLE 1. Fasting recommendations for healthy patients undergoing elective procedures¹. The fasting periods apply to patients of all ages including women undergoing elective caesarean section, but not to women in labour.

Summary of fasting	Recommendations
Clear liquids	2h
Breast milk	4h
Infant formula	6h
Non human milk	6h
Light meal	6h
Heavy meal (fried/fatty foods, meat)	8h (possibly longer)

TABLE 2. Pharmacological prophylaxis prior to elective and emergency caesarean section.

	Oral antacid	H2-receptor antagonist (Ranitidine)	Pro-kinetic agents e.g. Metoclopramide
Elective CS	No	150mg on the night prior to and on the morning of surgery	10mg on the night prior to and on the morning of surgery
Emergency CS	0.3M Sodium citrate (30ml) Prior to induction of general anaesthesia only	Prior to surgery 50mg IV	
High risk labour	No	150mg 6-8 hourly during labour	

**FIGURE 1.** Maternal anaesthetic deaths in the United Kingdom 1952 - 2008. Derived from *Confidential Enquiries into Maternal Deaths in the United Kingdom. 1952 - 2008*.

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COMBINED SPINAL EPIDURAL OR EPIDURAL ANALGESIA FOR LABOR AND DELIVERY: A BALANCED VIEW BASED ON EXPERIENCE AND LITERATURE

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Introduction: Almost two decades have passed since French and American trials evaluated the use of spinal opioids during labor and since European randomized trials compared conventional epidural analgesia with combined spinal epidural (CSE) analgesia (19,35,50). CSE analgesia has gained worldwide acceptance and is becoming increasingly popular as the method of choice for labor pain relief (54,117,126,134,135,164). Numerous (>280 trials, performing a literature search using CSE, combined spinal epidural analgesia and labor as search terms, were identified) studies compared CSE with conventional epidural, evaluated various intrathecal drug combinations or reported on side-effects of CSE.

Obstetric anesthetists are divided when questioned on the place of CSE in labor analgesia. Whilst some authors feel it should be the technique of choice, others reserve CSE for certain indications (34,80,129,131,141,142). Recently, Simmons et al. published a Cochrane review concluding that CSE offers little benefit as compared to conventional epidural analgesia (151). However, the authors of this meta-analysis did acknowledge that CSE produced faster analgesia, resulted in less need for rescue analgesia and was associated with less urinary retention. Apart from a slight increase in the incidence of pruritus, these beneficial effects were not associated with more complications. In this authors opinion the three demonstrated benefits of CSE are sufficient to promote its use if the side-effect profile remains unaltered. Furthermore it must be stressed that this Cochrane review can be criticized. Firstly, a number of well performed studies were excluded from analysis because of uncertain reasons. Inclusion of these well performed studies into the analysis might have affected the overall conclusions. Secondly, a number of outcomes were not considered in the analysis such as one-sided analgesia, epidural catheter reliability, anesthetist intervention rate, local anesthetic consumption and the occurrence of fetal heart abnormalities. Finally, very different types of CSE were used in the various studies. They were all considered to be a generic procedure and analyzed combined.

This manuscript reviews the available literature, including those trials that were ignored by the Cochrane review, and draws conclusions regarding the place of CSE in the management of labor pain. This review will evaluate efficacy and safety of CSE and make comparisons with conventional epidural analgesia, advise on the ideal spinal drug combination and give recommendations regarding maintenance of epidural analgesia once the spinal component wears off.

Characteristics of labor pain relief: CSE vs conventional epidural.

Onset time of analgesia.

Arguably the most obvious advantage of the CSE technique is the rapid and spectacular onset of effective analgesia with minute concentrations of local anesthetics with or without adjuvant drugs (151). Consistently, effective labor analgesia is accomplished within 4 - 6 minutes following the intrathecal injection of drugs (1,19,35,36,37,58,73,74,104,121,152,159,162,166,167) (Figure 1). Following conventional epidural analgesia, initial analgesia is usually achieved between 15 and 25 minutes. Some detractors argue that conventional epidural analgesia provides equally fast analgesia (104).

It is important to note, however, that although the onset time of epidural analgesia might be reasonable, the reported values are means. With epidural analgesia a wide inter-patient variability exists with respect to onset time of analgesia depending on parity, stage of labor and other relevant obstetric and non-obstetric factors. Especially during late labor, analgesia following an epidural injection is often delayed and only successful if large doses are

administered. With CSE, onset time is short in all patients irrespective of the stage of labor and other factors. The dose of local anesthetic only needs slight increases when labor is significantly advanced.

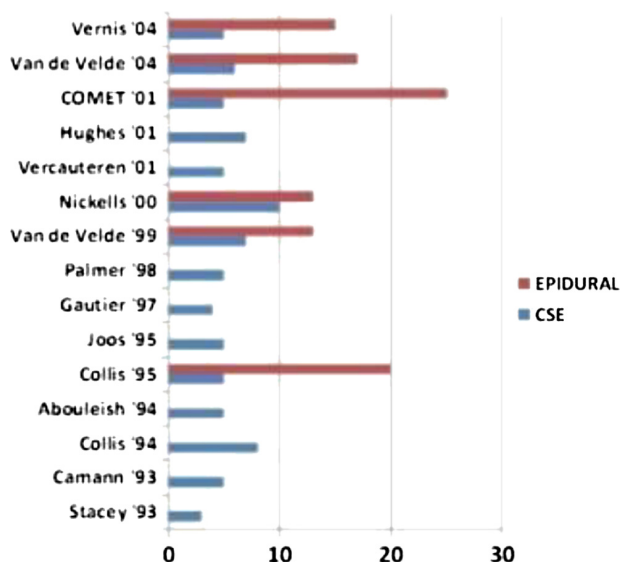


FIGURE 1. Onset time of analgesia following CSE or conventional epidural analgesia (minutes). Onset time is consistently shorter in CSE treated patients.

Quality of pain relief: VAS scores, satisfaction and anesthetic intervention rate.

Several trials demonstrated lower VAS scores for labor pain with CSE as compared to epidural analgesia (36,62,77,154). However, other comparative trials could not demonstrate a difference in VAS scores for pain (69,104,132). No trials report higher VAS scores with CSE. Most likely especially during the first 30 to 60 minutes VAS scores are lower when patients are treated with CSE.

Most anesthesiologists would agree that CSE provides better quality analgesia throughout the course of labor (84). Vernis and co-workers demonstrated that less patients reported unilateral analgesia with CSE as compared to conventional epidural analgesia (167). Interestingly, Hess et al. investigated the factors associated with breakthrough pain during neuraxial labor analgesia and found that patients treated with conventional epidural analgesia were three times as likely to experience recurrent breakthrough pain as compared to CSE treated women (71). Goodman et al. in a prospective study however failed to corroborate the latter study (62). These authors noted that additional top-ups to treat breakthrough pain were requested by similar numbers of patients irrespective of the analgesic strategy used (62).

The presence of a dural puncture may facilitate the passage of epidurally administered drugs during maintenance of analgesia to the cerebrospinal fluid. At least in animals such an effect has been reported (155). In patients, Leighton et al. also reported that epidural bupivacaine blocked more dermatomes when administered following an initial dural puncture as compared to epidural bupivacaine administered without prior dural puncture (87). Leighton et al. used a 24 and 27G spinal needle. Cappiello and co-workers performed a study in which the dura was perforated with a 25G Whitacre needle without administration of spinal drugs (22). The control group had no dural puncture. In both groups analgesia was initiated with an epidural local anesthetic/opioid mixture. Patients treated with a dural puncture had better sacral spread, shorter onset of analgesia and better quality pain relief. Thomas et al. performed a similar study using a 27G Whitacre needle and could not find a difference between patients treated with or without a dural puncture (156). So spinal needle size may be important.

Many studies report higher patient satisfaction with CSE (36,37,47,162), while no studies report on the opposite.

Local anesthetic consumption.

Despite similar or improved quality of analgesia, local anesthetic requirements are significantly reduced with CSE as compared to low dose conventional epidural techniques (36,37,77,162,167). Discussion remains whether this is the result of the omission of the initial epidural bolus or that also

during labor a dose sparing effect persists. The presence of the dural whole and the facilitated passage of epidurally administered local anesthetics could offer part of the explanation.

Duration of initial analgesia.

Duration of initial spinal analgesia is usually similar to the duration of an initial epidural bolus (69,104,162). Spinal analgesia typically lasts for 90 - 150 minutes, but a wide variety exists depending on administered spinal drugs and pain modulating factors such as parity, stage of labor, speed of labor, etc.... (19,27,43,49,73,95,116,118,150,168). In ideal circumstances and using multi-drug combinations spinal analgesia might last for more than 4 hours (43,116). Many authors continue the search for long lasting spinal analgesia, hoping that single shot spinal analgesia would ultimately be achieved. Despite extensive research, disappointingly, no more (and often less) than 50% of patients deliver during initial spinal analgesia (168).

Epidural catheter reliability.

Following initial spinal analgesia, bilateral analgesia and sensory changes occur, making testing of the epidural catheter difficult. The epidural catheter cannot prove itself and many may question the reliability of the catheter to achieve bilateral analgesia once the spinal dose is worn off. However various investigators noted that the reliability of epidural catheters following CSE was similar or increased as compared to stand alone epidural catheters (22,38,86,98,107,109,156,161)(Table 1). There was less need for epidural catheter replacement and there was less unilateral analgesia requiring catheter manipulation. Lee et al. reported less catheter failure when topping up for Cesarean section when the catheter was placed as part of a CSE technique of labor analgesia (86).

When using a CSE technique, a perfect midline approach is required to identify the subarachnoid space and consequently more epidural catheters reliably are positioned into the epidural space (161). Thomas et al. interestingly noted that when no cerebrospinal fluid was obtained following attempted CSE, subsequently much more epidural catheters required replacement as compared to those catheters placed when cerebrospinal fluid was noted (156).

TABLE 1. Reliability of epidural catheters: % of failed epidural catheters not producing adequate analgesia and that were resited.

	CSE	Epidural
Norris 2000 (107)	0.2 %	1.3 %
COMET 2001 (38)	4.0 %	6.8 %
Van de Velde 2001 (161)	1.49 %	3.18 %
Thomas 2005 (156)	9.3 %	8.0 % *
Cappiello 2008 (22)	3 %	13 %
Lee 2009 (86)	1 %	6 %
Miro 2008 (98)	3.4 %	6.2 %

* Thomas et al. reported more catheter replacement when the spinal component failed (22.2%).

Failed spinal component.

Failure to identify the spinal space and produce good spinal analgesia is reported in 0-18% of patients (156). As with every technique failure may occur, but in these instances the epidural catheter can still be used to provide analgesia. Failure of the spinal component indicates that the epidural needle is not perfectly situated on the midline and is a risk factor for subsequent epidural catheter failure (156). Re-positioning of the epidural needle is advocated by this author.

Complications of labor analgesia: CSE analgesia vs conventional epidural analgesia.

Pruritus.

This is the most common side effect of intrathecal opioids, occurring in almost all patients, if directly questioned (36,98,162,167). In the most recent Cochrane review, pruritus was reported more frequently following CSE and was reported to be the only complication occurring more frequent as compared with conventional epidural analgesia (152). It usually develops shortly after analgesia. It is mild and hardly ever requires antipruritic therapy. Prophylactic ondansetron is ineffective to reduce the incidence or severity of opioid induced pruritus (169). Opioid induced itching is dose-dependent and can be modulated by other adjuvant drugs such as epinephrine (12,19). Since patients hardly ever require therapy and seldom report pruritus as a reason for dissatisfaction, pruritus is no reason to refrain from using CSE and intrathecal opioids.

Nausea.

Nausea and vomiting are very rare complications during CSE and conventional epidural analgesia. No differences in the incidence of nausea have been reported when comparing the two techniques, except in the retrospective trial by Miro et al. who reported more nausea and vomiting in patients treated with epidural analgesia (98). We must remember that nausea is a part of the birth process especially during induced labour.

Hypotension.

As with any neuraxial technique, hypotension can occur following labour analgesia. Both CSE and conventional epidural analgesia have been associated with usually mild hypotension, which is easily treated (110). Both Rofael et al. and Van de Velde et al. reported a high incidence of hypotension following CSE using a combination of local anesthetics and opioids (139,162). Hypotension following the spinal injection is transient and occurs within the first 30 minutes following initiation of analgesia (99,149,167). In clinical, routine practice it is important to avoid the supine position. We always keep our patients in the completely left lateral decubitus position to avoid any effect of aortacaval compression.

Hypotension occurs due to sympathetic blockade, alleviation of pain and perhaps because incorrect baseline values are used as reference (13). Indeed if blood pressure immediately preceding the block is taken as baseline value, the diagnosis of hypotension may be made inappropriately. Pain and discomfort induce hypertension and cloud the issue. Various authors therefore recommend to use the prenatal blood pressure as the baseline value.

Although opioids do not produce sympatholysis, hypotension is observed with pure intrathecal opioid analgesia (26,91,102,138). When local anaesthetics are combined, hypotension seems to be more pronounced, but clinically usually easily treated (102). Intrathecal clonidine, however, is often associated with severe hypotension and this author can not recommend its routine use based on his personal experience with this drug. Hypotension can be severe and is often protracted requiring prolonged supportive vasopressor therapy (27,125).

Respiratory depression.

Respiratory depression is a recognized complication of intrathecal opioids during labor, probably as a result of rostral spread. Several case reports have demonstrated that lipid soluble opioids may induce this potentially life threatening complication (10,52,63,67,73,76,90,120,124). In some, but not all, cases respiratory arrest occurred in relatively short stature women who had received parenteral or epidural opioids prior to the spinal injection. Fortunately, respiratory depression occurred typically within the first 30 minutes and was easily treated and reversed using naloxone. In one patient chest compressions and resuscitation was required (124). Ferrouz et al. performed a retrospective chart analysis and reported 1 respiratory arrest in over 5000 CSE performed with 10 µg spinal sufentanil (52). As this complication is rare, most authors advocate vigilance and advise to use lower doses of intrathecal opioids than those initially used on empirical grounds (5).

Other complications related to excessive rostral spread of opioids and local anaesthetics have been described and include: aphonia, aphagia, dysphagia, altered levels of consciousness, high sensory block, transient swallowing difficulties, etc... (32,41,53,65,83,145). Also sudden hypoglycemia has been described (40,78).

Central nervous system infections.

Some authorities claim that the risk of central nervous system infections is increased secondary to the breach of the dura (16). However, Camann and Birnbach both agree that at the moment there is no scientific evidence indicating that CSE analgesia is associated with more infectious problems than epidural analgesia (13,20). Indeed several case reports of meningitis or epidural abscess have been reported following CSE anesthesia in obstetric patients (7,15,25,66,128,167), but also with simple spinal anesthesia and conventional epidural techniques central nervous system infections have been reported (11,45,103,136). Despite these occasional case reports, CNS infections remain extremely rare irrespective of the neuraxial technique used. Six publications evaluate the risk of infections following neuraxial anesthesia in obstetric patients (5,39,68,119,123,146). In over 900,000 patients only 2 cases of epidural abscess and 3 cases of meningitis were reported. Most authors, however, agree that strict aseptic techniques are of vital importance to prevent serious infections.

Neurologic complications.

As with any regional technique the potential for nerve damage is present. Several case reports in pregnant women of damage to the conus medullaris have been reported when using CSE (137). Especially with CSE it is imperative to perform the block as low as possible since the conus medullaris might extend below the L2 vertebral body. Up to 5% of parturients can have a

conus which extends lower than the L2 vertebral body (24). To avoid conus damage, careful attention to the correct interspace is required. It has been clearly demonstrated, using radiography and ultrasound, that most anesthesiologists, using anatomical landmarks, are 1 to 4 interspaces away from where they think to be (24,170). Identification of the correct interspace is therefore of prime importance. Ultrasound may be useful, especially in obese patients, to identify or confirm the correct interspace (24).

Post dural puncture headache (PDPH).

Since CSE includes a dural puncture, there is a theoretical risk of post-dural puncture headache (PDPH). This is a devastating complication in an otherwise healthy mother, keen on taking care for her newborn child. However the use of small-gauge atraumatic spinal needles (26-29 G) has dramatically decreased the problem. From the available literature it seems that PDPH occurs in no more than 1% of patients. Furthermore the incidence is not increased as compared to conventional epidural analgesia (13,36,38,47,84,91,98,100,109,110,160,161,167). Norris et al. reported that unintended dural puncture with the epidural needle occurs much more frequently when using conventional epidural analgesia as compared to CSE (110). Rarely the spinal needle itself is responsible for PDPH. Usually a dural tap with either the Tuohy needle or the epidural catheter causes postural headache. It is also worthwhile to mention several reports advising to insert the epidural catheter in the subarachnoid space following an accidental dural tap. The incidence of PDPH and bloodpatching seems reduced when the epidural catheter is threaded intrathecally (30,111,143,148,160).

Of interest is that air should be replaced by saline in the loss of resistance technique, as air might cause more PDPH, increase its severity and induce other problems with your epidural block such as recurrent breakthrough pain (3,88).

Motor block.

For many years, strategies to reduce the incidence and severity of motor block, associated with epidural analgesia, have been designed. Lower concentrations of local anesthetic solutions, the addition of opioids and other adjuvant drugs, the introduction of patient controlled epidural analgesia and the use of newer local anesthetic agents have been instrumental in reducing problematic motor block. Low dose epidurals are successfully used to allow laboring women to maintain mobility whilst being completely pain free (37,100). With CSE it is easier to provide effective analgesia with no or very minute doses of local anesthetics. As already described, CSE decreased total local anesthetic consumption (36,37,162) and decreased the occurrence of motor block compared to standard epidural techniques (36,37,100,162).

Some authors have questioned the safety of walking during labor and neuraxial analgesia. However, several authors demonstrated that with CSE motor function and balance remained intact, whilst low dose epidurals induced clinically detectable dorsal column deficits (17,44,127). Ambulation became common practice and can be advised, provided adequate precautions, written protocols and testing of motor function following initiation of analgesia is performed. Motor function testing is straightforward and includes the ability to perform a deep knee bend unassisted and to perform a straight leg lift for 30 seconds with the eyes closed. It remains unclear how epidural maintenance of analgesia affects postural stability and motor function (44).

Caution is required when using epidural test doses following insertion of an epidural catheter, since test doses can significantly impair motor strength (31). Controversy also exists on the effects of spinally administered epinephrine (64,166) on motor block. Whilst minute doses do not impair motor function, larger doses have a significant impact. A small dose of intrathecal epinephrine conveys clinical benefits in terms of prolonged spinal analgesia (64,166).

Although reduced motor block and ambulation during neuraxial analgesia are certainly feasible, controversy concerning the benefits of ambulation remains (17,51). Several trials demonstrated that ambulation during labor does not affect the outcome of labor (100), whilst others did note a beneficial effect of ambulation. In patients without epidural analgesia, ambulation halved the operative delivery rate (4). Ambulation also reduced the length of the second stage of labor (60). In the COMET trial mobile techniques of labor analgesia were associated with an improved labor outcome (37,38). Despite this controversy, those women actually using ambulation during labor prefer ambulation as it increases their feelings of self control. It was also noted that epidural top-ups administered during ambulation induced less hypotension than top-ups administered in the supine position (8).

Progress and outcome of labor.

Epidural analgesia has been implicated in prolonged labors, in an increased instrumental delivery rate and in an increased Cesarean section rate.

Extensive research has now led to unanimous consensus that epidural analgesia does not produce more instrumental vaginal and operative deliveries. However, epidural analgesia prolongs the duration of the first stage of labor and increases the need for exogenous oxytocin.

Tsen et al. demonstrated in a prospective, randomized trial that CSE is associated with an increased cervical dilation rate. Patients randomized to CSE analgesia experienced a doubling of the mean cervical dilation rate and a reduced duration of the first stage of labor as compared to epidural analgesia (157). Several mechanisms have been proposed to explain these observations. First, CSE rapidly reduces epinephrine plasma levels. Since epinephrine is tocolytic (147), CSE quickly enhances uterine activity. Because analgesia and epinephrine reductions occur much more rapidly than with conventional epidural analgesia, progression of labor could be enhanced. Second, since high doses of local anesthetics are avoided with CSE, the in vitro and in vivo observations that bupivacaine impairs uterine activity are also avoided (74,171). Disappointingly, several randomized trials comparing CSE with conventional epidural analgesia could not demonstrate a difference in labor duration (37,109,159,162).

CSE as compared with low dose epidural strategies was not associated with an increased spontaneous vaginal delivery rate in most trials (36,37,47, 109,132,159,162). Only one trial reported less instrumental vaginal deliveries with CSE as compared to epidural analgesia (100).

Fetal heart rate changes.

Abnormal fetal heart rate recordings and fetal bradycardia are worrisome side effects that may follow any type of effective labor analgesia. Wong et al. reported more abnormal cardiocardiographic readings following CSE as compared to systemic analgesia (173). Some authors reported that this complication could be more common following intrathecal opioids than following conventional epidural analgesia (28,29,72,79). Clarke et al. were the first to describe in detail the association between intrathecal opioids, uterine hyperactivity and fetal bradycardia in the absence of maternal hypotension (28). Since then several non-randomized trials have evaluated the incidence of fetal heart rate changes following either intrathecal opioids and conventional epidural analgesia (106,122,161,163). Nielsen et al. and Eberle et al. did not observe an increased incidence of fetal heart rate abnormalities, whilst all other non-randomised reports noted at least a doubling of the incidence of worrisome fetal heart rate changes (5) (Table 2).

TABLE 2. Incidence (%) of fetal heart rate abnormalities following CSE or conventional epidural analgesia as reported using a non-randomised study design.

	CSE	Conventional epidural
Nielsen 1996 (106)	15.4 %	18.8 %
Eberle 1998 (48)	3.9 %	3.9 %
Kahn 1998 (75)	5.6 %	2.5 %
Palmer 1999 (122)	12 %	6 %
Van de Velde 2001 (163)	11.4 %	5.9 %

Mardirossof et al. performed a meta analysis of several prospective trials comparing intrathecal opioid analgesia with non-intrathecal opioid analgesia with respect to fetal bradycardia (93). These authors concluded that intrathecal opioids were associated with significantly more fetal heart rate abnormalities. Vercauteren suggested that the incidence of fetal bradycardia depended on the dose of the intrathecal opioid (165). Van de Velde et al. performed a prospective, randomized trial specifically designed to evaluate the effects of intrathecal opioids on the incidence of worrisome fetal heart rate changes (162). These authors concluded that high doses of intrathecal opioids increased the incidence of fetal heart rate abnormalities despite a reduced incidence of hypotension. Similar results were published by Nicolet et al. (105). These authors also indicated that older age and higher VAS scores prior to analgesia were risk factors associated with fetal heart rate abnormalities after CSE. Gaiser suggested that the risk of abnormalities in the fetal heart rate is increased when the fetal head is not engaged or when decelerations are already present prior to initiation of analgesia (56).

The presumed mechanism of opioid induced non-reassuring fetal heart rate tracings is uterine hyperactivity caused by rapid analgesia and as a result a rapid decrease in maternal circulating catecholamines. Based on laboratory investigations by Segal et al. increased myometrical tone and increased uterine vascular resistance may be caused by the decrease of epinephrine

levels in the continuing presence of high norepinephrine levels when CSE analgesia is performed (26,147). Abrao et al. recently measured uterine tone using an intrauterine pressure catheter following either CSE or conventional epidural analgesia (2). Fetal heart rate changes and uterine hypertonus occurred more frequently following CSE. Analgesia was initiated rather late in labor and unfortunately these authors only measured intrauterine tone and fetal heart rate for 15 minutes after initiation of analgesia. So changes associated with epidural analgesia might have been missed. They also demonstrated that the faster analgesia occurred and the more pronounced it was, the higher the probability of abnormal cardiocardiographic readings. Of course this effect is strengthened by the simultaneous occurrence of maternal hypotension in certain patients.

Further study into the mechanism therefore seems required. Other mechanisms, such as direct central effects of sufentanil, are possibly involved. We can only speculate about alternative pathophysiological mechanisms. Maternal rostral spread of spinal opioids may centrally affect the release of oxytocin and subsequently induce uterine hyperactivity. It is known that intravenous opioids have central effects and alter the release of various central peptides, including oxytocin and vasopressin (140). In a recent interesting paper, Stocche et al. studied the release of oxytocin in women in first stage labor undergoing regional analgesia (153). They compared conventional epidural analgesia using plain bupivacaine 0.25 % with intrathecal sufentanil 10 µg and measured maternal plasma oxytocin levels at 15, 30, 60 and 90 minutes after induction of analgesia. Intrathecal sufentanil decreased the plasma concentration of oxytocin. These results contradict with the hypothesis that spinal opioids may induce uterine hyperactivity by modulating central oxytocin release. However the authors themselves admit they only infrequently sampled blood. As oxytocin release typically occurs in spurts, has an extremely short plasma half-life and as the authors only performed their first sampling at 15 minutes, they may have missed an initial increase in oxytocin release followed by the observed decrease in plasma oxytocin. More work is therefore required to elucidate the mechanism responsible for uterine hyperactivity and fetal bradycardia occurring after intrathecal opioids.

It is important to note that neonatal and obstetric outcome is not affected by the use of intrathecal opioids. Carvalho et al. failed to demonstrate any changes in fetal oxygen saturation following CSE analgesia (23). In none of the reports emergent C-sections had to be performed as a result of sufentanil induced non-reassuring fetal heart rate tracings (2,48,75,93,106,122,162, 163,166). Also neonatal outcome, as assessed by Apgar scores, umbilical artery pH and admittance to the neonatal intensive care, was unaffected by the technique used. Albright and Forster performed an institutional retrospective survey involving 2500 patient records and observed no increase in emergency Cesarean delivery associated to the use of intrathecal opioids (6). Only Gambling et al. contradicted this and reported an increased C-section rate due to more non-reassuring fetal heart rate abnormalities (57). However also in their study neonatal outcome was good and not different from the epidural group.

Testing the epidural catheter following CSE.

Since epidural catheters can inadvertently be misplaced in either the cerebrospinal fluid or in an epidural vein, anesthetists have been using test doses to verify the correct position of the catheter. Unfortunately, test doses are neither sensitive nor specific (33,108). Furthermore epinephrine containing test doses can induce motor impairment and thus complicate ambulation during labor (31). Some authors also suggested that an epinephrine containing test dose has potential adverse effects on uteroplacental perfusion (92). As a result several authors suggested to abandon routine testing of the epidural catheter, since adequate analgesia confirms the correct position of the catheter without prior testing (14).

With CSE, analgesia occurs rapidly and testing the functionality of the epidural catheter is not possible until the initial spinal dose wears off. Many authors consider the fact that the reliability of the epidural catheter is uncertain during this period as a major disadvantage. Their concern is related to the possibility that the catheter may be dysfunctional when an emergency cesarean section is required. Especially in high risk pregnancies this is considered a major drawback. However, it is important to note that even with a well tested epidural catheter, we can never be absolutely sure that several hours later the catheter remains correctly positioned. Even with conventional epidural catheters fractionated dosing or a de novo test dose are required the moment the catheter is used for the injection of high doses of local anesthetics.

A second concern involves the fact that some authors do not want to initiate epidural analgesia immediately after the spinal dose. Only when the epidural catheter is formally tested once the spinal dose has worn off, the catheter is used

throughout labor. As a result most patients will experience breakthrough pain. However, several authors initiate an epidural infusion immediately following the initial spinal dose (55). With low volume, low dose techniques, the risk of total spinal anesthesia or toxic side effects is minimal. These doses cannot produce systemic toxicity or total spinal anesthesia even when direct intravascular or intrathecal injection occurs. However if a continuous epidural infusion or patient controlled epidural analgesia does not produce adequate analgesia, one must consider an intravascular position of the catheter.

Intrathecal drug combinations.

Local anesthetics.

Currently bupivacaine is mostly used for intrathecal labor analgesia, usually in combination with opioids. Also levobupivacaine and ropivacaine have been used successfully during labor analgesia. Lim et al. compared 2.5 mg bupivacaine with 2.5 mg ropivacaine and 2.5 mg levobupivacaine (89). Bupivacaine produced the longest analgesia but with the highest incidence of motor block. These results were not confirmed by Sah et al. who did not find a difference between levobupivacaine and bupivacaine (144). Camorcia and co-workers described the minimum local anesthetic doses of all three local anesthetics and suggested a potency hierarchy of spinal bupivacaine > levobupivacaine > ropivacaine (21). Whitty et al. described the ED₉₅ of spinal bupivacaine combined with fentanyl (170). Van de Velde et al. were the first to construct the full dose response relationship of spinal ropivacaine, levobupivacaine and bupivacaine combined with opioids for labor analgesia. Contrary to Camorcia et al., these investigators noted that bupivacaine was significantly more potent than both other local anesthetics and that ropivacaine and levobupivacaine were of similar potency (158).

Opioids.

Plain intrathecal opioids are successful in producing labour analgesia. Palmer et al. established that fentanyl 25 µg was the optimal intrathecal dose (121). Increasing the dose above 25 µg did not improve the duration or quality of analgesia, but increased the incidence of side effects. For sufentanil an ED₉₅ of 8.9 µg was established (70). However, certainly in Europe, most anaesthesiologists prefer the intrathecal combination of local anaesthetics and opioids. Adding opioids to the spinal mixture, reduces the ED₅₀ of the local anaesthetic agent and prolongs dose-dependently the duration of initial spinal analgesia (154). Therefore most authors recommend a local anesthetic / opioid combination for initial spinal analgesia. Wong et al. showed that 15 µg fentanyl added to the local anesthetic/opioid mixture was the optimal dose in terms of efficacy and side-effects (172).

Patients may react very differently to intrathecal opioids. Landau et al. demonstrated that mu-opioid receptor genetic variants influence the dose required to produce effective analgesia (85).

Respiratory depression following intrathecal opioids has been described. This occurred usually in small patients receiving high doses of opioids following initial parenteral opioid analgesia. Respiratory depression occurred within 30 minutes from injection. Vigilance following the intrathecal injection of opioids is therefore required. During labour analgesia, intrathecal opioids have been associated with new onset foetal heart rate changes (28,162). Usually these changes were related to uterine hyperactivity and not maternal hypotension. Several authors postulated that an imbalance between maternal catecholamines following rapid spinal analgesia produces uterine hypertonicity. It remains unclear why this only occurs following high dose intrathecal opioids and not following the combination of lower doses of opioids and local anaesthetics (162).

Clonidine.

Chiari et al. studied the use of pure spinal clonidine labour analgesia (27). This seems not feasible since doses producing adequate analgesia also induce unacceptable side effects such as hypotension. Adding lower doses of clonidine (15 - 45 µg) to spinal analgesics does improve the duration and quality of initial spinal analgesia (9,95,96,118). However, especially when clonidine is combined with local anaesthetic agents, significant and prolonged hypotension is likely to occur (9,96,118,125).

Epinephrine.

Epidurally administered epinephrine significantly reduces the MLAC concentration of bupivacaine in labouring patients and improves the quality of analgesia (130). Also for spinal use epinephrine, combined with local anaesthetics and opioids, has been evaluated in a wide range of doses from 2.25 - 100 µg. Duration of intrathecal analgesia was consistently prolonged (58,64).

Unfortunately, epinephrine also induces an increased incidence of maternal motor deficit especially when administered epidurally or intrathecally (31,61). Vercauteren, however, reported that minute doses (2.25 µg) of spinal epinephrine were not associated with more motor block (166). This was

confirmed by Gurbet and co-workers (64). Epidural epinephrine might also prolong labour duration by β-agonist effects, especially when higher doses are infused in the epidural space (46,112,115). Furthermore adding epinephrine to pharmacist pre-prepared solutions complicates storage and significantly increases the price of handling and preparation. Thus, this author has abandoned the addition of epinephrine from the local anaesthetic solution used for spinal and epidural administration.

Neostigmine.

Nelson et al. investigated the analgesic potential and side effect profile of 5, 10, 20 µg intrathecal neostigmine alone (101). From this first phase, these investigators chose 10 µg as the optimal dose to be added to intrathecal sufentanil and determined the ED₅₀ of spinal sufentanil with and without neostigmine. Neostigmine successfully reduced the ED₅₀ of spinal sufentanil. In a further step, they compared twice the ED₅₀ of spinal sufentanil with neostigmine to twice the ED₅₀ of plain spinal sufentanil. A synergistic effect on duration of analgesia of neostigmine was observed. D'Angelo et al. however reported no increase in analgesic duration with neostigmine as part of a multi-drug combination (local anaesthetic, opioid, clonidine and neostigmine) (42). Furthermore several authors reported a very high incidence of severe nausea and vomiting (116).

Other drugs: magnesium and adenosine.

Both adenosine and magnesium have been added to intrathecal opioids to relief labour pain (18,133). No significant advantages of adding adenosine to the analgesic mixture were observed. Magnesium prolonged intrathecal fentanyl analgesia.

TABLE 3. Suggested drug combinations for intrathecal use to initiate CSE labour analgesia. Dose may vary according to the stage of labour and intensity of labour pain.

	Local anesthetic (mg)	Opioid (µg)	Volume (mL)
Suggestion 1	Bupivacaine 2.5 - 3.5 mg	Sufentanil 1.5 - 2.5 µg	2 - 3 mL
Suggestion 2	Bupivacaine 2.5 - 3.5 mg	Fentanyl 10 - 15 µg	2 - 3 mL
Suggestion 3	Levobupivacaine 3.5 - 4.5 mg	Sufentanil 1.5 - 2.5 µg	2 - 3 mL
Suggestion 4	Levobupivacaine 3.5 - 4.5 mg	Fentanyl 10 - 15 µg	2 - 3 mL
Suggestion 5	Ropivacaine 3.5 - 4.5 mg	Sufentanil 1.5 - 2.5 µg	2 - 3 mL
Suggestion 6	Ropivacaine 3.5 - 4.5 mg	Fentanyl 10 - 15 µg	2 - 3 mL

These are just suggestions based on literature evidence and personal experience from the author.

Maintenance of epidural analgesia following the initial spinal dose.

Okutomi et al. studied the optimal moment to initiate a continuous epidural infusion following the initial spinal dose (114). These authors suggested to start the infusion early, within 30 minutes of the spinal dose, to avoid breakthrough pain. Missant et al. studied patient controlled epidural analgesia (PCEA) with or without a continuous epidural infusion. They concluded that a background infusion resulted in less breakthrough pain, less anaesthetist interventions and less local anesthetic consumption (97). Okutomi et al. recently confirmed these findings with a slightly higher background infusion (113).

General conclusions.

CSE analgesia is a very popular technique for labor pain relief. A recent Cochrane review suggests that CSE produces much faster analgesia than conventional epidural analgesia. Although various authors limit the use of the technique to specific indications, a wide variety of indications has been described by different authors. As a result, almost all patients fall in one of these categories. CSE analgesia provides rapid, highly effective analgesia with minimal motor block, reduced local anesthetic doses and perhaps an improved obstetric outcome. Maternal satisfaction is improved. An important advantage of the CSE technique is the enhanced epidural catheter reliability. PDPH and infections do not occur more frequently as with conventional epidural analgesia. Non reassuring fetal heart rate tracings occur significantly more frequently following high doses of intrathecal opioids. Occasionally, respiratory depression, following high doses of opioids intrathecally, can occur.

This author strongly recommends using CSE as the standard technique of labor analgesia.

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NEURAXIAL OPIOIDS: WHICH DRUG, DOSE, WHICH IS THE BEST?

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1. Introduction:

Various opioids have been injected into the epidural and intrathecal spaces to provide and enhance pain relief in parturient¹. As sole agents, opioids may provide analgesia for the first stage of labour and in the postpartum period. Opioids are not effective as sole agents in relieving the pain of the second stage of labour (more intense and involves a somatic component).

2. Mechanisms of action:

All opioids produce analgesia by binding to G protein-coupled opioid receptors, located not uniformly throughout the CNS. Opioids administered into the epidural space must first traverse the dura and penetrate the spinal cord to exert their effect. Only a fraction of the dose crosses into the intrathecal space following epidural injection because the epidural venous plexus absorbs a large proportion of drug. This absorption can produce significant plasma drug concentration after epidural administration with epidural morphine². Some authors have even questioned whether the actual site of drug action is the spinal cord or the brain given the large doses of opioids administered into the epidural space and secondary systemic redistribution. Subsequent studies have shown that the site of action of lipophilic opioids administered epidurally is indeed in the neuraxis³.

Spinal opioid administration requires a much smaller dose and the onset of action is more rapid, so intrathecal administration (compared to epidural administration) of opioids minimizes systemic side effects due to the minuscule doses of opioid used. However, opioids administered into the epidural or intrathecal space may still result in untoward effects from direct spinal effects and from cephalad spread within the CSF to the brain.

The analgesic effects and side effects differ among the various opioids due to physicochemical differences. The most important physicochemical property is lipid solubility. As a rule, the more lipid soluble opioids (e.g., sufentanil) have a more rapid onset of action because their rapid penetration of lipid membranes allows them to quickly reach the opioid receptors in the spinal cord. However, high lipid solubility also results in a relatively short duration of action, as these drugs are readily able to traverse blood vessel walls and undergo systemic redistribution. Other physicochemical characteristics that impact the clinical profile are size and pKa.

3. Opioids:**3.1. Morphine**

Morphine was the first opioid administered into the neuraxis to provide labour analgesia⁴. Morphine's poor lipid solubility confers a prolonged duration of action, as it remains in the CSF in the ionized form for many hours, exerting an analgesic effect for up to 24 hours. This attribute makes it an attractive choice for providing analgesia for the entire first stage of labour

with a single dose. The prolonged analgesic action of neuraxially-administered morphine can provide excellent postoperative pain relief following caesarean section (CS) in doses ranging from 0.1 to 0.25 mg, or even 0.5 mg. A spinal morphine dose of 0.1 mg was found to be optimal, producing post-CS analgesia comparable to that provided by doses as high as 0.5 mg, but with less severe pruritus. However, a high incidence of serious complications and bothersome side effects (nausea, vomiting, pruritus), observed even with reduced doses, has limited the widespread use of intrathecal morphine for labour analgesia. Although decreasing the dose reduces the incidence and severity of side effects, it also reduces the duration of analgesia.

Different doses of epidural morphine after caesarean deliveries have been used, in order to compare the quality of analgesia and the incidence of adverse effects. One study assigned randomly in 90 healthy pregnant women who underwent caesarean delivery to receive 2.5, 3 or 4 mg of epidural morphine for postoperative analgesia. Epidural morphine provided sufficient pain relief for approximately 24 hours. About 27 per cent of the patients from each group were pain-free for up to 48 hours without further analgesics. Mild pruritus and nausea occurred in all three groups and there was no significant difference between them. No serious complications were observed. The authors conclude that low dose epidural morphine is effective in providing adequate analgesia following caesarean delivery⁵.

Intrathecal morphine has also been used for analgesia after CS. Yang et al.⁶ reported in 60 women that 0.1 mg intrathecal morphine plus NSAIDs (100 mg indomethacin suppository at the end of surgery and 500 mg naproxen po b.i.d.) provides analgesia of similar quality to 0.25 mg but with fewer undesirable side effects (pruritus, itching and nausea).

Abouleish et al.⁷ studied the addition of 0.2 mg of morphine, 0.2 mg of epinephrine, or their combination to hyperbaric bupivacaine for spinal anaesthesia in 70 CS. The results showed that the spread and regression of the sensory and motor blocks were similar among the groups. However, the intraoperative analgesia was superior in patients receiving bupivacaine combined with morphine and epinephrine, whereas there was no difference between those given an addition of either morphine or epinephrine. Postoperative analgesia was the shortest and opioid requirement in the first 24 h the most with epinephrine alone. No respiratory depression occurred. The neonatal condition was excellent in all groups. They concluded that the addition of 0.2 mg of morphine plus 0.2 mg of epinephrine to hyperbaric bupivacaine improves the intra- and postoperative analgesia without an added risk. This improvement is not due to vasoconstriction and a reduction in the absorption of bupivacaine from the subarachnoid space.

3.2. Diamorphine:

It is used in the United Kingdom in spinal doses of 0.3 mg to 0.4 mg, with less severe side effects than morphine. The ED₉₅ for the amount of intrathecal diamorphine required to prevent intraoperative supplementation during spinal anaesthesia for CS is 0.4 mg in clinical terms. Times to first requests for analgesia, incidence of nausea, vomiting and pruritus increase with dose⁸. Epidural diamorphine (2.5 mg) provides prolonged post-CS analgesia^{9, 10}.

3.3. Methadone:

Usual doses of epidural methadone are 2 to 5 mg. Epidural methadone has shown to provide potent postoperative pain relief after CS under epidural anaesthesia with less incidence of urinary disturbances (difficulty in micturition and the need for bladder catheterization) than morphine¹¹. Compared with diamorphine, methadone has lower times to further analgesia but less incidence of significant desaturation (< 90% for 30 s) than epidural diamorphine for CS¹². Beeby et al compared epidural methadone, morphine and bupivacaine for pain relief after CS in 178 women, concluding that epidural methadone is an effective and safe method of postoperative pain relief¹³.

3.4. Fentanyl:

Fentanyl is a synthetic opioid with higher lipid solubility than morphine, so its spread within the neuraxis is limited in comparison to morphine, and therefore side effects are less common and often less severe. The lipid solubility speeds its onset of action, so that analgesia occurs 5 to 10 minutes after epidural administration and less than five minutes after intrathecal injection. However, increased lipid solubility also accounts for a brief duration of action because it is rapidly redistributed from the site of injection due to its systemic absorption. The duration of action following intrathecal administration is approximately 1.5 hours. One trial found an analgesic ceiling effect at 25 mcg with 14 mcg the effective dose yielding pain relief in 50% of women (i.e., ED₅₀)¹⁴. In another study, the ED₅₀ was found to be 18.2 mcg¹⁵. Dahl et al.¹⁶ administered spinal fentanyl, in doses ranging from 2.5 to 60 mcg to augment spinal anaesthesia for CS. Pruritus, nausea, and vomiting were significantly reduced when doses lower than 35 mcg were administered, in comparison with doses of 40 to 60 mcg.

A typical epidural dose is 100 mcg, but even larger doses of 150 to 200 mcg result in a maximum of only 1.5 hours of analgesia. For labour analgesia, fentanyl (2 to 4 mcg/mL) is often added to a low-dose local epidural anaesthetic solution to potentiate the analgesic effect. It is also used intrathecally as the sole analgesic for the first stage of labour, and in combination with an intrathecal local anaesthetic to provide analgesia for the second stage of labour. Pruritus is the most common side effect of fentanyl or sufentanil.

The analgesia after CS provided by epidural fentanyl has been compared with sufentanil: the relative analgesic potency of epidural sufentanil:fentanyl is approximately 5 and that there are no differences between the opioids in the onset, duration, and effectiveness of analgesia when equianalgesic doses are administered¹⁷.

3.5. Sufentanil

Sufentanil has greater potency and lipid solubility than fentanyl. It is most commonly used to provide labour analgesia alone or in combination with local anaesthetics by the intrathecal route, although it has also been used as a sole agent for labour analgesia by the epidural route¹⁸.

The ED₅₀ of intrathecal sufentanil is reported to be 4.1 ± 0.31 mcg (4.4 times as potent as fentanyl when given intrathecally to parturient)¹⁹. Spinal sufentanil 2.5 to 20 mcg has been used with bupivacaine for CS. Braga Ade et al.²⁰ reported in parturients receiving hyperbaric bupivacaine 12.5 mg with sufentanil 0, 2.5, 5, or 7.5 mcg that analgesia lasted longer with sufentanil 5 and 7.5 mcg, and pruritus and somnolence were more pronounced with 7.5 mcg, so they do not recommend a dose of spinal sufentanil greater than 5 mcg. Other authors described that intrathecal sufentanil 10 mcg provided more duration of analgesia than 5 mcg without differences in hypotension, nausea or vomiting²¹.

The indications for sufentanil administration are the same as for fentanyl. Except for relative potency, there do not appear to be significant differences in clinical profiles between the two opioids when administered into the neuraxis, and many clinicians use them interchangeably. The duration of analgesic action is similar to fentanyl, approximately 1.5 hours. Sufentanil is often coadministered with a local anaesthetic.

A background infusion in PCEA with sufentanil (except for a lower pain score during the initial hours) does not offer major advantages in terms of sleep quality or sufentanil consumption, and side effects may be more pronounced owing to increased drug administration²².

3.6. Alfentanil

Alfentanil is infrequently used for labour analgesia. It has been used for epidural analgesia²³ in 24 women randomized to receive epidural alfentanil 500 mcg in 10 mL 0.125% bupivacaine as a bolus dose followed by continuous infusions of alfentanil 20 mcg/mL in 0.125% bupivacaine; or fentanyl 50 mcg in 10 mL 0.125% bupivacaine, (bolus) followed by continuous infusions of fentanyl 2 mcg/mL in 0.125% bupivacaine for labour analgesia. However, in one study with 16 primiparous patients requesting pain relief during labour, a single drug continuous infusion of epidural alfentanil at 30 mcg/kg per hour rapidly obtained excellent pain relief in early labour in all patients, but analgesia was inadequate in the latter part of stage I and during the second stage in five of the 16 patients—nonwithstanding several additional doses of alfentanil, and bupivacaine had to be administered. No serious maternal side effects, except nausea, were encountered. Although all neonatal Apgar scores were between 7 and 10, the Amiel-Tison test clearly indicated the existence of neonatal hypotonia. The continuous extradural administration of alfentanil proved to be unsatisfactory for pain relief in labour in this study²⁴.

Alfentanil has also been administered intrathecally in a dose of 0.25 mg, with and without bupivacaine 2.5 mg in 30 women²⁵. Onset of analgesia did not differ significantly between groups but duration was significantly longer in those receiving alfentanil-bupivacaine (mean 55 min vs. 40 min; $p < 0.05$). Quality of analgesia was satisfactory for all women, although the cumulative analgesia scores were significantly lower in the women receiving the alfentanil-bupivacaine mixture ($p = 0.003$). The incidence of adverse effects in mother and foetus was similar in both groups. The authors concluded that intrathecal alfentanil 0.25 mg alone as part of a CSE technique provides rapid analgesia of satisfactory quality without detectable motor blockade.

3.7. Meperidine

Meperidine is the only opioid that has local anaesthetic effects, and thus produces analgesia on a dual basis when administered into the neuraxis: it interacts with spinal opioid receptors and it also blocks axonal conduction.

A dose of 25 mg as the sole agent in the epidural space provides labour analgesia of short and variable duration (50 to 160 minutes). Repeated doses may be needed, resulting in accumulation of the drug in plasma with the risk of respiratory depression in mother or child²⁶, so epidural meperidine is not

a popular choice for labour analgesia. A dose of 50 mg administered epidurally in 34 non-labouring parturient resulted in no maternal hemodynamic changes, but did have local anaesthetic effects, a detectable sensory level in 2 patients²⁷. A benefit of epidural meperidine is a decrease in the incidence of shivering following epidural blockade²⁸.

Intrathecal meperidine, 10 to 20 mg, produces analgesia within 2 to 12 minutes, which may last for 1 to 3 hours. Comparing the analgesic efficacy of intermittent injections of intrathecal fentanyl (10 mcg), meperidine (10 mg), or sufentanil (5 mcg) administered to 65 parturient during the first stage of labour, Honet et al.²⁹ reported that the groups did not differ in onset or duration of effective analgesia. The meperidine group, however, had significantly lower pain scores once cervical dilation progressed beyond 6 cm. Side effects included mild pruritus and nausea. After intrathecal drug injection, variable decelerations of the foetal heart rate increased in the fentanyl and meperidine groups. All neonates had a 5-min Apgar score of 7 or more. The authors concluded that intermittent intrathecal injections of fentanyl, meperidine, or sufentanil could provide adequate first-stage labour analgesia. Meperidine appears to provide more reliable analgesia as the first stage of labour progresses²⁹. However, greater doses of intrathecal meperidine are associated with a high incidence of nausea and vomiting (16 of 21 patients in one study with doses of 15 or 25 mg³⁰).

3.8. Butorphanol

Butorphanol, an opioid with profound dose-dependent sedation has been used epidurally in low doses (0.5 mg and 0.75 mg) with 0.125% bupivacaine and compared to bupivacaine alone in 121 parturient following caesarean delivery. A combined spinal, epidural technique was used. Spinal anaesthesia was used for surgery. The epidural route was used for postoperative analgesia with the study drug. The incidence of sedation was 5% in all the three groups. The lower dose of epidural butorphanol with bupivacaine produces a significantly earlier onset, longer duration and better quality of analgesia than bupivacaine does³¹.

4. Adverse effects:

4.1. Maternal adverse effects:

4.1.1. Pruritus:

Pruritus is a common side effect of neuraxial opioid administration. It is more likely to occur after intrathecal rather than epidural techniques³². The aetiology of neuraxial opioid-induced pruritus is unclear.

Antihistaminic drugs are not efficacious. The ideal treatment is a small dose of an opioid antagonist such as naloxone (40 to 160 mcg IV, initially 40 to 80 mcg and titrate additional small doses to effect), naltrexone (6 mg orally), or the mixed opioid agonist-antagonist nalbuphine (2.5 to 5 mg intravenously). Small doses of opioid antagonists are known to selectively reverse opioid side effects without affecting analgesia³³. Sometimes, the patient may be given intravenous patient-controlled analgesia (PCA) naloxone, to allow her to self-titrate 40 mcg every five minutes³⁴ to prevent recurrent itching. Other strategy is prophylactic serotonin (5-HT₃) that prevents neuraxial opioid-induced pruritus³⁵ and reduces the incidence of severe pruritus and the need for treatment³⁶.

4.1.2. Nausea and vomiting

Nausea occurs commonly in labouring patients due to visceral pain. Epidural and spinal local anaesthetic block diminish or eliminate pain, but they may also precipitate nausea and vomiting by decreasing blood pressure and causing hypoperfusion of the area postrema in the medulla. Opioids administered into the neuraxis may also produce nausea and vomiting due to cephalad spread in the CSF to the chemoreceptor trigger zone. The incidence of nausea and vomiting after neuraxial opioid is much greater with the relatively poorly lipid soluble morphine compared to more lipid soluble agents, because morphine travels more readily within the CSF³⁷.

Nausea and vomiting resulting from hypotension are treated by administration of vasopressors, and those opioid-induced nausea are treated with naloxone or nalbuphine³⁸. A systematic review of placebo-controlled randomized trials of prophylactic serotonin (5-HT₃) receptor antagonists in patients who received intrathecal morphine for CS found that these agents significantly reduced the incidence of postoperative nausea (22 vs. 33.6%) and vomiting (7.7 vs. 16.8%) and the use of antiemetic medication (8.8 vs. 22.8%)³⁶.

4.1.3. Hypotension:

Hypotension occurs in 5% to 10% of parturients who receive intrathecal opioids (the incidence is higher when a local anesthetic or clonidine is added to the opioid)^{39, 40}.

4.1.4. Respiratory depression

Respiratory depression due to cephalad spread of opioids to brainstem respiratory centres after neuraxial block is a rare complication in labouring patients. Factors that increase the likelihood of respiratory depression

include a large opioid dose, poor opioid lipid solubility, concomitant use of additional sedatives and opioids by other routes, and the use of the sitting position soon after injection of opioids (hypobaric relative to cerebrospinal fluid). The major recommendations⁴¹ are the identification of women at increased risk of respiratory depression (history and physical examination) and the prevention after neuraxial opioid administration (adequate drug and dose selection, monitoring and detection). Treatment includes supplementary oxygen, ventilation if necessary and intravenous naloxone, titrated to effect (40 to 80 mcg increments) and then an infusion of a dose sufficient to maintain an adequate respiratory rate should be instituted until the effect of the opioid has dissipated (e.g., 1 to 2 mcg/kg/min)⁴².

4.1.5. Urinary retention

Urinary retention is a bothersome side effect of intraspinal opioid administration, produced by relaxation of the detrusor muscle.

4.1.6. Delayed gastric emptying:

Labour may delay gastric emptying⁴³ and opioids may further exacerbate this delay.

4.1.7. Recrudescence of herpes simplex virus infections:

Some reports have suggested a relationship between spinal⁴⁴ and epidural⁴⁵ opioid administration and reactivation of oral herpes infection.

4.2. Foetal effects

4.2.1. Transplacental passage

The opioids may affect the foetus and/or neonate by gaining access to the maternal circulation and undergoing transplacental passage. The doses of opioid used for intrathecal administration are considerably lower than epidural doses, and systemic uptake is negligible. Thus, maternal absorption of intrathecally-administered opioids does not pose a direct risk for the foetus or neonate.

The plasma kinetics following injection of epidural morphine are similar to those seen after an intramuscular injection^{46,2}.

Epidural fentanyl and sufentanil have high lipid solubility and a faster onset of action, greater systemic absorption and lower concentrations in the foetal circulation than morphine.

4.2.2. Foetal bradycardia

Intrathecal opioids may induce uterine hypertonus contraction leading to foetal bradycardia⁴⁷, with an incidence nearly twice as high with the intrathecal rather than the epidural route⁴⁸. A meta-analysis reported foetal bradycardia within one hour of intrathecal opioid administration occurred in 7.3 vs. 4.8% controls⁴⁸, but not increased rate of CS in women receiving intrathecal opioids. Uterine hypertonus may be reversed with nitroglycerin (60 to 90 mcg IV)⁴⁹, and another dose of nitroglycerin or terbutaline 0.25 mg IV if persistent hypertonus.

4.2.3. Effect on breastfeeding

The potential effect of neuraxial analgesia in labour on subsequent breastfeeding success is controversial. The American College of Obstetricians and Gynaecologists concluded that breastfeeding is not affected by choice of anaesthetic; thus anaesthetic choice should be based upon other considerations⁵⁰.

4.3. Effects on the neonate and child

4.3.1. Neonate

Systemic opioid absorption can result in neonatal respiratory depression, which is sometimes observed following systemic opioid administration during labour^{51, 52}.

There are in controversies in Early Neonatal Neurobehavioral Scale (EENS) scores in neonates of mothers who had received epidural analgesia or not, although the great majority of articles reported no differences⁵³, or even a meta-analysis reported neonates of mothers receiving epidural analgesia were more alert than those of mothers who received systemic opioids or no medication⁵⁴.

Neurobehavioral assessment of neonates using the Neurologic and Adaptive Capacity Score (NACS) has not shown perceptible changes after prolonged epidural infusions of sufentanil⁵⁵ or fentanyl⁵⁶.

4.3.2. Child

The effects of in utero exposure to neuraxial analgesia on long-term brain development were not independently associated with learning disabilities diagnosed before age 19 years⁵⁷.

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DIRECT NEUROTOXICITY OF LOCAL ANESTHETICS

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Background: Perioperative nerve injuries are a rare complication of regional anesthesia. Risk factors contributing to neurologic deficit after regional

anesthesia include traumatic injury to the nerves during needle or catheter placement, neural ischemia, infection, and choice of local anesthetic solution. (1) Additionally, postoperative neurologic injury due to pressure from improper patient positioning or from tightly applied casts or dressings and surgical trauma, are often attributed to the regional anesthetic. Patient factors such as body habitus or a pre-existing neurologic condition may also contribute. (2) Moreover, neurologic complications after neuraxial anesthesia might be a direct result of local anesthetic toxicity. Both laboratory and clinical evidence suggest that local anesthetic solutions are potentially neurotoxic with neurotoxicity varying among local anesthetic solutions. Neurotoxicity depends on P_{ka} , lipid solubility, protein binding and potency. (3) Additives such as epinephrine and bicarbonate may also contribute to neurotoxicity as does a preexisting neurology condition.

Local anesthetic toxicity and the central nervous system

Most local anesthetics administered in clinical doses and concentrations seem not to cause nerve damage according to clinical experience. However, high doses / concentrations and prolonged exposure of local anesthetics at the spinal roots may result in permanent neurologic deficits. (3) Cauda equina syndrome has been reported after single dose and continuous spinal anesthesia, after accidental intrathecal administration of epidural anesthesia and after repeated intrathecal injection after failed spinal block with lidocaine. (4) In fact, Auroy et al reported that 75% of the neurologic complications after atraumatic spinal anesthesia occurred after injection of hyperbaric lidocaine, including one patient who received a 5% lidocaine infusion over 5 hours for a total of 350 mg. These clinical observations have led to recommendations like not to use more than 60mg of lidocaine, to avoid epinephrine to prolong lidocaine spinal anesthesia (5) or to use isobaric solutions during continuous spinal anesthesia to avoid non uniform distribution within the intrathecal space. (6) 2-Chloroprocaine was introduced 50 years ago and was blamed for causing neurotoxicity in a series of 8 cases after a large volume of anesthetic solution administered accidentally intrathecally. Sodium bisulfite contained in the solution was assumed to be the source of this neurotoxicity (7) With the availability of preservative-free (plain) 2-chloroprocaine and the positive study results on volunteers and patients (8-10) the interest in a short-acting intrathecal agent aroused about a decade ago. Further clinical experience will give more information about the revival of old local anesthetics (shortacting 2-chloroprocaine and articaine and the intermediate-duration-acting prilocaine) for spinal anesthesia mainly in the ambulatory setting. (11)

Transient neurological symptom (TNS)

Transient neurological symptoms (TNS) after spinal anesthesia are characterized by postoperative pain or dyesthesia in the buttocks or the lower extremities and was first described in 1993. Schneider et al. described four cases of severe radicular back pain without sensory or motor deficits after spinal anesthesia with hyperbaric 5% lidocaine in lithotomy position. Symptoms resolved spontaneously within several days. (12) These symptoms were investigated further in subsequent larger studies, and initially referred to as transient neurologic toxicity, and subsequent terms for them included transient radicular irritation before the etiologically neutral term TNS was introduced. (13) Randomized-controlled trials have implicated lidocaine in the occurrence of TNS after spinal anesthesia. Compared with lidocaine, bupivacaine and levobupivacaine are less commonly associated with TNS after spinal anesthesia. (14) The incidence of TNS ranges between 0% and 37%, and depends on the used local anesthetic, surgical, and undefined patient factors. (15) Freedman et al. described in a large, multicenter, study involving 1863 patients a 11.9% incidence of TNS with lidocaine compared to tetracaine (1.6%) or bupivacaine (1.3%). (16) Thirty percent of patients described pain as severe and pain resolved within a week in over 90% of cases. Moreover, obesity, outpatient status and lithotomy position seem also to increase the risk of TNS for patients exposed to lidocaine suggesting that the risk of TNS is increased among outpatients in the lithotomy position (24.3%) compared to inpatients having surgery in positions different from lithotomy (3.1%). These risk factors have not been described using bupivacaine or tetracaine. Factors not increasing the risk of developing TNS after lidocaine spinal anesthesia according to Freedman et al. and confirmed by a systematic review are described in table 1. (16,17) Apart from the above-mentioned 2-chloroprocaine, mepivacaine may be a suitable substitute. In a series of 1273 patients undergoing spinal or combined spinal-epidural anesthesia, TNS occurred in only 6.4% of cases. (18) Etiology and clinical significance of TNS remain unknown. The most suggested mechanism is local anesthetic toxicity, although the mechanism seems not to be identical to that of cauda equina syndrome. (19) In fact, it is of pivotal importance to distinguish between factors associated with serious neurologic complications,

such as cauda equina syndrome, and transient symptoms for a proper clinical management of these patients. An increase in the concentration or dose of lidocaine with additional epinephrine increases the risk of irreversible neurotoxicity, without increasing the risk of TNS. The choice of the appropriate intrathecal solution and potential adjuvants have to be chosen adapting to surgery time and intraoperative position for each case.

Ischemic complications

Spinal cord blood flow can be altered in different ways by local anesthetics. Lidocaine and tetracaine maintain or even increase blood flow, whereas bupivacaine and levobupivacaine impair blood flow. (20) Adding epinephrine or phenylephrine further impairs blood flow. However, clinical studies have failed to correlate vasoconstrictors to temporary or permanent neurological deficits. Single case reports of vasoconstrictor-induced neurological deficits showed often several other concomitant risk factors. (4,21) Peripheral nerves show a dual blood supply with intrinsic endoneurial vessels and extrinsic epineurial vessels. However, reducing peripheral nerve blood flow might result in neural ischemia. Intraneural injection of volumes as small as 50 to 100 mL can lead to intraneural pressures which exceed capillary perfusion pressure for as long as 10 minutes and consecutively cause neural ischemia. Endoneurial hematomas caused after needle trauma have also been reported after intraneural injection. (22) The peripheral application of epinephrine enjoys an excellent safety profile based on extensive human experience, but worsens animal nerve injury in the setting of physical nerve damage or local anesthetic neurotoxicity. (23,24) The clinical relevance of this observation is unknown, but potentially, local anesthetic solutions containing epinephrine for peripheral nerve blocks might theoretically lead to peripheral nerve ischemia, especially in patients with microvascular disease. Therefore, it can be suggested that reduction of peripheral epinephrine dose or avoidance in select patients might be prudent.

Local anesthetics and preexisting neurologic disorders

The presence of preexisting chronic neurologic deficits might lead to an increased risk for further neurologic injury. The most cited mechanism is a "double crush" of the nerve at two different locations resulting in a nerve injury of clinical significance. (2) This concept suggests that nerve damage caused by local anesthetic toxicity or traumatic needle placement during the performance of a regional anesthetic might worsen neurologic outcome in the presence of an additional patient factor or surgical injury. Therefore, different recommendations have been published to minimize the risks of regional anesthesia for this patient category. (25) High doses of local anesthetics have been reported to induce nerve injury potentially by reducing nerve blood flow. Therefore, fibers in diabetic nerves may be more susceptible to anesthetic toxicity both because they are exposed to a higher local concentration of anesthetics due to impaired blood flow and because they are already stressed by chronic ischemic hypoxia. Kalichman et al showed in a streptozotocin-induced diabetic rats model that nerve-fiber injury, based on light microscopic scoring of axonal degeneration and demyelination, was evident in all lidocaine groups and was significantly greater for nerves of lidocaine-treated diabetic rats compared with lidocaine-treated controls. This data suggested that the risk of local anesthetic-induced nerve injury during regional anesthesia may be greater in diabetic patients. (23) Newer results in a diabetic rat model analyzed if the effects of smaller local anesthetic dose that produced negligible nerve fiber damage in normal rats would produce significant nerve damage in diabetic rats and if adding adjuvant drugs modulated this effect. (26) The main findings of potential translational importance of this important study were (modified according to Williams et al. (27)):

- All of the local anesthetic solutions tested (lidocaine 1% with or without epinephrine or clonidine additives and ropivacaine 0.5%) produced a longer mean duration of sensory nerve block in diabetic rats compared to non diabetic rats;
- Lidocaine 1% (plain) was not toxic to the sciatic nerve in diabetic rat, and none of the treatments were toxic to the sciatic nerve in the non diabetic rat;
- Neither the clinical dose of epinephrine (5 kg/ml) nor the "supraclinical" dose of clonidine (7.5 kg/ml) without local anesthetics was toxic to the diabetic rat sciatic nerve; and
- Block duration in diabetic rat correlated with nerve fiber degeneration.

This study and the established model make an important step towards optimization of the local anesthetic and adjuvant mixture with the ultimate clinical goal to improve the 1:1000 theoretical complication rate in diabetic patients to 1:10,000. If these findings can be translated to other neurologic disorders must be further studied.

Mechanisms of neurotoxicity of local anesthetics

Neurotoxicity of many local anesthetics has been demonstrated in many animal studies. (28) According to experimental evidence the suggested mechanism of local anesthetics-induced neurotoxicity seems to be unrelated to the blockade of the voltage-gated sodium channel or electrical inactivation of a nerve. (29) Due to biometric reasons it remains difficult to compare the neurotoxic potency for different local anesthetics in animals. Local anesthetics have been shown to induce elevations of intracellular calcium concentration through external influx or release from intracellular stores. (30) Moreover, local anesthetics activate special kinases and inhibit the energy production in the mitochondria (31,32) leading to apoptosis, which is one mechanism of neurotoxicity in vitro at high concentrations (33) The sub-cellular mechanism of apoptosis induction by different local anesthetics in neuronal cell cultures has been recently studied. (32,34) These investigation may help to evaluate which properties of local anesthetics are responsible for their toxic effects and how toxicity can be influenced. Recently, it was shown that lipophilicity but not stereospecificity might be a major determinant in local anesthetic-induced cytotoxicity. (34) and that lithium attenuates bupivacaine-induced neurotoxicity in vitro. (35) Questions like: is the chemical structure (ester or amide type) relevant for toxicity? Are there certain physicochemical properties that determine the toxic potential of a local anesthetic like lipophilicity, pKa value, protein binding, or molecular weight? How can we adapt our local anesthetic and possible adjuvants to reduce neurotoxicity? are of pivotal importance to avoid complications like neurotoxicity in peripheral and central regional anesthesia.

Age (< 60 yr vs 601 yr)

Gender

Preexisting neurologic disorder or back pain

Paresthesia during needle placement

Lidocaine dose (< 50 mg vs 51-74 mg vs >75 mg)

Intrathecal epinephrine

Intrathecal opioid

Intrathecal dextrose

Needle size (22 gauge vs 24-25 gauge vs 26-27 gauge)

Needle type (Quincke vs pencil point)

Bevel direction during injection (cephalad vs caudad vs lateral)

Table 1: Factors not increasing the risk of developing TNS after lidocaine spinal anesthesia, modified according to Freedman et al. (16)

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REGIONAL ANESTHESIA IN PATIENTS WITH PREEXISTING NEUROPATHY

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Perioperative nerve damage has long been thought to be multifactorial in etiology. Next to direct toxicity of local anesthetic and adjuvants, nerve block technique, surgical risk factors and patient positioning, patient-related factors are increasingly heralded as potential risk factors (1). In the event of a nerve damage occurring perioperatively, regional anesthesia is the most obvious intervention to be blamed for the injury to the patient, even though other risk factors should equally be considered, such as surgical injury and positioning (1,2). Pre-existing neuropathy has long been considered a risk factor for the development of nerve damage following regional anesthesia.

The conditions summarized by the term "neuropathy" are genetic, inflammatory, metabolic, or mechanical in origin. They may influence the anesthesiologist's deliberation of whether to include a regional technique in the anesthesia plan. For example, the patient with long-standing diabetes mellitus (DM) and significant end-organ damage presenting for extremity surgery may benefit from regional anesthesia, but intuitively, the presence of diabetic neuropathy may preclude performance of regional anesthesia because of concerns over increased risk of nerve damage. Anesthesiologists have long cautioned against RA in patients with preexisting neural disease (3). However, the evidence at this moment is not definitive and conclusions need to be extrapolated from limited clinical evidence, case report series, and animal experiments. This lecture will focus on diabetic neuropathy and multiple sclerosis as potential risk factors for nerve damage after regional anesthesia.

Diabetic neuropathy

Diabetic neuropathy is becoming a very frequent diagnosis in clinical practice. From the millions of patients (and rising) suffering from Diabetes mellitus, 10% feature signs of peripheral neuropathy at diagnosis and the number rises to more than 50% after 5 years (4). Diabetic neuropathy may influence toxicity, duration, success rate and use of a nerve stimulator. While some animal studies in type I diabetes models found increased toxicity when high doses of local anesthetic were used, other investigations found no overt signs of increased toxicity (1). Block duration is consistently increased in animal studies, and a recent study replicated these findings in patients with diabetes mellitus (5). A long list of case reports reporting nerve damage after regional anesthesia in patients with diabetic neuropathy is complemented by only one epidemiologic study. Here, it was reported that the incidence of nerve injury was higher in patients with diabetic neuropathy than the incidence reported in healthy patients (6) but numbers of both enrolled patients and patients with complications were low. There is limited evidence that higher stimulation thresholds may be necessary to stimulate severely neuropathic nerves (7). Block success in diabetic neuropathy may counterintuitively be higher, because the neuropathic nerve may be more sensitive to local anesthetic, the sensory area may already be partly anaesthetized by

neuropathy, and microangiopathy may delay systemic absorption of local anesthetic (8).

To minimize risk in patients with severe diabetic neuropathy, it is advised to reduce the dose of local anesthetic where possible, and to omit adrenaline as adjuvant.

Multiple sclerosis

Multiple sclerosis is a chronic demyelinating neuroinflammatory disease. Perioperatively, exacerbations may be due to fatigue, pyrexia, and iatrogenic nerve injury (regional anesthesia, delivery) (1). Most evidence concerning multiple sclerosis and regional anesthesia has been gathered in obstetrics. Spinal anesthesia has traditionally been considered unsafe in multiple sclerosis patients, and anecdotal evidence links exacerbation to prior administration of spinal anesthesia. However, weighing a possible exacerbation against alternative risks, e.g., difficult airway, a recent survey found that a large majority of UK anaesthetists would still perform a spinal rather than a general anesthetic in multiple sclerosis patients presenting for caesarean section (9). Epidural analgesia is most likely safe in parturients, and clinical trials show no association between epidural analgesia and relapse (10). However, it is important to know that the postpartum period is associated with a high risk of relapse due to the differential regulation of cytokines such as interleukin-10 (10,11). Finally, local anesthetics can directly interact with sclerotic lesions. Systemic lidocaine has even been proposed as a potential therapy against positive symptoms of multiple sclerosis (neuralgia, tonic), but the therapeutic range with respect to exaggeration of negative symptoms (paresis) was too small to permit routine use (12). In conclusion, whereas peripheral nerve blocks and epidural analgesia are most likely safe in multiple sclerosis, spinal anesthesia should only be performed after a very careful weighing of risks and benefits. In the presence of safe and feasible alternatives, spinal anesthesia should most likely be avoided in multiple sclerosis patients. In the perioperative phase, multiple sclerosis patients may experience aggravation of their disease, regardless of the anesthetic plan.

Regional anesthesia is a safe and effective way to provide perioperative pain relief. Extrapolating from very limited clinical and limited experimental evidence, pre-existing neuropathy does not represent an absolute contraindication for regional anesthesia, but should trigger a thorough risk-benefit analysis. In some patients (e.g., severe diabetic neuropathy), adaptation of the regional anesthetic technique (e.g., reduction of local anesthetic dose) may be prudent.

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LIPID RESCUE IN LOCAL ANAESTHETIC TOXICITY - WHERE IS THE EVIDENCE?

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How did it start? The interaction between lipophilic drugs and intravenous lipid emulsions (ILE) was suggested already in 1962 (1) when it was shown in rats that corn-based fat emulsion shortened thiopentone anaesthesia. In 1998 Weinberg et al. (2), demonstrated that higher bupivacaine doses were required to produce cardiac arrest when rats received pre- or posttreatment with ILE. After supportive studies in dogs and in isolated rat heart the basis for "lipid rescue" was created, and suddenly in 2006 and in the following years several human case reports of success of the use of ILE in bupivacaine and ropivacaine intoxications were published suggesting a possible benefit of ILE in the treatment of intoxications caused by lipophilic local anesthetics (3). *Suggested mechanisms of action:* The suggested main mechanism of action was based on the lipid sink theory, i.e., lipophilic agents may be entrapped in the lipid plasma thus diminishing the drug concentration in the hydrophilic plasma phase. Also other mechanisms, mainly concerning the role of fatty acids in improving cardiac contractility in cases of severe cardiac intoxication caused by bupivacaine, have been proposed.

Numerous human case reports about the use of ILE in intoxications caused by either local anaesthetics or other intoxicants, the majority with a favourable outcome, have been published. Generally, the treatment has been confounded by the fact that the reported patients have also received other supportive therapy, such as advanced cardiac life support, resuscitative fluid therapy, inotropic cardiac support, etc. Presently, case reports about successful ILE treatment in local anaesthetic intoxications in man are not considered interesting worth publishing anymore. Instead, treatment with ILE of out-of-hospital intoxications caused by more or less lipophilic drugs seems to be a new focus area in emergency medicine journals (4).

Premature recommendations: In spite of the lack of evidence base from controlled human studies certain anaesthesia speciality organizations have launched recommendations (5, 6) regarding the use of ILE in local anaesthetic intoxication. Interestingly enough, these recommendations do not recognize lipophilicity of the drug as a crucial factor despite the above mentioned most popular, and most accepted possible mechanism of action, the "lipid sink" theory. The recommendations include ILE treatment in intoxications of any local anaesthetic, i.e., a drug with a low degree of lipophilicity like lidocaine (octanol/water logP 1.8) and that with a much higher degree of lipophilicity like bupivacaine (logP 3.3).

Controlled human studies: For obvious reasons controlled intoxication studies in humans are difficult to perform. There is until now only one published randomized and controlled trial (RCT) regarding the effect of ILE on intravenously administered bupivacaine in human volunteers (7). The male volunteers received an intravenous infusion of a non-toxic bupivacaine dose (0.5 mg/kg) in 20 min. Thereafter 20% Intralipid[®] or Ringer solution was infused (first a 1-min bolus of 1.5 ml/kg and followed by a 29-min continuous infusion of 0.25 ml/kg/min). In the analytical laboratory, after differential centrifugation free and total bupivacaine plasma concentrations were measured in the separated phases from samples taken during the study. There was no binding (entrapment) of bupivacaine to the lipid phase (ILE). However, during the ILE infusions, the total plasma bupivacaine concentration decreased slightly in comparison with control treatment (Ringer infusion) suggesting enhancement of distribution into the well perfused tissues.

There were not adverse effects of ILE in the volunteers.

Animal studies in support of lack of bupivacaine entrapment by ILE:

In anaesthetized pigs there was none, or only minimal entrapment of bupivacaine by ILE (ClinOleic[®] and Intralipid[®]), and no entrapment at all of mepivacaine (logP 2.2) (8). Furthermore, recovery from severe local anaesthetic induced cardiac depression was similar with both Ringer and ILE infusion.

Controversy regarding best animal model:

Generally, studies concerning severe cardiac toxicity studies in rats, rabbits and dogs have shown results in favour of the benefit of ILE in bupivacaine intoxications (4). On the other hand, studies in pigs have been contradictory, i.e., no entrapment and no enhancement of recovery (8), nor any superiority of ILE over adrenaline in survival or recovery (9). Due to the development of a reddish flare and skin colouring in studies on the effect of ILE in amiodarone intoxication (10) an unfounded unscientific allergy label has been placed on pigs regarding their unsuitability for studies on "lipid rescue". The colouring was not caused by ILE alone but by the combined exposure to ILE and polysorbate, the solvent in the amiodarone formulation. Polysorbate may cause a complete activation-related pseudoallergy in animals and man.

ILE is not devoid of side effects:

Similar to any drug, intravenous lipid emulsions have known side effects which have been observed and documented associated with their use in intravenous nutrition. The side effects include allergic (soybean) reactions, hypercoagulability, dyspnoea, as well as late effects such as hepatomegaly, splenomegaly and thrombocytopenia.

The dose and speed of infusion of intravenous administration of ILE are exceeding by far the recommendations for ILE in intravenous nutrition. However, the above mentioned human case reports have not reported any significant side effects related to lipid rescue therapy in local anaesthetic intoxications.

Is there any future for ILE in the treatment of intoxications?

It is uncertain whether Intralipid[®], or any other of the ILE preparation ever can attain the status of an evidence based registered drug for the treatment of local anaesthetic intoxications. At the present the recommended treatment in local anaesthetic intoxications is based on vague human case reports and the suggested mechanisms of actions are theoretical and unproven.

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FUNCTIONAL AND RADIOGRAPHIC OUTCOMES OF KYPHOPLASTY FOR THE TREATMENT OF OSTEOLYTIC VERTEBRAL FRACTURES CAUSED BY MULTIPLE MYELOMA AND METASTASIS - 3 YEARS FOLLOW-UP V

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Purpose: Vertebral body fractures secondary to a malignant osteolysis like multiple myeloma and metastasis are an increasingly common problem. The purpose of this study was to assess functional outcomes and radiographic results in the long term.

Materials and methods: Patients prospectively included in our study had progressive and painful osteolytic fractures as a result of multiple myeloma or metastasis.

Kyphoplasty multiple myeloma

459 patients (265 male, 194 female) (698 vertebrae)

3 years follow-up:

307 patients (189 male, 118 female) (437 vertebrae)

Kyphoplasty metastasis:

309 patients (132 male, 177 female) (508 vertebrae)

2 years follow-up:

102 patients (39 male, 63 female) (211 vertebrae)

Non surgical treatment myeloma:

48 patients (29 male, 19 female) (80 vertebrae)

6 months follow-up:

43 patients (26 male, 17 female) (68 vertebrae)

All patients were treated from 2002 until 2009 with Balloon-Kyphoplasty, from 2009 until today the patients were treated with Radiofrequency Kyphoplasty. Clinical and radiological data were evaluated until 36 months post op when patients were still alive. Preoperatively conventional radiographs in lateral and a.p. view, CT and / or MRI were performed. Pre- and postoperatively the clinical parameters VAS (Visual Analogue Scale) and the Oswestry score were evaluated. Radiographic scans were performed pre- and postoperatively and after 3, 6, 12, 24 and 36 months. The vertebral height and endplate angles were measured.

Results: The median pain scores (VAS) decreased from pre- to post-treatment significantly ($p < 0.001$) as well as the Oswestry score ($p < 0.001$). Kyphoplasty led to a significant and sustained reduction of pain resulting in a significant functional improvement of the patients. A restoration of vertebral height and reduction of the kyphotic angle could be achieved with both kyphoplasty techniques ($p < 0.05$). Further, the minimal-invasive procedure was able to stabilize the spine also over a longer period of 36 months. No significant difference between the Balloon Kyphoplasty and Radiofrequency Kyphoplasty could be seen in term of clinical and radiological follow-up.

Radiofrequency Kyphoplasty showed in comparison to Balloon Kyphoplasty a significant lower leakage rate (6.1% / 27.8%) and therefore provides significant safer procedure for the patient.

A radiation therapy and / or chemotherapy could be performed without loss of time.

Patients treated conservatively because they denied a surgical intervention did not show a significant improvement in pain and physical function after 6 months. Most of these patients ended in a significant height loss and increase of kyphotic deformity.

Conclusion: Kyphoplasty provides a save minimal invasive procedure for the stabilization of osteolytic vertebral compression fractures resulting in excellent clinical and radiological results in the long term.

RF Kyphoplasty is a very save procedure because of lower leakage rate.

A conservative care is not the first line of treatment anymore and should only be done in patients which are not able to undergo minimal invasive surgery anymore.

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EPIDUROSCOPIC LYSIS OF EPIDURAL ADHESIONS

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Epiduroscopy is a surgical technique introduced in pain therapy at the end of the last century (3). The chance to identify and to visualize the causes of chronic lumbar pain is considered as essential both in diagnostic and therapeutic phase (4, 7). It's possible to discern between inflammatory areas, neovascularization phenomena, scar tissue and dural abnormalities. In lumbar chronic pain there is no correlation between scar tissue amount and pain

intensity, however scar tissue can cause mechanical stress by reducing the medulla physiological motility inside the spinal canal. This can bring on inflammatory and neovascularization phenomena. Epiduroscopy is a minimal invasive approach: despite this, worldwide clinical experiences are still sparse. **Methods:** The results from 161 epiduroscopies on patients suffering from pain were investigated. Pain syndromes treated with epiduroscopy included FBSS (Failed Back Surgery Syndrome), lumbar syndrome and stenosis, alone or in association with radiculopathy.

Patients were on average 65.3 ± 10 years old and female were more than male patients (71% vs 29%). A thorough clinical examination of the patient was the first and essential step for prescribing percutaneous epiduroscopy, excluding the contra-indications. Major indications to Epiduroscopy is the treatment of chronic pain syndrome in Spinal Canal Stenosis and FBSS. FBSS is defined as pain that persists or reoccurs after one or more surgical procedure on the lumbo-sacral spine. FBSS can occur despite successful back surgery in up to 40% of patient who undergo back surgery. Contra-indications for percutaneous epiduroscopy are Epilepsy, Vasculopathy, Aneurism, Ocular pathology such as Glaucoma or Retinic pathology, Coagulopathy, Cefalalgia.

In the operating theatre, the preparations for epiduroscopy are in line with those for the customary micro-invasive operating standards. Patient vital functions are monitored by an anaesthetist. According to the Seldinger method (6) we use a puncture needle 18 G, a guide wire and a dilator 9.5 F. Sacral access route to the epidural space is chosen for all patients and they are placed face down on the operating table. Following skin disinfection and sterile covering, a local anaesthetic, consisting of 1% mepivacaine hydrochloride, is administered. In each patient sacral hiatus is punctured at an angle of about 45° at first and, after the needle had perforated the sacrococcygeal ligament the guide wire was inserted. A control X-ray examination taken laterally is usually carried out to identify the guide wire in the hiatus sacralis. The dilator is inserted into the sacral canal and subsequently a disposable and sterile endoscope is introduced into the epidural space. Epidural endoscope has an atraumatic tip and four operative lines for the optical fiber, for the infusion of physiological saline solution and for surgical instruments. Continuous and adapted epidural flushing with a physiological saline solution is required. A Fogarty catheter balloon can be introduced both for diagnostic and therapeutic purpose. It can be used to enlarge the epidural space and to allow a better view of the epidural structures or it can be used directly to cut scar tissue. Each epiduroscopy takes about 30 minutes.

Data were collected retrospectively by evaluating 161 epiduroscopies from 2010 up to June 2012. Sacral hiatus access was performed without problems in 154 patients. In 7 patients (4,35%) it was impossible to insert the introducer because of the calcified nature of the bony sacral canal. In all other cases it was possible to insert the epiduroscope and to identify epidural space. Pathological findings were found in the majority of epiduroscopies: fibrosis and scar tissue were found in most patients (52%), while stenosis and chronically inflamed tissue were found respectively in 33% and 8% of patients. Minimal epidural haemorrhages were observed during 4 epiduroscopies. No complications occurred in these or other patients.

Discussion and conclusions: Epiduroscopy provides direct imaging of dura mater, blood vessels, connective tissue and nerves in the epidural space. It permits the identification of the epidural space and thus diagnosis can be extended in a way that would be otherwise impossible. The majority of back pain is caused by changes to the soft tissues, which cannot always be made visible even with MRI; on the contrary some disc protrusions are asymptomatic. Recent studies suggest that often there is poor correlation between the spinal segments at which clinically significant pathology is determined by clinical evaluation and by MRI (1). Under these preconditions, as a micro-invasive endoscopic process, percutaneous epiduroscopy can be a sensible addition for diagnostic purposes as well as enriching the range of treatment for chronic pain syndrome. Anyway an accurate selection of patients undergoing epiduroscopy is mandatory. The procedure is an outpatient procedure but it's necessary to remember that there are some significant risks associated such as injury to nerves, spinal cord, dura, infection, development of a hematoma and retinal detachment. However, in our patients there were 4 cases of minimal epidural haemorrhage, no one followed by complications. No side-effects were registered. In general, epiduroscopy can be considered as a safe procedure (6, 7) but it requires significant skills and environment structure. Epiduroscopy has also therapeutic aims such as lysis of epidural adhesions, steroids injection and epidural space decompression to reduce periradicular and dura inflammation and favour physiological mobility of the neural structures. In case of drug epidural injection direct visualization allows reducing risks of complications such as dural injury or epidural

haemorrhages. Epiduroscopy confirms its role in diagnostic and therapeutic in pain medicine (2).

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EVIDENCE-BASED INJECTION THERAPY FOR LOW BACK PAIN?

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Introduction: The evidence for injection therapy for low back pain was recently assessed in two systematic reviews. Staal et al.¹ published in 2009 an updated Cochrane Review: "Injection therapy for sub-acute and chronic low back pain and Henschke et al.² published in 2010 a systematic review on "Injection therapy and denervation procedures for chronic low-back pain"

The conclusion of the first review is: "There is insufficient evidence to support the use of injection therapy in sub-acute and chronic low back pain. However, it cannot be ruled out that specific subgroups of patients may respond to a specific type of injection therapy"¹ It is not surprising that the second review has a comparable conclusion. The authors use exactly the same sentence to refer to patient selection. The IMMPACT recommendations point towards a potential explanation for unsuccessful trials: "Lack of knowledge of the causes of chronic pain and poor understanding of patient heterogeneity in pathophysiological mechanisms and treatment response are a major explanation for unsuccessful trials"³

This indicates that it is impossible to judge the efficacy of a target specific treatment without specifying the patient population studied. Therefore evidence should be assessed according to the clinical diagnoses.

The most frequently occurring types of low back pain are: radicular pain, facetogenic pain, and pain originating from the intervertebral disc.

Lumbosacral radicular low back pain A lumbosacral radicular syndrome (LSR) is characterized by a radiating pain in one or more lumbar or sacral dermatomes; it may or may not be accompanied by other radicular irritation symptoms and/or symptoms of decreased function. The terms radicular pain and radiculopathy are also sometimes used interchangeably, although they certainly are not synonyms. In the case of radicular pain, only radiating pain

is present, while in the case of radiculopathy, sensory and/or motor loss that can be objectified can be observed. Both syndromes frequently occur together and radiculopathy can be a continuum of radicular pain. In this review lumbosacral radicular pain is considered as pain radiating into one or more dermatomes caused by nerve root irritation /inflammation and/or compression.⁴

When conservative treatment fails to provide satisfactory pain relief anesthesiological treatment techniques may be considered. For the management of sub-acute radicular pain, epidural administration of corticosteroids is generally indicated. In patients with chronic radicular complaints, corticosteroids will not provide any improvement in the outcome in comparison to local anesthetics alone. This indicates that epidural corticosteroids are more effective for (sub)-acute radicular pain where a significant inflammatory pain component is present.⁵

Epidural corticosteroid administration brings the anti-inflammatory product directly onto the inflamed nerve root. There are three approaches: interlaminar, transforaminal, and caudal.

Interlaminar corticosteroids

The available evidence concerning interlaminar corticosteroid administration has been studied in systematic reviews. The conclusions of these reviews are divergent depending on the chosen evaluation parameters. McQuay and Moore calculated the Number Needed to Treat (NNT). To achieve 50% pain reduction in the short term (1 day - 3 months), an NNT of 3 is obtained and an NNT of 13 for long term pain relief (3 months to 1 year).⁶ A systematic review of RCTs concluded that there is insufficient proof of the efficacy of this technique. If there are benefits, then they are of short duration.⁷ A recent systematic review of RCTs showed that among the 11 RCTs of interlaminar steroid injection for radiculopathy, four trials are rated high quality.⁸ Three of the four trials used ligamentum interspinale (interspinous ligament) saline injection as control intervention. All three trials showed positive results for short term benefits (≤1 months).⁹⁻¹¹ The other trial used epidural saline injection as control and did not show any benefit.¹²

Transforaminal corticosteroids

The variable results of corticosteroids administered interlaminarly are ascribed to the fact that there is no certainty that the needle reaches the epidural space and even if it did, there is no certainty that the medication reaches the ventral section of the epidural space.¹³ Transforaminal administration allows a more precise application of the corticosteroids at the level of the inflamed nerve root. Three high quality, placebo controlled trials evaluating transforaminal approach reported mixed results.⁸ One showed long-term benefits in one year¹⁴, one showed mixed short-term benefits¹⁵, and one showed no benefit.⁵

In a double blind, randomized study, patients who were scheduled for a surgical intervention received an epidural injection with local anesthetic only or local anesthetic with corticosteroid *at random*. By the follow-up (13 to 28 months), 20/28 patients in the local anesthetic with corticosteroid group had decided not to undergo surgery, while in the local anesthetic only group, 9/27 decided to forego a surgical intervention.¹⁴ The majority (81%) of the patients who had not yet had surgery 1 year after infiltration were able to avoid the operation after 5 years.¹⁶ There was no statistical difference between the treatment groups.

A prospective controlled study of transforaminal epidural corticosteroids showed superiority of this procedure over trigger-point injection in patients with disc herniation.¹⁷ Karpinnen's group¹⁵ carried out a randomized, controlled study in patients with radicular pain and disc herniation documented by MRI, in which the transforaminal administration of local anesthetic with corticosteroid was compared with transforaminal injections of normal saline solution. Two weeks after the treatment, the clinical result in the corticosteroid group was better than that of the group treated with normal saline solution. After 3 to 6 months, on the other hand, patients in the group with normal saline were in better condition owing to a rebound effect that was noted in the corticosteroid group. A sub-analysis in which the results of patients with a "contained" herniation were compared with those of patients with an "extruded" herniation showed that in the first group, corticosteroid injections were superior to placebo while in the group with "extruded" herniation, the opposite was found.¹⁸ In this study, "contained herniation" was defined as a herniation with a broad base which is still contained within the ligamentum longitudinale posterius. "Extruded herniation" is a herniation that breaks through the ligamentum longitudinale posterius.

In a comparative study, the effectiveness of caudal, interlaminar and transforaminal corticosteroid administration in the epidural space was compared in patients with radicular pain as a result of disc herniation. The

transforaminal approach gave the best clinical results.¹⁹ A double blind, randomized study compared the efficacy of interlaminar and transforaminal corticosteroid administration in patients with lumbar radicular pain as a result of CT- or MRI-confirmed herniated disc that lasted less than 30 days. Six months after the treatment, the results in the transforaminal-treatment group was significantly better than that of the group that was treated interlaminarly in the areas of pain reduction, daily activity, free-time and work activities and anxiety and depression.²⁰

Caudal corticosteroids

Four placebo-controlled trials were conducted, but none were rated high quality.⁸ The results are mixed and no definitive conclusions can be drawn from these studies. A randomized controlled trial compared the effect of subcutaneous saline injection with caudal saline injection and caudal corticosteroid injection. No difference in clinical outcome was observed between the three groups at 6, 12 and 52 weeks. The authors conclude that caudal epidural steroid or saline injections are not recommended for chronic lumbar radiculopathy.²¹

Selection of the corticosteroid

There has been debate regarding the safety and potency of the different depot corticosteroid preparation.

Particle size of different corticosteroid preparations were studied undiluted and diluted in saline or local anesthetic. The results of this in depth research illustrated that differences in the percentage of large particles exists between compounded and commercially available preparations. Because, the specifications of corticosteroid preparations commercially available in different countries may be different it is difficult to draw conclusions for clinical practice.²² Two RCT's compared the efficacy and safety of particulate and non-particulate corticosteroids. The first study showed a greater efficacy for triamcinolone compared the dexamethasone.²³ In the second study dexamethasone was compared to methylprednisolone. Both products seemed to be close in efficacy and safety. There is however a trend towards less pain relief and shorter duration of action of dexamethasone.²⁴

In summary, one can state that the transforaminal epidural corticosteroid administration is preferable. In practice, due to the not yet completely elucidated, rare neurological complications associated with the transforaminal administration route, the interlaminar and caudal approaches can also still be considered.

Lumbar facet pain Pain emanating from the lumbar facet joints is a common cause of low back pain in the adult population. Golthwaite was the first to describe the syndrome in 1911, and Ghormley is generally credited with coining the term "facet syndrome" in 1933. Facet pain is defined as pain that arises from any structure that is part of the facet joints, including the fibrous capsule, synovial membrane, hyaline cartilage and bone.²⁵⁻²⁷

Diagnostic Blocks Diagnostic blocks are most frequently performed under radiographic guidance, but can also be done under ultrasound.^{28,29} Although intra-articular injection and medial branch (facet joint nerve) blocks are often described as "equivalent", this has yet to be demonstrated in a comparative, crossover study design.⁵ Neither of these approaches have been shown to be superior.³⁰ Both medial branch and intra-articular blocks are associated with significant false positive and false negative rates. For both techniques, the rate of false positives is most often cited as ranging between 15-40%.²⁷

Perhaps because of their safety, simplicity and prognostic value, diagnostic medial branch blocks are done more frequently than intra-articular injections

Intra-articular corticosteroid injections

The use of intra-articular corticosteroid injections in the facet joints is controversial. Uncontrolled studies have mostly demonstrated transient beneficial effects, but the results of controlled studies have been mostly disappointing. Lilius et al.³¹ performed the largest randomized study, involving 109 patients. They found no difference between large-volume (8 ml) intra-articular saline injections, intra-articular corticosteroid and local anesthetic, and the same mixture injected around two facet joints. In a randomized, controlled study, Carette et al.³² found only a small difference between the injection of saline (10% good effect) and depot corticosteroid (22% good effect) up to 6 months after treatment. One caveat with placebo-controlled trials that is not commonly recognized is that the intra-articular injection of saline may itself provide therapeutic benefit.³³ Observational studies involving intra-articular local anesthetic and corticosteroid typically show symptom palliation lasting for up to 3 months.^{34,35} Based on the literature, one can conclude that intra-articular corticosteroid injections are of very limited value in the treatment of unscreened patients with suspected facetogenic pain.

However, subgroup analyses have revealed that patients with positive single photon emission computed tomography (SPECT) scans may be more likely to respond than patients without an acute inflammatory process.^{34,36}

Sacro iliac joint

The sacroiliac (SI) joint has long been considered an important source of low back pain due to the empirical finding that treatment targeting the sacroiliac joint can relieve pain. The International Association for the Study of Pain (IASP) has formulated criteria for the diagnosis of SI-joint pain.³⁷ SI-joint pain is defined as pain localized in the region of the SI joint, reproducible by stress and provocation tests of the SI joint, and reliably relieved by selective infiltration of the SI joint with a local anesthetic.

Patients with SI-joint pain resistant to conservative treatment are eligible for intra-articular injections.

Articular injections

SI-joint injections with local anesthetic and corticosteroids may provide good pain relief for periods of up to 1 year. It is assumed that intra-articular injections would produce better results than peri-articular infiltrations. Yet, peri-articular infiltrations were demonstrated to provide good pain relief in short-term follow-up in two double blind studies,^{38,39} indicating the importance of extra-articular sources of sacroiliac pathology.⁴⁰⁻⁴² Controlled studies support the assertion that both intra- and extra-articular injections may be beneficial. Luukkainen et al.⁴¹ randomized 24 patients to receive either peri-articular corticosteroid with local anesthetic (n=13) or local anesthetic and saline (n=11). One month after the intervention, VAS pain scores had decreased significantly in the corticosteroid group compared to the control patients. Maugars et al.⁴³ treated 13 SI joints in 10 patients. Intra-articular corticosteroids were injected into 6 SI joints, while the remaining 7 joints received physiological saline solution. After 1 month, pain reduction of >70% was noted in 5 of the 6 SI joints treated with corticosteroid, whereas no benefit was noted in the placebo group. In all control patients and two in the treatment group who had short-term symptom palliation, a repeat corticosteroid injection was performed. After 1, 3 and 6 months, significant pain reduction was observed in 86%, 62% and 58% of patients, respectively.

Discogenic pain

Discogenic pain shares clinical signs with lumbosacral radicular pain characterized by radiating pain in one or more lumbar or sacral dermatomes with or without neurological deficits. Discus herniation in patient under the age of 50 and spine degeneration in older patients are often associated with chronic low back pain.⁴⁴

Intradiscal Corticosteroid Injections

The goal of intradiscal corticosteroid injections is the suppression of the inflammation that is considered to be responsible for discogenic pain. The literature on this topic is limited to case reports that only yield positive results. However, positive and negative results are been found in prospective studies. Butterman published in 2004 a prospective study comparing patients with degenerative discus disease (DDD) and end-plate inflammatory changes on MRI (Modic Type 1) with a patient group having DDD and no end-plate inflammatory changes. The group with Modic Type-1 changes had significantly better results after intradiscal steroid injection compared to the group without Modic Type-1 changes.⁴⁵ In a recently published randomized controlled trial, patients with positive discography and MRI controlled Modic changes were divided in 3 groups: in the first group saline was intradiscally administered, in the second group betamethasone was given and in the third group betamethasone and a polypeptide was administered. At 3 and 6 months after the intervention patients in the saline group did not show any improvement while a significant improvement in VAS and ODI was observed in the two other groups.⁴⁶

In 1992 Simmons published a study in which 25 patients received 80 mg methylprednisolone intradiscally versus a control group to whom 1.5 mL bupivacaine (0.5%) was administered.⁴⁷ No significant difference was found between the two groups. Khot et al.⁴⁸ published a comparable study of 12 patients in which, after positive discography, the patients were randomly divided into two groups. In one group intradiscal corticosteroids were administered and in the control group, physiological saline solution was administered. The authors concluded that intradiscal corticosteroids do not improve clinical outcomes in patients with discogenic low back pain relative to placebo.⁴⁹ Intradiscal injections with other chemical substances are being investigated. Klein et al. published a pilot study in which a glucosamine and chondroitin sulfate solution combined with hypertonic dextrose and dimethyl sulfoxide (DMSO) were injected intradiscally.⁵⁰ It has been suggested

that the injection of these substances synergistically promotes the hyper-metabolic response of chondrocytes and retards the enzymatic degradation of cartilage. The authors reported positive results in the VAS score and in the "disability score".

Ozone Discolysis

The injection of a mixture of O₃ and O₂, usually both intradiscally as well as epidurally has been investigated for the treatment of discogenic pain. Intradiscal and transforaminal epidural corticosteroid injection is compared to intradiscal and transforaminal epidural steroid injection with the addition of an O₃/O₂ mixture.⁵¹ Another study compared transforaminal epidural ozone injection with steroid injection. In both studies, ozone resulted in a significantly better effect than corticosteroids.

Methylene blue

A well designed randomized trial compared the intradiscal injection of methylene blue with placebo. At 24 months follow-up the patients in the methylene blue group showed significant pain reduction and improvement of functionality compared to the placebo group.⁵² These findings could however not be confirmed up till now.

Conclusions: Injection therapy for the management of low back pain should be considered according to the clinical diagnoses.

For the management of lumbosacral radicular pain there is contradictory evidence regarding the interlaminar epidural steroid administration. In case of radicular pain due to contained herniation there is evidence supporting the recommendation of this treatment. The caudal administration was shown not to have an advantage over saline or subcutaneous saline administration.

The evidence regarding the intra-articular injections for the treatment of pain originating from the lumbar facet joints is contradictory.

There is good evidence to recommend to use of intra-articular injections into the sacro iliac joint of corticosteroids and local anesthetic.

The intradiscal injections of corticosteroids cannot be recommended.

The intradiscal and transforaminal injection of ozone has been studied, but the results should further be confirmed as well as the intradiscal injection of methylene blue.

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BOTULINUM TOXIN IN CHRONIC PAIN

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Introduction: Botulinum toxin (BTX) is a potent neurotoxin produced by the bacterium *Clostridium botulinum*. It causes flaccid muscle paralysis by blocking acetylcholine (ACh) release at the neuromuscular junction.

It is certainly known that botulinum toxin type A proteolytically degrades the synaptosomal-associated protein with the molecular mass of 25kDn (SNAP-25) protein, a type of SNARE protein. The SNAP-25 protein is required for vesicle fusion that releases neurotransmitters from the axon endings (in particular acetylcholine).[1] The type B toxin deactivates the vesicle associated membrane protein, which is located on the vesicular membrane itself.

BTX selectively blocks cholinergic transmission at the neuromuscular junction (proteolytic activity directed specifically on SNARE proteins, essential for vesicle fusion). This mechanism of action makes BTX useful in clinical practice. Of the seven distinct serotypes of BTX (A to G), types A and B are currently used in clinical practice. Three types of BTX type A (Botox, Dysport, Xeomin) and one of BTX type B (Neurobloc) are commercially available. These toxins have different units that are not comparable among them.[2]

BTX works by inhibiting the release of a number of neurotransmitters from presynaptic vesicles via deactivation of specific proteins located at, or in proximity of, the vesicular membrane.

It has been widely used in chronic pain for the treatment of multiple conditions with a component of localized muscle spasm, such as focal dystonia, cramps or isolated spasms, chronic myofascial pain syndromes and headaches.[3]-[4] Recent studies suggest that botulinum toxin is effective in the treatment of neuropathic pain syndromes such as post-herpetic neuralgia[5] or painful scars[6] even if its mechanisms of action are not fully understood.

The Acute Pain Service (APS)

Chronic low back pain is one of the leading causes of physician office visits and work absenteeism in developed countries. Low back pain causes significant disability to those who suffer from it and represents a large direct economic burden, both directly as healthcare resources consumed and indirectly as absenteeism and disability benefits.

It is estimated that from 49% to 70% of the adult population will suffer at least one episode of low back pain over their lifetime.^[7]

Although the etiopathogenesis of nonspecific low back pain is unknown, multiple factors may be involved in pain occurrence. Involvement of the muscles directly or indirectly stabilizing the lumbar spine may play a significant role in the occurrence and maintenance of low back pain syndromes.^[8]

Myofascial Pain Syndrome (MPS) is a nosological entity characterized by regional pain, affecting one or several muscle groups and their fascias, so that the muscles involved have the following characteristics:

- Pain generated and maintained by one or more "trigger points".
- The trigger point is defined as a localized, palpable and painful area of tissue within a tense muscle band which when compressed externally causes local and referred pain as well as a local muscle response in the form of focal spasms.
- The pattern of referred pain is characteristics for each muscle.
- The maximum force of contraction of the affected muscle is decreased, with weakness and increased fatigability, but without muscle atrophy.
- The range of muscle lengthening is restricted.
- There may also be coexisting regional autonomic symptoms such as skin changes, increased sweating or temperature, small local edemas, etc.

Trigger points are essential in the diagnosis of myofascial pain syndrome, the latter being a known cause of musculoskeletal pain.^[9]

The presence of trigger points in the quadratus lumborum muscle (a key muscle in lateral stabilization of the spine) is frequently associated with nonspecific chronic low back pain, and the presence of trigger points in the psoas muscle (an important muscle in biomechanics of the lumbar spine) occurs more frequently when the quadratus lumborum muscle is affected.^[10]

Dry needling of the TrPs, as well as the injection of various substances including local anesthetics, corticosteroids, and botulinum toxin (BTX), has been shown to be effective in treating MPS.^[11]^[12]

Although theoretically reasonable, the use of botulinum toxin to relieve myofascial pain in general and lumbar pain in particular is not fully supported by clinical evidence. As reported by several authors, BTX injection seems to be effective in treating muscular pain of myofascial origin^[11,13,14], but its efficacy is not greater than other substances (NaCl, local anesthetics, sterile water).^[12,15,16] A recent evidence-based review² graded the use of BTX to treat MPS as a U level of evidence (the evidence to support or refute efficacy is insufficient due to contradictory results). May be the reason is the huge difficulties in evaluating treatment efficacies owing to heterogeneous selection of patients, treatment types, doses and administration sites.

Regarding inespecific low back pain, Foster et al.^[17] studied 31 patients mostly with chronic spine disease (e.g., stenosis, disc degeneration) and low back pain. They injected BTX type A into paravertebral muscles at the lumbar level (L1 to L5 using 40 IU per level) and compared with placebo. At 2 months, 60% of the patients reported 50% or more decrease in pain intensity. Similar results were found later, by the same group of investigators.^[18] The level of evidence for the use of BTX in the paravertebral muscles is graded as C (possibly effective - may be used at the discretion of the clinician).²

MPS involving deep muscles and treated with BTX (as Piriformis Syndrome) have been also studied. The piriformis muscle is inserted medially on the anterior surface of the sacrum by digitations between the sacral foramina; it exits the pelvis through the greater sciatic foramen. This muscle is closely related to important vascular and nerve structures that also exit the pelvis through the greater sciatic foramen such as, for instance, the inferior and superior gluteal nerves and vessels.

Childers et al.^[19] conducted a double-blind study in 10 patients with Piriformis Syndrome. 100 IU of BTX type A were injected into the piriformis muscle. The pain relief using VAS was significant in the BTX group compared with placebo. Similarly, Fishman et al.^[20] compared BTX type A (200 units) with lidocaine plus steroid and with placebo injection in 72 patients with PS. BTX type A was significantly better than placebo and steroids plus lidocaine in relieving pain. The degree of recommendation rises to Level B (probably effective, should be considered for treatment).²

Cervical Dystonia

Cervical dystonia (CD), the most common focal dystonia, frequently results in cervical pain and disability as well as impairments affecting postural control. The predominant treatment for cervical dystonia is provided by physicians, and treatment can vary from pharmacological to surgical.

Several studies evaluated the issue of pain in CD in relation to BTX treatment. Troung et al.^[21] compared BTX type A with placebo; at 4 weeks, the level of pain reduction measured by VAS was significantly better for BTX vs. placebo. Similar results were found by other researchers using BTX type A^[22]^[23] and also with BTX type B.^[24]^[25]

BTX type A and type B are an effective and established treatment for pain in CD. The degree of pain relief in CD is comparable among type A toxins and is similar between type A and type B toxins. With these results the degree of evidence is Level A (efficacy established and recommended).²

Headaches

Chronic migraine

Chronic migraine is defined as a headache with a frequency of 15 or more headache days per month (at least eight migraine types), for more than 3 months, lasting more than 4 hours per day.^[26]

Two large multicenter studies^[27]^[28] (with more than 700 patients in each paper) assessing efficacy of BTX type A in chronic migraine have been published. Both studies included patients with medication overuse. The number of headache days was better in both studies in the group of BTX vs the placebo group. The level of evidence in this issue is grade A (efficacy established and recommended).²

Discrepant results are found when BTX is evaluated for treating *Chronic Daily Headache*.^[29]^[30]^[31]^[32] The inconsistent results of the aforementioned studies qualified for level U evidence (the evidence to support or refute efficacy is insufficient due to contradictory results) for BTX treatment of CDH.²

Neuropathic pain disorders

Neuropathic pain has been recently redefined as "pain arising as a direct consequence of a lesion or disease affecting the somatosensory system".^[33] The estimated prevalence of this entity is around 7% with moderate to severe intensity in up to 5% of persons.^[34] The quality of life of patients suffering this condition is significantly affected.^[35]^[36]

Post-herpetic neuralgia

Liu and colleagues have reported a case of post-herpetic neuralgia that was treated with subcutaneous BTX-A into the area of allodynia, gradually reducing pain severity as measured by the VAS from a score of 10 to 1 from the second day onwards and persisting at 52 days.^[37] A similar case was published by Ruiz Huete and colleagues;⁵ in this case the relief was complete (VAS of 0) and persisting for 2 months. A randomized, placebo controlled double blind trial including 60 patients reported a significant decrease in pain intensity and opioid use in patients with postherpetic neuralgia treated with subcutaneous botulinum toxin compared with placebo and lidocaine.^[38] The level of evidence in this issue is level B (probably effective, should be considered for treatment).²

Diabetic neuropathy

Yuan and colleagues^[39]^[40] conducted a randomized, double-blind crossover trial to compare BTX-A to placebo administered subcutaneously in 18 patients with diabetic neuropathy and found a significant reduction in VAS scores in the treated group at 1, 4, 8 and 12 weeks compared with the placebo group, persisting up to 12 weeks after treatment. Besides they found significantly improvement in sleep quality in the BTX-A group. Study limitation includes small number of patients and crossover design of the study. With these results the level of evidence is grade C (possibly effective - may be used at the discretion of the clinician).

Complex Regional Pain Syndrome

Carroll et al.^[41] compared the duration of lumbar sympathetic block with local anesthetic alone or combined with BTX-A in nine patients with refractory complex regional pain syndrome. They found that the addition of BTX-A significantly prolonged the analgesia provided by the local anesthetic (71 days to analgesic failure in the group of bupivacaine plus BTX-A vs 10 days in the group of local anesthetic alone).

Trigeminal neuralgia and chronic facial pain

Borodic and colleagues^[42] treated 44 patients with chronic facial pain (temporomandibular joint syndrome, postsurgical pain syndromes, idiopathic trigeminal neuralgia...) with botulinum toxin injections tailored to the location of pain with positive response in 75% of patients during from 2 to 4 months. Piovesan et al.^[43] studied thirteen subjects with trigeminal neuralgia

treated with subdermal injections of botulinum toxin over the painful areas. After the procedure VAS score and surface area of pain measured in square centimetres were reduced in all patients. Other researchers published similar successful results^{[44],[45],[46],[47],[48],[49]}. More recently Bohluli et al^[50] conducted an open-label study with 15 patients suffering from trigeminal neuralgia, treated with botulinum toxin A injected at the trigger zones. All of the patients improved regarding frequency and severity of pain up to 6 months after injection. In 7 patients, pain was completely eradicated with no need of further medication.

Occipital neuralgia

Kapural et al^[51] retrospectively analysed a series of six patients with severe occipital neuralgia who underwent occipital nerve block with 50 UI of BTX-A; they obtained significant decreases in pain VAS scores in 5 of the 6 patients after four weeks. Similarly Taylor and colleagues^[52] injected 50 UI of botulinum toxin type A, through a needle inserted inferolateral to the occipital protuberance on six subjects affected with refractory occipital neuralgia with satisfactory results.

Miscellaneous

Improvements have also been reported in other conditions that exhibit a neuropathic pain component. Ranoux et al^[53] studied a series of 29 patients including patients with chronic post-surgical pain of various kinds (hernia repair, carpal tunnel syndrome or hysterectomy), post-herpetic neuropathy and post-traumatic neuralgias, and found a direct analgesic effect on the neuropathic component independent from the effect of the toxin on muscle tone when compared to placebo. Similarly, in all patients, BTX-A improved allodynia to brush and decreased pain thresholds to cold, without affecting perception thresholds. Uyesugi B et al⁷ treated successfully a painful keloid with injections of botulinum toxin type A. Tsai and colleagues^[54] reported long-lasting antinociceptive effects of botulinum toxin A in patient with carpal tunnel syndrome. They injected 60 IU of botulinum toxin type A “intracarpally” in 5 patients with carpal tunnel syndrome. They found improvement of pain intensity in three patients. Our group have successfully treated a patient with refractory chronic post-thoracotomy pain with subcutaneous botulinum toxin type A.^[55]

Summary: According accumulated evidence, botulinum toxin is a promise treatment in several types of refractory pain syndromes. Botulinum toxin works by breaking the spasm/pain cycle, but new evidences support direct antinociceptive effect distinct from any reduction in muscle spasm. Future developments in specific research will provide more and sustainable evidence for more specific indication for this drug.

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CURRENT EVIDENCE AND INDICATIONS FOR PROLOTHERAPY WITH PLATELET RICH PLASMA IN CHRONIC MUSCULOSKELETAL CONDITIONS

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Introduction: Platelets have known roles in coagulation, inflammatory processes, and immunity modulation; they also have “restorative” properties. Indeed, during degranulation, platelets release different cytokines and growth factors (VEGF, PDGF, TGF- β , IGF-I, and HGF) that promote angiogenesis, tissue remodelling (bone, skin, muscle, tendon, etc.), and wound healing [1].

PRP is obtained by centrifuging autologous blood to obtain a concentration of platelets, usually between 3 and 10 times that of whole blood, depending on the isolation method [2]. For this reason, different PRP preparation techniques cannot provide a consistently identical final product, but there is currently no international consensus on this issue [3].

Overall, PRP could be an attractive therapeutic option for treating chronic musculoskeletal conditions, such as tendinopathy, plantar fasciitis, osteoarthritis, and nonunion.

The use of PRP for the treatment of tendinopathies: Tendons do not have a high metabolic index. Growth factors released by platelets promote tenocyte proliferation, stimulate angiogenesis and have analgesic properties, thus it could stimulate and accelerate tissue regeneration in animal models [4, 5]. In addition to PRP, optimal tissue quality requires the application of mechanical loads [6, 7]. PRP should be considered for tendinopathies for more than 3 months. Indeed, the goal is to initiate an acute inflammatory reaction that quickly moves on to the proliferative phase that involves collagen synthesis, which is necessary for appropriate tendon healing. PRP should therefore not be used for acute tendinitis or tenosynovitis.

For *lateral epicondylitis*, studies assessing the effect of PRP compared to a control group reported significantly better outcomes (on pain and function) in the PRP group [8, 9]. These results were confirmed up to a 2-year follow-up [10]. It is important that groups underwent an eccentric program after infiltration. However 2 randomized controlled trials comparing an infiltration of autologous blood to PRP showed similarly improvement in middle term [11, 12].

To our knowledge no studies have studied the effect of PRP in *rotator cuff tendinopathy*. However, long term observation of arthroscopic rotator cuff suture with adjunction of PRP showed that pain in the first month after surgery was lower in the PRP group [13, 14, 15]. No differences by MRI were observed. These results contrast with other studies which did not show any positive effect of applying PRP during cuff suturing compared with a control group [16, 17].

For *patellar tendinopathy*, series have shown significant improvements of algo-functional scores [18, 19, 20], and MRI appearance [21]. Even if these good result had been evolving for an average of up to 2 years [22], most of these studies needed 3 injections of PRP [21, 22]. In our study, 20 patients

with superior patellar tendinopathy refractive to conservative treatment, who had not undergone treatment for over a month, received PRP infiltration in the affected area without local anesthesia [23]. After 6 weeks, we observed improved algo-functional scores and reduced pain during physical tests (without significant performance improvement). This trend continued for 3 months. No significant changes were observed on ultrasound or MRI.

Finally, for *Achilles tendinopathy*, results are controversial. Even if, observational series showed a decreased pain and improved algo-functional scores after PRP infiltration and echo-Dopler images [24], the only randomized controlled and double blind study (PRP infiltration was compared to that of isotonic saline, followed by eccentric activities) did not show any difference between the 2 groups after 24 weeks [25] and 1 year [26]. The authors did not demonstrate any significant ultrasound differences for tendon structure or neovascularization [27]. However, this studies is subject of methodological bias.

The use of PRP for the treatment of plantar fasciitis: Only two studies on PRP injections (vs corticosteroid infiltration) have been published. One with excellent results for pain and favorable functional progression which were associated with various favorable ultrasound changes after infiltration of PRP [28], and one which did not observe different outcomes after PRP or corticosteroid infiltration [29].

PRP treatment for osteoarthritis: Osteoarthritis is a degenerative phenomenon of the cartilage with complex, multifactorial pathophysiology. The healing potential of this type of injury is very poor. There are a multitude of conservative pharmacological treatments that are palliative rather than curative that can be used to delay the eventuality of a joint replacement. PRP could serve a new therapeutic alternative for traumatic and degenerative cartilage defects.

Sanchez et al. were the first to compare three PRP injections with hyaluronic acid as part of a study of a retrospective cohort in 30 subjects with gonarthrosis [30]. At 5 weeks, they observed a significant improvement in pain and algo-functional questionnaires for patients who received three PRP injections.

The same observations were made in different prospective studies comparing three PRP injections to hyaluronic acid in moderate cases of gonarthrosis [31-36]. Indeed, the PRP patient groups showed significant improvements in pain and algo-functional scores after a follow-up period of up to 1 year. They also emphasize the absence of side effects associated with this treatment.

A cohort study (144 patients) comparing the effect of two different PRP preparations for gonarthrosis cases also reported significant clinical improvement compared to baseline in both groups, despite the fact that one of the two techniques initially produced more pain and swelling [37]. However, the best results were observed in younger patients with a low degree of cartilage damage.

In a written debate on the indication for knee arthroplasty versus therapy via PRP injection in cases of gonarthrosis, it appears that the two options seem reasonable in a 60-year-old patient with moderate symptoms who wishes to continue skiing [38]. Because PRP infiltration therapy is less costly, less invasive, and less risky than knee arthroplasty, it could be considered as a first line treatment. In the event of patient dissatisfaction regarding pain control and improved knee function, arthroplasty can then be considered.

Finally, in a cohort study (6-month follow up) of 40 patients with severe hip osteoarthritis, Sanchez et al. observed significant improvements in pain and algo-functional scores after three injections of PRP under ultrasound guidance [39].

PRP treatment for nonunion: A fracture will normally fuse, and nonunion is the absence of fusion between bone fragments. This produces pain and abnormal movements of varying degrees. The efficacy of percutaneous PRP injection under fluoroscopic guidance to treat nonunion remains unclear and controversial [40-42]. However, it seems that this technique could produce encouraging results and provide a less invasive alternative to open bone-grafting techniques [40].

Conclusions: By releasing different platelet growth factors, PRP may be used as a new therapeutic option for chronic musculoskeletal injury. Its ease of preparation, relatively low cost, and minimal invasiveness are arguments in its favor. Despite the proven efficacy of PRP tissue regeneration in vitro, there is currently little tangible clinical evidence for chronic tendon disorders, plantar fasciitis, osteoarthritis, or nonunion. The few studies that have been performed appear unlikely to be comparable. Randomized controlled

studies with appropriate placebo groups are needed to determine the real effectiveness of PRP for treating chronic musculoskeletal injuries.

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INJECTION THERAPY AND NEW DRUG RELEASE FOR SUBACUTE AND CHRONIC PAIN: NANOMEDICINES FOR CHRONIC PAIN MANAGEMENT INDICATIONS

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Nanomedicine is a novel and rapidly evolving, highly technical approach to optimizing delivery and control of medicines. My personal entrée to nanomedicine was based on an interest in the inverse proposition: the capture rather than the delivery of drug (in my case, local anesthetic) by use of a 'nearly nano' emulsion (eg, TPN solution). The key feature shared by all nanomedicines is the encapsulation or incorporation of a drug or drugs into very tiny (< 100nm) delivery vehicles. The ultimate goals of nanomedicine are improved drug efficacy and safety - the holy grail of pharmacology. The standard notion for use of nanomedicines is that once administered, (implant, inhalation, transdermal, transmucosal, injected or ingested) then drug release is sustained, reliable and controllable by the specific architecture and design of the delivery vehicle. This is possible because of the unique and unusual chemical features acquired by molecular assemblies on the nano-scale. These include specific electrical, chemical and mechanical properties that can be used to create optimal drug delivery systems including bilayer vesicles, unilamellar micelles, nanospheres, nanotubes, nanocrystals, and nanoshells among others. I will devote a portion of the talk to defining each of these. There are currently a wide array of available preparations based on nanotechnology, including anti-cancer, antibiotic, hormonal replacement or agonist therapy, anti-rejection, anti-nausea, hypnotic and analgesic drugs among others. Not surprisingly each of the standard agents for treatment of pain (e.g., opiates, NSAIDs, local anesthetics, corticosteroids) can be engineered into nanomedicines. These include, for example, Depo-dur morphine-containing liposomes for long lasting epidural-based analgesia, Actiq for transmucosal (eg buccal) delivery of fentanyl citrate to treat breakthrough pain and Exparel, a liposomal preparation for sustained release of bupivacaine that can be delivered to an incision for postoperative analgesia. There is one very well-known liposomal preparation used by anesthesiologists the world over for anesthetic (albeit not analgesic) purposes.

The main advantage of nanomedicine preparations to date has been sustained release for prolonged, steady-state effect, especially for non-water soluble drugs. However, the future of nanomedicine is virtually unlimited in terms of the potential for regulating, controlling and monitoring release of the drug. Many of the technologies required for such advanced application are currently in the design and development phase but will be available to clinicians before long. Some already are. Controlled release is currently based on polymer technology that can be triggered by simple diffusion, pH or temperature. Future possibilities include regulating delivery by programmed 'Smart' devices, triggering release by wireless communication, regulating release by biosensors that function as real-time servos to allow continuous, graded release based on concentrations of specific metabolites (e.g. glucose), drugs (e.g., opiate) or biological markers (e.g., epinephrine, QT interval). Nanomedicines can hypothetically realize the goals of maximizing efficacy while reducing the occurrence of adverse effects, poor compliance, drug

diversion and prescription drug abuse. Currently, preparations can be positioned close to sites of action (e.g. epidural injection in proximity to spinal opiate or adreno-receptors) so that drug doses can be lowered. In the future, surface modification of nanoparticles will allow them to be targeted to specific surface receptors of sites of pain perception and integration, possibly even the brain. This will theoretically improve drug specificity and allow even very small doses to be highly effective.

We can see the future of nanomedicine has great potential. Now what are the downsides? First is the issue of safety. The FDA has approved all the nano-medicines available in the US. However, there are major questions to be raised about the methods of their assessment of these novel preparations. Has the FDA come to grips with the rapidly growing market for novel nanomedicines? Aside from the question of regulatory mechanisms, one most also ask, "Are nanomedicines safe"? That means are they non-toxic, non-mutagenic, and non-teratogenic. What is known of the long term effects and results of chronic exposure? Are there good models for pre-clinical assessment of these risks? Is there a risk of nano-pollution? That is how are these products dispersed in the environment and what the consequences? Finally comes the issue of efficacy. Are these products really better than their more conventional predecessors or just better marketed? Time will tell us something, but high quality clinical trials are needed to be certain that the promise of these agents is fulfilled and that these advantages justify the added costs.

57 MORPHOLOGICAL CONTRIBUTIONS TO KNOWLEDGE OF PHYSIOPATHOLOGY OF PDPH

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Intracranial hypotension due to cerebrospinal fluid leak (CSF) and the resulting traction of pain-sensitive brain structures is one of the most acclaimed theories explaining post-dural puncture headache (PDPH). This review aims at presenting recent findings and new contributions related to the pathophysiology of the PDPH.

In previous studies we have applied both light and electron microscopy techniques to examine: 1) the morphology of the human spinal dural sac; 2) features of the lesions of the dura mater caused by lumbar needles of different diameters and tip design, before and after lumbar puncture. Moreover, dissection of fixed brains allowed us to identify areas of cranial nerves susceptible of caudal traction.

These findings help to improve our knowledge of morphological details which are essential in our understanding of the pathophysiology of PDPH, allowing also to anticipate new challenges.

Introduction: Headache occurring after dural puncture had been described since the initial subarachnoid injections performed by August Bier and his assistant Anton Hildebrandt in 1898 (1-2). They performed subarachnoid injections to each other in order to learn the effects of cocaine and experienced severe headache for about a week, thereafter. Different hypotheses were proposed to explain the mechanisms leading to postdural puncture headache (PDPH). Among them, intracranial hypotension due to cerebrospinal fluid (CSF) leak and caudal traction of pain-sensitive brain structures have been accepted widely over the years, although other hypotheses stated the effects of irritant substances reaching meningeal layers. During the 1990s, the use of non-reusable lumbar needles of different tip designs, with the aim of reducing the incidence of PDPH, became standard practice. At the time, it was observed that the incidence of PDPH compared to Quincke type needles, was lower with spinal needles with non-cutting pencil tips, which separated

instead of cutting dural fibers, limiting the extent of the dural lesion. It was claimed that the dural lesion resulting from short beveled cutting type needles was responsible for the higher incidence of headache. These theories were postulated on assumptions based on traditional anatomical concepts defining the dura mater as a structure where fibers display a longitudinal disposition, parallel to the axis of the vertebral canal (3-4). Therefore, it was an obvious deduction that pencil-point needle tips would separate dural fibers and produced smaller dural lesions. These needles were called at the time non-traumatic needles.

We proposed that the causes leading to PDPH are far more complex and there are different factors involved, deeming thorough examination (5-6). Some of these factors are related to the morphology of the components of the dural sac, others are associated to the nature of the lesions caused by different types of needles, both to their shapes and sizes and lastly to the intrinsic anatomical relationships of the neurological structures affected by the CSF hypotensive syndrome.

Research Methodology: Neural tissue sections are initially examined under light microscopy using specific standard staining techniques. Subsequently, ultrastructural details of tissues are obtained by employing immunohistochemical techniques in combination with transmission and scanning electron microscopy imaging. The first is more suitable for the observation of internal structures and the latter allows optimal visualization of surface features.

We determined the following items: the thickness of the dura mater (7-8), arachnoid lamina (9) and the subdural compartment (10-11), and studied the surface characteristics of each layer (12-14) (Figures 1 and 2). Tissues with dural puncture lesions caused by lumbar needles are routinely examined to identify the edges of lesions, their perimeter and possible retractions of dural and arachnoid layers opening widths, 15 minutes after needle removal.

The study of the brain by means of macro- and micro-dissection techniques provides essential information about morphology and size of the cranial nerves, as well as the locations where these structures are more vulnerable to traction forces due to intracranial hypotension caused by CSF leak after lumbar dural puncture.

Ultrastructural Features of Relevant Neural Anatomical Structures. Dural Sac

In view of the nature of PDPH, it is essential to provide a thorough coverage of the ultrastructural anatomy of the dural sac. The human spinal dural sac contains the spinal cord, nerve roots and CSF fluid and is surrounded by the epidural space. It is formed by the dura mater, which occupies 90% of its thickness externally and internally by the arachnoid membrane. A thin neurothelial cellular layer is also found separating both membranes which limits the subdural compartment. As the dura mater is detached from the arachnoid, part of this neurothelial layer remains attached to the inner surface of the dura, and the other part to the outer surface of the arachnoid.

The spinal dural sac is more resistant to handling than other membranes. It is light brown colored, with a degree of opacity, although in some samples, its transparency allows the identification of blood vessels supplying the spinal cord. Therefore, as a lumbar needle pierces the spinal dural sac during lumbar puncture it goes progressively through the dura, the neurothelial cellular layer limiting the subdural compartment and the arachnoid (Figures 1 and 2).

The dura mater has a thickness of 0.25 to 0.40 mm and consists mainly of fibers (7), and to a lesser extent of isolated cells, including fibroblasts, mast cells and macrophages. Dural fibers are mostly of collagen but also of elastic nature. These fibers are arranged in concentric layers of about 4 to 6 microns (12-14) (Figure 1). These layers are known as dural laminae. The dura mater is formed by approximately 70 to 80 dural laminae (Figure 1). The orientation and composition of dural fibers confer remarkable resistance to the membrane as a whole. Their compact disposition remains constant along the spine. The dura consists almost exclusively of fibers and proteoglycans occupying the spaces between the fibers, making it permeable.

The arachnoid layer has a thickness of 35-40 microns (μm) (9) (Figure 2). Unlike the dura, this membrane is a barrier to the passage of molecules. Its barrier effect is due to the various planes of arachnoid cells that are closely linked together. These cells occupy 25% of the arachnoid internal thickness whereas the outer surface of the arachnoid cells is in direct contact with neurothelial cells of the subdural compartment. The diameter of arachnoid cells measures about 5 to 8 μm , while a number of 4 to 5 arachnoid cells form the thickness of the arachnoid membrane (9) (Figure 2). They keep firmly

attached by special membrane unions such as desmosomes and tight junctions. The intercellular space between arachnoid cells measures 0.02 to 0.03 μm .

The neurothelial cells are stellate in shape, their cytoplasm is flat and narrow, and may branch into several cytoplasmic prolongations. Neurothelial cells, unlike arachnoid cells, have desmosomes type unions, but a reduced number of tight junctions. The neurothelial layer is therefore less resistant to traction forces and separation is more feasible between neighbouring cells (10-11).

As it has been already described, a smaller number of tight junctions and the presence of amorphous substance, among other factors, increase the tendency to tear. Traction forces are employed during an anatomical dissection, surgical opening of the dural sac, spinal trauma, and by injection of air or solutions during epidural procedures.

Mechanisms Involving Dural and Arachnoid Lesions

In order to achieve a better understanding of the relationship between leakage of CSF and the CSF hypotension, it is essential to undertake a thorough examination of the processes involving dural and arachnoid lesions caused to the dural sac during lumbar puncture. Therefore, it is convenient to review the steps followed during lumbar needle puncture of the dural sac and study how such lesions evolve, once the needle is removed.

As the tip of the needle advances through the epidural space, the pressure exerted by the tip of the needle pushes the dura mater inwards, displacing CSF towards more cephalic areas. This deformation of the dura-arachnoid is known as the "tent-like" effect (5-6) (Figure 1).

The single-use, short-beveled spinal needles used at present, produce little "tent-like" effect as they pierce the dura in the first attempt at dural puncture. Non-cutting tips of Pencil point needles produce greater distension of the dural sac and increased "tent-like" effect as they pierce the dura-arachnoid membrane.

Due to the "tent-like" effect, the use of Pencil point spinal needles increases the risk of advancing the needle further inside the dural sac than expected and causing nerve paresthesias. In our studies, lesions produced by 22G, 25G, 26G and 29G short-beveled tip spinal needles (Figure 3) were similar (5-6, 15-17). On the other hand, lesions caused by non-cutting pencil point spinal needles of sizes 22G, 25G and 27G (Figure 4) produced a lesion of similar pattern to their tip design. Such observations remain constant if the needles did not hit bone prior to piercing the dural sac. Although after withdrawal of the needle, tissue borders tend to retract, the diameter of the lesion after 15 minutes is similar in size and correlates with the external diameter of the spinal needle used during lumbar puncture.

Dural Puncture with Short-Beveled Spinal Needles

Short-beveled Quincke spinal needles has a characteristic bevel shape. Initially, the end of the tip produces a small cutting lesion through which the tip advances, and as the bevel progresses the sharp edges cut and distend the dura, favouring a clean progression. Quincke spinal needles produce precise cutting and limit the damage of dural and arachnoid membranes (5-6, 15-17). The dura-arachnoid lesions produced by this type of needles have a "crescent moon" shape (Figure 3). As the needle tip advances, the cut fragment is folded inward. As the tip of the needle advances, all dural, neurothelial and arachnoid layers are entirely severed and the edges of the lesion displaced inwardly. The sizes of these lesions are proportional to the external diameter of the spinal needle. Spinal needles 25G y 27G spinal needles have an external diameter of 0.4-0.5 mm.

As soon as the spinal needle is withdrawn, the edges of the lesion tend to retract due to the viscoelastic properties of the affected tissues. These may favour the return of fragmented edges to their original position, speeding the closure of the lesion (Figure 3).

In our studies it was observed that after 15 minutes, time needed to fix the samples with glutaraldehyde, several samples showed obvious closure around the edges of the lesion. The closure was more evident in lesions caused by short-beveled cutting spinal needle tips, where only the thin orifice remained open, with minimal loss of tissue.

Lesions caused by short-beveled Quincke spinal needles resemble a "U" or "V" letter shape similarly to the lid of a can, with clean cut edges (Figure 3).

Although several factors influence the closure of lesions affecting the dural sac, it is worth considering the shapes of the outer and inner edges of lesions inflicted upon the dural sac by spinal needles. The morphology of dural lesions depends mainly on the type of spinal needle tip used. The residual area of the lesions caused to the dural sac by 25G spinal needles measured 0.023 mm² (95% CI, 0.015-0.027 on the outer surface of the dural lamina observed from the epidural space) and 0.034 mm² (95% CI,

0.018-0.051% on the inner surface of arachnoid layer, observed from the side of the subarachnoid space) (15).

In our studies, the relevance of the parallel alignment of the needle tip bevel to the axis of the spinal cord was evaluated by comparing the extension of lesions caused to the dural sac after lumbar punctures following this alignment with lesions caused by lumbar punctures performed by the tip of the needle with a perpendicular alignment. Spinal Quincke needles of 25G and 22G were used in the study. Although 22G spinal needles are not commonly used by anesthesiologists, their larger external diameter facilitates the identification of possible differences among lesions derived from changes in needle tip alignment.

Statistical analysis failed to show significant differences in the sizes of the lesions, not only when comparing lesions of the outer surface of the dural sac but also of the inner surface of the dural sac.

Comparing the diameter of lesions immediately after dural puncture and 15 minutes after needle insertion, in those produced by 25G Quincke needles, only 11.7% (CI 95% from 7.6 to 13.7) of the initial diameter remains open at the dural outer surface and 17.3% (95% from 9.1 to 25.9) at the arachnoid inner surface (5).

Image analysis of the process leading to the closure of the lesion shows that lesions take longer to close at the inner arachnoid surface, than at the outer dural surface of the dural sac. This is probably because the dura mater has higher content of elastic fibers, which facilitates tissue retraction.

Dural Puncture with Pencil Point Spinal Needles

Pencil point spinal needle have non-cutting tips. During lumbar puncture the needle tip tends to displace the dural sac forwards before piercing the dural lamina. These needles produce a larger "tent effect" because of their lack in sharp beveled tips. Higher pressure is therefore required to overcome the resistance and achieve effective piercing of the dural sac.

Pencil point tips produce greater tearing of the tissue margins and folding at the edges of the lesion. Piercing the dural sac with this type of needle requires greater pressure and consequently, the needle advances further inside the spinal canal, where more spinal nerve roots are located. The edges of dural lesions caused by pencil point needles are irregular with fragmented portions of tissue due to tearing (Figure 4). These findings contradict previous theories, which raised the possibility of a less damaging effect of pencil point spinal needle tips. The proposed explanation was that separation of parallel dural longitudinal fibers would cause less tissue damage (5-6).

Measurements of the area of the dural sac lesion immediately after lumbar puncture with 25G Whitacre needles resulted in diameters of 0.026 mm² (95% from 0.019 to 0.032) at the outer dural surface and 0.030 mm² (95% from 0.025 to 0.036) at the inner arachnoid surface of the dural sac. Out of the initial measurements of lesions produced by 25G Whitacre, 13.2% (95% CI 9.7 to 16.2) of the initial diameter remains at the outer dural surface and 15.2% (95% CI 12.7 to 18.3) at the inner arachnoid surface (15).

Lesions produced by both Whitacre and Quincke needles with identical external diameters were compared and no statistically significant differences were found between the areas of lesions to the dural lamina, nor to the arachnoid layer.

Closure of Lesions to the Dural Sac after Lumbar Puncture

Histological characteristics of each of the components of the dural sac ought to be considered in order to obtain a more accurate insight of the mechanisms involved in the closure of lesions to the dural sac (18). The arachnoid membrane may show a slow tissue closure in relation to the dura (Figures 3 and 4), because its main function is to act as a barrier, and therefore it lacks the elastic properties of the dural layer. The outer edges of the lesion correspond to the dura membrane where retraction of the tissue margins is favoured by its elastic properties. Ultrastructural images show clearly that the lesion at the arachnoid surface has a larger diameter than the lesion at the dural surface, as the later closes at a faster speed. These images also show the multilayer structure of the dura mater, clearly visible across the dural lesion. The arachnoid layer limits the passage of fluid and substances across it, therefore the amount of CSF lost through the punctured orifice is related to the speed of closure of the arachnoid lesion. In this regard, parallel or perpendicular orientation of the needle bevel affects only the dura mater, therefore the orientation of the needle tip would not be as relevant as originally expected. Establishing a relation between the sizes of spinal needle tips and dural fibers is important to grasp the concept of "fiber separation" stated in support of pencil point tip spinal needles as being less traumatic.

Here, it is worth considering that most dural collagen fibers measurements are in the range of 0.1 μm and dural elastic fibers measure about 2 μm in diameter, whereas the external diameter of 25G needles measure 0.5 mm (500 microns). The size ratio between the diameter of the needle and collagen fibers is 5,000 / 1.

The disproportion in sizes between spinal needles and tissue components of the dural sac explains why it is rather unfeasible to separate dural fibers in either case of parallel alignment of short beveled needle tips or using pencil point needle tips. In clinical practice, there are other factors to be considered such as deformations of the tip of the needle after hitting bone during repeated attempts at dural puncture, which can distort the original shape of the spinal needle tip.

Certain limitations in our studies must be considered. First of all, the isolated dural sac is not subjected to tensile forces affecting the dural sac of individuals during postural changes. Such forces are exerted under forced flexion of the spine, commonly adopted to favour the opening of the interlaminar foramina prior to lumbar puncture. Injuries caused by pencil point needles, instead of separating dural fibers, possibly produce lesions to the dural sac that are the result of a complex mechanism involving tearing, cutting and separation of dural fibers. In this respect, the design features of this type of spinal needle may be relevant for other reasons. Probably the resulting tearing and folding of the margins of the dural lesions, as opposed to the clean cut produced by Quincke needles, lead to a more intense inflammatory reaction around the edges accelerating its closure. On the other hand, Quincke needles are more vulnerable to tip deformation on hitting bone. If used repeatedly, there is an increased risk of tissue damage. The degree of deformation depends on the force applied against the bone, the number of attempts, and the position and angle of the bevel. In contrast, pencil point needles are more resistant retaining better their original design.

Cranial Nerve Distribution and Their Role in Cerebrospinal Hypotension Syndrome

Puncture of the dural sac leads to CSF leak, which eventually produces CSF hypotension. In the standing upright position, the brain and brain stem are pulled downwards, affecting several anatomic structures that are anchored to the cranium such as cerebral veins draining into the sagittal sinus, cerebellar veins draining into the transverse and straight sinuses, some areas of the dura, and arteries near the base of the brain (circle of Willis). Consequently, the cerebellar tonsils may be dragged below the foramen magnum while the cranial nerves are pulled by the brain (6, 19-20).

Intracranial pressure changes affecting brain structures lead to clinical symptoms such as fronto-occipital headache, nausea and vomiting, dizziness, diplopia, decreased visual acuity and impaired visual accommodation (6, 19-20).

Frontal headache is caused by the affection of branches of the trigeminal nerve. Compression of the dura, arteries or veins at the skull base give rise to headache located in the occipital area and is mediated by upper cervical fibers with contributions of facial, vagus, glossopharyngeal and hypoglossal nerves (21). This type of headache may trigger shoulder and neck muscle contraction due to affection of the accessory and upper cervical nerves.

Clinical symptoms correlate well with affected cranial structures stretched under traction forces (Figures 5 and 6). The effects on clinical symptoms caused by postural changes help to evaluate the effect on brain structures (21-23). Postural changes from the supine to the upright position produces severe headache symptoms, which reflects the abrupt changes in pressure affecting cranial nerves. As the CSF leak increases, brain structures experience higher traction forces and the speed of onset of symptoms is similarly influenced by the degree of downward displacement of brain structures (6, 21-23). The abducens nerve (VI) is commonly affected, causing diplopia (Figure 6). This nerve may be stretched between its exit at the bulbo-pontine sulcus and the Dorellós canal, limited by the apex of the petrous portion of the temporal bone and the petrosphenoidal ligament. It is probably more vulnerable at its anchoring points. Traction of olfactory nerve (I) would relate to smell disorders. Pulling of the optic nerve (II) in its intracranial course from the optic chiasm to the optic canal could lead to visual fields defects (Figure 5). Traction of the oculomotor nerve (III) as it leaves the interpeduncular fossa and close to the roof of the cavernous sinus (oculomotor triangle), may affect motor fibers of four of the six extrinsic muscles of the eye (6, 21-23) (Figure 5).

The trochlear nerve (IV) which supplies the superior oblique muscle of the eye may be affected on its way from its exit in the posterior midbrain and caudal to the inferior colliculus, to its entry point at the free edge of the tentorium. Traction of the trigeminal nerve (V) may occur between its origin

in the ventrolateral aspect of the pons, where it merges with the middle cerebellar peduncle and the pore of the Meckels cave (Figures 5 and 6). Traction of the facial nerve (VII) may occur in its way from its exit in the cerebellopontine angle, near the pontobulbar junction to its entry into the facial canal (located at the end of the internal auditory canal in the petrous portion of the temporal bone) (21-23) (Figure 6). Glossopharyngeal, vagus and accessory nerves take their course towards the dorsolateral region of the medulla (Figure 6). The glossopharyngeal nerve (IX) exits behind the inferior olive and under the inferior cerebellar peduncle. The vagus nerve (X) is formed at the dorsolateral sulcus of the bulb by eight to ten rootlets, caudal to the glossopharyngeal nerve (22-23).

The accessory nerve (XI) is formed by small rootlets from the caudal dorsolateral sulcus of the bulb (bulbar root) and a larger one from the cranial portion of the spinal cord (spinal root), located behind the dentate ligament (Figure 6). These spinal accessory nerve rootlets joint together in a trunk that ascends in the subarachnoid space and parallel to the spinal cord to enter the cranial cavity through the foramen magnum. These three nerves, IX-X-XI, leave the skull through the jugular foramen. The hypoglossal nerve is formed from several rootlets emerging from the anterolateral sulcus of bulb between the pyramid and the inferior olive, and leaves the skull through the hypoglossal foramen in the posterior cranial fossa (22-23).

Clinical symptoms concomitant to PDPH may be related to cranial nerve damage. In this way, thorough record of the progression of the symptoms in these patients may provide indirect evidence of the physiopathology affecting brain structures resulting from the CSF hypotension syndrome.

Conclusions

Little progress has been made in treating PDPH in recent decades. It is perhaps worth reconsidering the mechanisms involved in the development of PDPH from different perspectives, not only physiological, but anatomical and histological; an integrated analysis to test previous hypotheses or that may help raise new ones. At present, the most widely accepted hypothesis is related to CSF hypotension. Other hypotheses explain the effects of antiseptics, keratin, and irritant agents present in the skin and their toxic effects. These hypotheses state that contamination of needle tips with powder from surgical gloves and their deposition in the meninges influence the severity of PDPH. The presence of concomitant neurological diseases has also been considered. In our studies, we focused on the relationship between the type of spinal needle tip used in lumbar punctures and the resulting dural lesions. The study of the lesions to the dural sac and its membranes is necessary, if we aim to achieve a better understanding of the loss of CSF and resulting hypotension syndrome. It is therefore worth focusing on primary details of the anatomy of brain and spinal structures that may be affected during spinal puncture. In this way, As such, it may become feasible in the near future to prevent unwanted complications from medical procedures of common practice such as lumbar spinal punctures.

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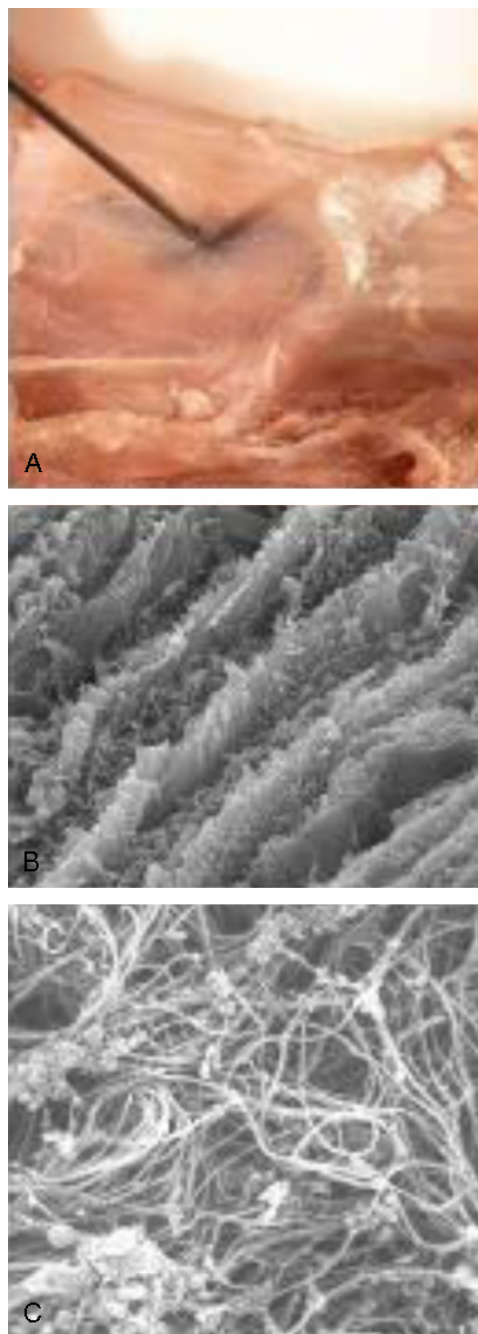


FIGURE 1. Human spinal dural sac. A: "Tent effect" on the dural sac with 22G Quincke needle bevel. B: Partial detail of its thickness where concentric dural lamina are seen x800. C: Collagen fibers in different directions over the outer surface of the dura mater (Detail of the outermost dural lamina facing the epidural space) x6500. Scanning electron microscopy. With permission of the author. Published in references 6 and 14.

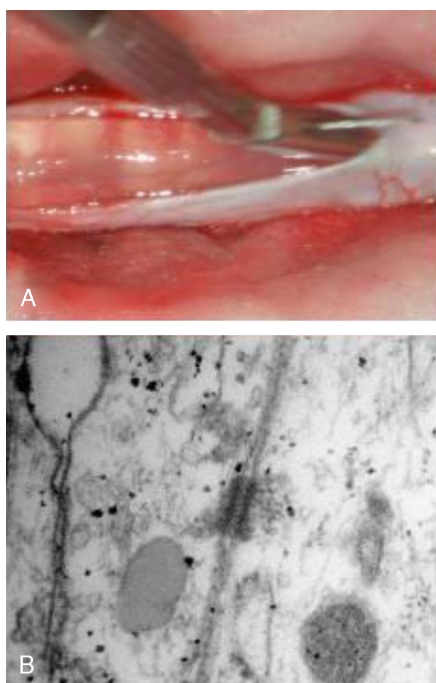


FIGURE 2. Human arachnoid lamina. A: Dissection of the dura and maintaining the entire arachnoid layer (appears transparent). B: Arachnoid cells (cell barrier), membrane specialized junctions (desmosome and tight junctions) x150000. Scanning electron microscopy. With permission of the author. Published in references 9 and 18.

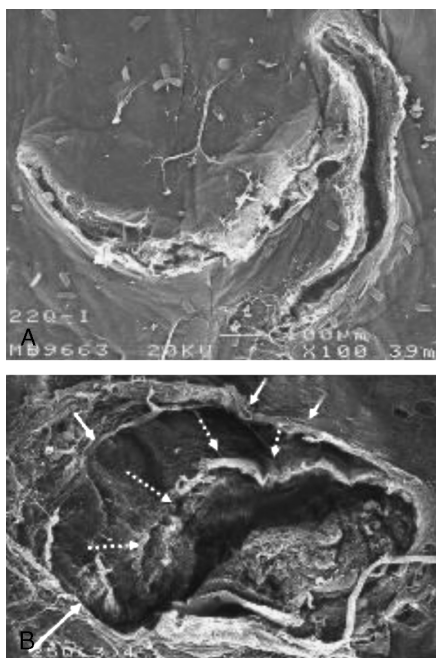


FIGURE 3. Dura-arachnoid lesions produced by Quincke spinal needles in the human dural sac. A: 22G Quincke needle aligned in two directions (inner or arachnoid surface), x100. Scanning electron microscopy. B: 25G Quincke needle (inner surface), x200. The arrows indicate larger lesions affecting the arachnoid layer, the broken arrows indicate smaller sized lesions affecting the dura mater. With permission of the author. Published in references 5 and 16.

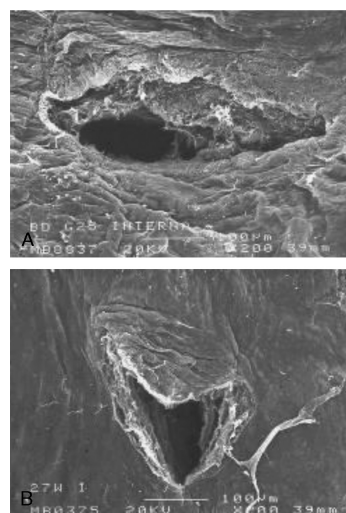


FIGURE 4. Dura-arachnoid lesions produced by Pencil Point spinal needles in the human dural sac. A: Whitacre 25G needle (inner surface), x200. B: 27G Whitacre needle (inner surface), x200. Scanning electron microscopy. With permission of the author. Published in references 5 and 17.

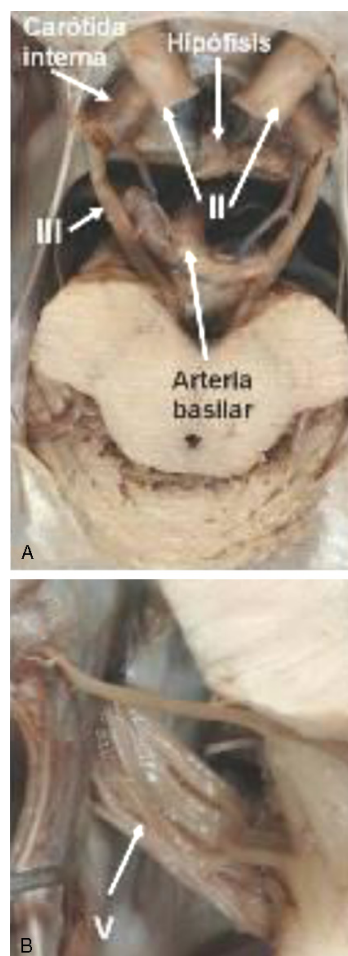


FIGURE 5. Dissection of human cranial nerves. Detail of III, IV and V cranial nerves. With permission of the author. Published in references 6.



FIGURE 6. Dissection of human cranial nerves. Detail of V, VI, VII, VIII, IX, X and XI cranial nerves. With permission of the author. Published in references 6.

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THE PLACE OF ULTRASOUND IN SPINAL ANAESTHESIA

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Spinal anaesthesia remains the primary mode of anaesthesia in obstetric practice, lower limb orthopaedic surgery and in many places lower abdominal procedures. This technique has a high success rate due to the definitive end point and reliable spread of local anaesthetic within the intrathecal space. Spinal anaesthesia can be employed in all age groups either as the sole anaesthetic or a part of a balanced anaesthetic technique and is becoming increasingly used in ERSA techniques for major abdominal surgery. Complications associated with spinal anaesthetic techniques include, back pain, superficial bleeding/infection, post dural puncture headache, nerve damage (isolated nerve root/cauda equina or spinal cord), meningitis, epidural abscess and haematoma. Physical damage to the cord or conus can occur from direct needle trauma and it is important to place the needle at the correct level. The incidences of these complications are well documented and the need for caution in the use of spinal anaesthesia in patients with ongoing infection or anticoagulation is essential. What is not well documented is the incidence of technical failure associated with spinal anaesthesia, the causes of which include, obesity, age, anatomical changes of the spine associated with disease entities e.g. osteoarthritis, ankylosing spondylitis, kyphoscoliosis, osteoporotic collapse - trauma and post surgical changes (decompression, fusion and instrumentation). Technical failure is as a result of either poorly identified superficial landmarks, rotation or lateralization of the midline, and the loss of an easily defined intralaminar and intra-

spinous window to access with the needle. In some cases this window may be very narrow or even absent due to bony encroachment.

Identification of the correct spinal level is routinely achieved by marking the level at which Tuffier's line crosses the midline on the patient. Anatomically it is stated that this line, 'joining the highest points of the iliac crests' crosses the midline at the spinal level of L4/5. The clinical ability to identify correctly a lumbar interspace has been shown to be poor, with a one space (higher) inaccuracy in 59% patients, with a range from 1 space below to 4 spaces above, with the correct space only being identified correctly in 29% patients.⁽¹⁾ This can cause problems as described by Reynolds F, in which seven cases of neurological injury following spinal anaesthetic were reported.⁽²⁾ Three anatomical factors were highlighted in this report: 1 the variability in the level at which the spinal cord terminates 2 the inaccuracy of Tuffier's line and 3 the complexity of the relationship of the conus and the spinal cord. Radiological assessment of the spinal level of Tuffier's line by Snider et al⁽³⁾ showed that in men this correlates best with the L4 body or inferior endplate of L4, in female with the body L5 or the superior endplate of L5. Ultrasound also shows, that in clinical practice, the palpated intercrystal line was identified at the L3-4 interspace in 73%, at L4-5 (14%) and L2-3 (13%) patient's with the palpated intercrystal line at L2-3 in taller male patients.^(4,5) MRI studies have shown that level of the conus may vary from T12 - L3 (90% between upper border of L1 & 2) and that the distance between the conus and Tuffier's line decreases with age^(6,7). As a result of these studies it shows it is important to identify the correct space when performing a spinal anaesthetic and to be aware that errors in identification usually lead to a higher interspace being targeted. In some cases this could be associated with an increased risk of direct needle trauma to the spinal cord or roots.

Technical difficulties in performing spinal anaesthesia are predictably associated with increasing age and obesity, which causes loss of easily identified landmarks and reduced adequacy of patient positioning. Success rates for first attempt can vary from 61-89% depending on experience⁽⁸⁾.

Ultrasound has been used with good effect in Obstetrics as both a pre-procedural scan and as a tool to improve the learning curve and success rate in performing lumbar epidurals^(9,10). As a tool to help with spinal anaesthesia the evidence is limited.

Chin KJ et al looked at fifty patients prior to having hip arthroplasty, 38% had poor or impossible palpable landmarks. The Longitudinal Parasagittal (LP) and Transverse Midline (TM) ultrasound scans had adequate or above visibility (100% vs 98%) of the Posterior Vertebral Body (PVB) and Ligamentum Flavum / Dura Mater (LF/DM) complex. Visibility of the structures was easier in the LP view than the TM view. This translated to a 100% procedural success, with 84% first attempt and 98% second attempt rate and good correlation (ND 0.82) of depth of Intrathecal space (ITS)⁽¹¹⁾. The only note of caution in this study is that someone who was very experienced in spinal scanning and US guided neuraxial blocks did all the scans and procedures.

No studies to date have looked at the effect of pre-procedural Ultrasound on the procedural learning curve for spinal. Ultrasound has been shown in a number of case reports to be beneficial in patients with difficult and challenging anatomy^(12,13). The place for ultrasound in spinal anaesthesia is developing and until the number of clinician's confident in spinal scanning increases its true use and benefits will not be apparent.

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MODERN SPINAL ANAESTHESIA - DAY CASE / UNILATERAL /SADDLE BLOCKS

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More and more of elective surgery procedures are currently performed as outpatient surgeries. It is expected that patients with more complex medical problems are undergoing outpatient surgery, and the types and complexity of surgical procedures have expanded significantly. Our goal in day surgery is to choose our anaesthesia method in order to achieve high patient satisfaction, contribute to the overall efficiency of the operation theatres with good predictability and reduce health care costs, if possible.

Spinal anaesthesia has progressed greatly since its introduction in 1885 and is used in a number of different clinical situations. Spinal anaesthesia is used successfully in many day surgery units around the world. However, for a successful spinal block for a day surgery operation, patient anatomy, choice of local anaesthetic, physiologic effects of spinal anaesthesia, patient positioning, and the approach to spinal anaesthesia must all be considered. The patients receiving regional anaesthesia are more alert and suffer less from nausea and vomiting in the recovery room, compared with patients undergoing general anaesthesia (Mulroy 2003). The surgeon can discuss about the findings with the patient during the operation. Especially, during arthroscopy operations, there is a possibility for the patient watch the procedure from the video screen.

On the other hand some patients may associate spinal anaesthesia with unpleasant experience. They may be afraid of being paralyzed, while some may have a nonspecific anxiety about any degree of alertness in the operating room. Some patients do not want to see or hear things related to the operation during the surgery. Others are afraid of the actual block performance and the needle insertion, and the possibility of a failure (Kuusniemi 2001). Despite these concerns, in most studies more than 90% of the patients who had received spinal anaesthesia for their operation, would choose the same anaesthesia method in the future, when indicated.

Spinal anaesthetic agents

The perfect local anaesthetic for day case surgery is yet to be discovered. The use of lidocaine has declined almost totally since the reports of cauda equine syndromes with continuous lidocaine spinal anaesthesia (Rigler 1991) and discovery of transient neurologic syndrome (TNS) after single shot spinal anaesthesia (Schneider 1993), were published. Therefore, alternative local anaesthetics for day surgery have been investigated and used. The use of long acting local anaesthetics like bupivacaine, ropivacaine or levobupivacaine for day surgery necessitates the use of small doses, selective spinal anaesthesia (SSA) techniques and addition of adjuncts. Ropivacaine or levo-

bupivacaine do not seem to have any significant advantage when compared with bupivacaine.

Recently, new old spinal anaesthetics like articaine, prilocaine, procaine and 2-chlorprocaine have been studied vigorously for day case spinal anaesthesia. 2-chlorprocaine (Lacasse 2011), articaine (Bachmann 2012), prilocaine (Black 2011) all have been compared with low-dose bupivacaine. These local anaesthetics lead to faster onset of block and faster recovery than bupivacaine along with fentanyl. On the other hand, hypotension and urinary retention seem to be more common and the onset and extension of the spinal block more unpredictable with these local anaesthetics. Also, in many comparative studies the dose of hyperbaric bupivacaine (7.5mg) has been quite high.

Selective spinal anaesthesia (SSA)

The concept of limiting the spread of spinal anaesthesia so that only nerve roots supplying a specific area are affected, is not new. For instance, a Frenchman H. Chaput described in 1907 a technique where the segmental spread of hyperbaric local anaesthetic was restricted with a gravity control (Lund 1971). Limiting the spread of the spinal anaesthesia offers many clinical advantages. Unilateral spinal block permits early recovery and stable anaesthesia. In addition, other features present advantages for fitter patients, in particular the increased patient autonomy after surgery due to lack of motor block in the non-operated leg. This aids nursing management, as the patient can assist with the unblocked limb and maintain spontaneous micturition, earlier ambulation after surgery as well as improved patient well being by avoiding the unpleasant experience of sudden, though reversible, paraplegia. Unilateral or selective spinal anaesthesia is indicated for all procedures involving the lower limb both orthopaedic and vascular, some operations in the perineal area, and some general surgical procedures such as inguinal or crural hernia repair.

In different studies SSA has been called with different names like unilateral block, minispinal, low-dose spinal anaesthesia etc. Also, different dosages of bupivacaine (3-10mg) with or without additives have been used.

In attempting to restrict spinal block to the surgical side it is mandatory to consider various factors without compromising unnecessarily the time in readiness to surgery. In creating a SSA with low doses of local anaesthetic, the injection technique becomes especially important. An important aspect to consider whenever trying to perform unilateral spinal anaesthesia is the direction of the local anaesthetic solution flowing out of the spinal needle. It has been demonstrated that the use of directional pencil point needles together with a slow injection speed (about 3 ml/min) minimises turbulence so that anaesthetic solution and CSF mix to produce a homogeneous mixture with balanced baricity. One of the basic elements of the SSA technique is the maintenance of the lateral decubitus position for approximately 10min. Usually, the table should be tilted so that the vertebral column is slightly head down (appr. 5 degree) in order to achieve expected spread of the local anaesthetic. The sensory block should be tested regularly by using, for instance, cold stimulus and the table tilt adjusted accordingly. Use of a "block room" or induction area to perform SSA before the operation reduces significantly the preprocedure OR time when compared with the spinal performed in the OR.

Adjuncts

Many different types of drugs have been used as additives, with local anaesthetics for spinal anaesthesia. Because the use of most adjuncts mainly aims to prolong the anaesthetic action, only a few of them are suitable for outpatients (Korhonen 2004). Low doses of opioids improve intraoperative analgesia and the quality of anaesthesia (Goel 2003). Lipophilic opioids, like fentanyl, have a shorter duration of action than morphine, and the risk of respiratory depression is small with low-dose fentanyl (0.01-0.025mg). In most of the studies, addition of intrathecal fentanyl has been shown to augment intraoperative anaesthesia without prolonging recovery time (Liu 2001). The most usual complaint after the use of intrathecal fentanyl is pruritus. In most cases, this resolves before discharge without treatment.

Side effects**Failure**

The criteria of failure varies between different studies. With low-dose spinal anaesthesia with bupivacaine, failure rates between 0-25% have been reported. In most studies, especially if fentanyl had been used as an adjunct, failure rates between 0-5% have been reported (Kuusniemi 2001, Borghi 2003). This is in accordance with earlier overall failure rate with conventional spinal anaesthesia with lidocaine or bupivacaine (Tarkkila 1991). With shorter acting local anaesthetics, modern, bigger epidemiologic studies about failure risk are lacking.

Post dural puncture headache (PDPH)

The use of fine gauge, pencil point spinal needles and the resultant minimisation of post-dural puncture headache has been one reason for the increase of the popularity of spinal anaesthesia in outpatient surgery. Both the needle size and the needle tip have been shown to influence the incidence of PDPH. The risk for PDPH is reduced when a smaller spinal needle is used, compared with a larger needle of same type. When non-cutting needles are used, a lower incidence of PDPH is detected even when the cutting needles are smaller. The incidence of PDPH in one large study with 27G Whitacre spinal needle was 0.37% compared with 2.7% with 27G Quincke needle (eight fold difference). The use of pencil point 27G spinal needle does not seem to increase puncturing difficulties or failures compared with larger bore needles or cutting bevel needles. Thus, routine use of the 27G (0.41 mm) Whitacre (or other pencil point) spinal needle is recommended when performing spinal anaesthesia.

Difficulties in voiding

Disturbance of micturition is a possible adverse effect after spinal anaesthesia and therefore ability to urinate is still required in many ambulatory units before discharge. However, unilateral spread of anaesthesia, low amount of iv fluids during the operation and early ambulation seem to save the patients from urinary retention (Kuusniemi et al. 2000). Mandatory voiding can be omitted before discharge home in outpatients after spinal anaesthesia when using a short-acting spinal anaesthetics or hyperbaric bupivacaine < 7mg in patients with low risk of urinary retention (Mulroy 2002).

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THE IMPACT OF NEURAXIAL BLOCKS ON BLADDER AND BOWEL FUNCTION

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The impact of neuraxial techniques and substances commonly involved with them upon the function of bladder and bowel is still subject of debate. With respect to bladder function this may be more challenging in day-case surgery as for longer-lasting surgery in hospitalized patients the threshold to place an indwelling catheter is lower. Considering bowel function this is mostly affected by postoperative analgesic techniques and may, similar to voiding delay in day-case setting, also affect the duration of the hospital stay. **Bladder function:** Even more than general anaesthesia, the bladder function may be compromised by a neuraxial technique. The present manuscript will not discuss postoperative epidural analgesia during which patients may have received an indwelling urinary catheter at the surgeon's discretion and depending on the type of surgery. As epidurals are less commonly performed in day-case surgery, especially spinals have suffered in popularity due to their delay in bladder function recovery.

Most actual discussions have focused on the question whether anaesthetists should wait until the moment the patient has voided, to allow home discharge. Although there has been some common agreement in the past that patients operated for uro-genital surgery, hernia repair, those who had experienced bladder problems in the past, patients with prostate disease, aged persons and those operated under a neuraxial technique should void before discharge, actually the latter indication seems to fade. Arguments in favor of this were series of patients sent home with only few requiring a single bladder evacuation later on. Several reports do no longer support the attitude to keep the patient in the hospital if they were not able to void within the expected time interval (1-3). Some suggest patients to return to the hospital only when no voiding took place within 8 hours or until the evening of the day of surgery. Full recovery of the bladder function requires recovery of the detrusor reflex (S3) which requires at least 2.5-3 hours regardless of the substance or dose used for spinal anaesthesia.

Another frequently discussed issue has been whether patients needing to void before discharge should receive a 'normal' or 'restricted' amount of intravenous and subsequently oral fluids. Restricting the fluid load will not fill the bladder and as a consequence the patient will feel the urge to void rather late in the postoperative period. Otherwise when freely allowing fluids (though prehydration is not really mandatory) the bladder may fill too early at the moment the patient is still anesthetized risking over-distension of the bladder. With the common policy to allow patients to freely drink clear fluids up to 2 hours before surgery, the bladder may fill intra-operatively regardless of restricted intravenous fluid administration. There is also disagreement at which bladder volume its content should be evacuated as this ranges from >300mL to >600mL (1,2,4). The risk of over-distension should be weighed against possible infection caused by bladder catheterization. The use of bladder scanning has quantified more clearly the problem of postoperative voiding difficulty but has also some disadvantage that 'measuring is knowing'. It is clear that there is more than 'voiding' and 'no voiding' and that despite the fact that the patients claims to have voided, the post-voiding residual volume may be considerable. After optimal voiding it should be less than 25mL.

Several solutions have been suggested to accelerate voiding or reduce the incidence of urinary retention. These were lowering the LA dose (to extremely weak dose such as bupivacaine 3mg and lidocaine 20mg) while adding an adjuvant substance (5). However opioids will also affect bladder function, longer than some local anesthetics, while also clonidine may delay home discharge for other reasons such as sedation and hypotension. Adjuvant substances will decrease the sensation of bladder fullness and weak the detrusor contraction at the spinal but also at the central pontine level. As lowering the LA dose may risk possible failures, CSE may provide beneficial to rescue a possible block failure though a more expensive solution. As lidocaine has been discarded due to TNS complaints and other LA, causing less or no TNS, have a duration of action which is too long for a day-case setting (bupivacaine, levobupivacaine and ropivacaine), unilateral blocks with hypo- or hyperbaric solutions have been thought to reduce the bladder problems as only one side would be affected. There is still controversy whether this is really true (6,7). Older LA have also been proposed for day-case use such as chloroprocaine (as it is now available without preservative) (8,9) and prilocaine, actually available as a hyperbaric substance seeming to have a better daycase profile than the plain substance (10). Studies performed with the latter two substances were very promising as they have a rapid recovery time which may be translated in a faster recovery of qualitative voiding. However comparative studies with bupivacaine are obsolete because the superiority of the short-acting substances is predictable (11). The shortest time to micturition i.e. 103 minutes (as opposed to more than 400 minutes for bupivacaine) has been reported with chloroprocaine, but was achieved in volunteers (12). Unfortunately not all the studies with chloroprocaine and prilocaine were able to show any benefit with respect to bladder recovery (13,14). In the report by Kreuziger et al (14), 23% of the patients treated with hyperbaric prilocaine 60mg required urinary catheterization. Recently it was shown that plain artiacaine has an even faster recovery profile than plain prilocaine (15).

In our department we have performed 3 studies during the last 10 years. The first compared lidocaine, ropivacaine and levobupivacaine (16). Patients were asked to void before transfer to the operating room and intravenous fluids were restricted to 500mL. The study demonstrated that the latter two LA prolonged home discharge with 40 minutes while more patients had micturition problems (subdivided in 5 subcategories). It was also found that mostly male patients had voiding difficulty. Although this confirms previous reports (17), in the report by Kreuziger et al, significantly more females had to be catheterized (14). In a subsequent study in only males clonidine 30µg was added to a 25% lower dose of levobupivacaine (18). This did not affect voiding despite some shortening of the block duration but delayed discharge due to either sedation or hypotension. Especially when the local anesthetic dose is not lowered, addition of an adjuvant of any kind may improve block quality but will surely prolong the hospital stay. The most recent study has compared lidocaine and prilocaine with or without fluid loading or restriction. Voiding and discharge was faster with chloroprocaine while the hydration policy did not seem to influence voiding or discharge intervals. On the contrary, fluids allowed up to 700mL even accelerated discharge after chloroprocaine spinals, conforming the results by Orbey et al (19). Patients in our third study voided between 2.5-3 hours after the spinal at volumes between 330-430mL.

Very recently Choi et al (20) have written a review on bladder dysfunction in the perioperative period, covering 94 studies (11162 patients) including spinals, epidurals and local infiltration, retrospective, prospective and volunteer studies. As a consequence it was concluded that besides the effect of dose and potency of local anesthetics and adjuvants, it is extremely difficult to draw conclusions also because of additional reasons such as the heterogeneity of substances used, the differences in the definition of 'urinary retention' and the lack of comparisons with general anesthesia.

In conclusion, despite some arguments to stop focusing on bladder function after day-case surgery, it may be advisable to ask patients to void before the intervention, limit fluid intake 'before' surgery, use short-acting local anesthetics and preferably monitor micturition and bladder volumes during the first postoperative hours. Based upon our results it may be unwise to send patients home without necessity to void when measuring a bladder volume of 400mL or more, requesting them to return after at least another 4-5 hours. Depending on bladder volume at discharge the interval allowed before return to the hospital should be calculated and told to the patient.

Bowel function: The finding that epidural analgesia for postoperative analgesia may accelerate the recovery of bowel motility goes back to the eighties (21). At first sight this may seem logical as local anesthetics may

block the ortho-sympathetic efferents allowing the vagal nerve to receive a predominant role. Similar effects should not be expected by replacing LA by opioids (21). At the same time surgeons pretended that due to bowel constriction the anastomosis might be more difficult to make while, based on incidental reports, it was even suggested that faster recovery of bowel motility might be responsible for premature rupture of the anastomosis (22). The use of neostigmine was thought to be an additional risk while larger water content of the anastomosis was a possible hypothesis for its inferior quality. However, a meta-analysis could not reveal any enhanced risk with epidural use of LA (23). In animal models it was shown that the water mostly accumulates in the mesenterium, not in the bowel itself, and that the quality of the anastomosis might be even improved due to more collagen content, as found by authors (previously warning against epidural use postoperatively) but this was not confirmed by others (24,25). Actually some studies have even found decreased leakage incidence of the anastomosis in patients treated with epidural analgesia (25,26).

An additional concern, though still unclear and conflicting, has been the hypothesis that a limited thoracic epidural may block the sympathetic outflow in the blocked segments while compensation-wise increasing the outflow to other segments and bowel parts, thus decreasing the blood supply in that particular area and rather endangering than improving anastomotic healing (27). However this issue was contested in instrumented dogs (28). Others found that perfusion to the mucosa might be diverted to the muscularis layer (29). Much will depend on the hemodynamic effect of the epidural, the location and extent of the epidural and/or the presence of epinephrine in the mixture.

As since the early nineties opioids were commonly added to the local anesthetic, it may become less clear what may be the net result of such combination with the mixing of counterproductive substances with respect to their effects upon the bowel even if few studies found that epidural morphine may also shorten, albeit less than LA, bowel recovery time (30). Even if the additional effect of the epidural opioid remains unsettled, we should agree that opioids will prolong the time to first bowel activity or in the best case have no effect. When reviewing the literature, epidural analgesia, as compared to conventional pain therapy including intravenous PCA, may indeed provide superior analgesia and accelerate the appearance of first bowel sounds or first flatus (31-40). This faster return of bowel activity, as far as demonstrable, was mostly in the range of 0.5-2 days maximally while in the majority of studies and reviews this was not necessarily reflected in faster home discharge, demonstrating that other factors may play a role in this (33, 36-38, 40). Not surprisingly, one study even found a slower return of bowel activity with epidurals as compared to spinal anesthesia or PCA (41). Nevertheless fast-track protocols became very popular during the last 10-15 years in which epidurals played a predominant role in combination with avoidance of oral opioids, the use of adjuvant substances, non-opioid analgesics and early intake of fluid and solids.

The most commonly added opioids are fentanyl and sufentanil of whom it is known that despite their spinal effect, total doses, plasma-concentrations and side-effects after prolonged administration (continuous infusion) are similar to intravenous administration, but with a moderate dose-sparing when given by PCEA as compared to PCIA. This dose sparing (25-33%) may be insufficient to affect bowel motility. This compares to the addition of NSAIDs to parenteral morphine which also results in a 30-40% dose sparing, equally insufficient to accelerate bowel recovery. The bowel is very sensitive with respect to inhibitory effects of opioids as ileus will appear faster than the analgesic effects. The analgesic/constipation ratio seems to be 4:1. At least 60% opioid dose sparing should be mandatory before this might have a positive effect upon bowel motility. Therefore the commonly realized dose-sparing effect of < 40% is not enough in this context. In fact only morphine may appear to cause enormous dose-sparing when changing from the parenteral route to the epidural route. The most spectacular acceleration of bowel function recovery, first food intake and hospital discharge i.e. 4-6 days has been reported in oncological abdominal surgery and used morphine in the epidural mixture (42,43). Addition of morphine 0.1mg/h i.e. 2.4mg /day seems to be sufficient to improve LA induced analgesia (44). Other studies (28), especially those using morphine as the opioid to be combined with a LA, appeared to offer the best results, only occasionally achievable with the more lipophilic substances.

Addition of other substances to the epidural mixture such as epinephrine, clonidine or ketamine is hardly been the focus of studies, if any, with respect to their effects upon bowel activity.

Finally, most authors believe that the discussion with respect to restoration of bowel motility becomes irrelevant due to the conversion to laparoscopic

techniques in the first place. Home discharge is faster after laparoscopic procedures in such a way that it may become extremely difficult to demonstrate the effect or additional benefit of the analgesic technique. In the search for alternatives, faster bowel function recovery has been found with intravenous lidocaine infusion as compared to placebo, according to some studies similar to epidural analgesia (45-47). Simultaneously, epidurals are put more and more in a bad daylight as the mostly superior analgesic quality is ignored while the drawbacks of epidurals, though well-known for decades, are suddenly highlighted such as hypotension, pruritus, urinary retention, reduced bowel perfusion and costs.

In conclusion, more studies are mandatory to clear out possible beneficial or rather endangering effects of epidural analgesia upon the healing and strength of the anastomosis, the effects of adding opioids or other adjuvant substances to the local anesthetic in the epidural mixture upon the proven benefit of the latter upon bowel motility, risk/benefit ratio of placing epidurals for laparoscopic procedures and the effects of alternative, less invasive techniques upon bowel function while providing equal analgesic quality. Last but not least, surgeons should be encouraged to determine more clear hospital discharge criteria i.e. home-readiness milestones even if the patient stays in the hospital, based on an individual patient check-list rather than inspired by tradition, fixed length of stay for a certain procedure, hospital/regional policy, pre-interventional information given to the patient or patient expectations.

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MAINTENANCE OF LABOR ANALGESIA: NOVEL OPTIONS

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Regional analgesic techniques, such as epidural and combined spinal-epidural analgesia, are the most effective modalities for pain relief in labour. Once analgesia has been established, whether by using an epidural or a combined spinal-epidural (CSE) technique, the maintenance of analgesia through labour until delivery may be obtained with different techniques. Intermittent epidural bolus injection (top-up) of the analgesic solution by the anaesthetist via the epidural catheter is the standard technique in some countries, in the less busy maternities or where there is the constant availability of the anaesthesia staff in the labour and delivery room. Injections are usually timed to parturient complaints of pain or at set intervals, based upon the duration of action of each dose. However, this regimen has two limitations: first, if injections are not administered until pain returns, the parturient will experience intervals of analgesia after the dose takes effect alternating with intervals of pain as the analgesia wanes; and second, intermittent dosing requires frequent provider interventions. The advantage of this technique is that the anaesthetist may titrate the local analgesic solution, varying its dose, volume and concentration according to the progression of labour and intensity of pain. During the last decade, there has been a transition to maintenance of analgesia with a continuous epidural infusion (CEI). Continuous infusion of analgesics into the epidural space avoids the peaks and valleys of intermittent administration and results in a smoother analgesic experience for the parturient with fewer medical interventions. The infusion may be adjusted to individualise analgesia and additional rescue doses may be administered, as needed. The main problem with continuous infusion is the frequent occurrence of motor block and association with operative delivery. Use of patient-controlled epidural analgesia (PCEA) has become popular in some countries. PCEA is a reliable and effective method of maintaining epidural labor analgesia. Provided that sufficient drug volumes are allowed, a wide variety of drug combinations and settings have been used successfully. It is commonly believed that PCEA techniques give parturients the psychological

benefit of being in control of their own therapy because they are able to titrate the dose to the severity of pain they are experiencing. Compared to continuous epidural infusions, PCEA results in a lower total dose of local anaesthetics used over the course of labour, a decreased need for the physician to administer additional doses of anaesthetic, and a lower incidence of motor block. Most frequently a continuous infusion is supplemented by patient activated bolus injections (continuous background infusion with superimposed PCEA), but a 'pure' demand-only PCEA approach is also used. However, PCEA techniques need the support of the parturient who must be instructed to operate the pump correctly. Recently we have assisted to renew interest in the intermittent epidural bolus administration provided by automated pumps. Similarly to CEI, intermittent boluses (programmed intermittent epidural anaesthetic bolus technique, PIEB) may avoid wide fluctuations in sensory levels common with manually administered boluses but, in contrast to CEI, reduce the total anaesthetic dose. In the past, studies have already compared the intermittent epidural bolus technique manually given by the anaesthetist to continuous infusion, continuous infusion to PCEA without a background infusion, and PCEA with and without a background infusion. (1) The incidence and intensity of motor block is greater with continuous infusion compared to bolus administration whether the bolus is administered manually or by PCEA. Consumption of local anaesthetic is less with bolus administration (manual or PCEA) compared to continuous infusion. Similar findings were observed when PIEB has been used instead of intermittent manual epidural bolus technique. Wong *et al.* (2) compared PIEB with PCEA vs. PCEA with a background infusion in multiparous women. Although pain scores were not different between the groups, total bupivacaine consumption and the need for additional, manual 'top-up' boluses due to breakthrough pain during the maintenance of labour epidural analgesia were lower with PIEB. In addition, patient satisfaction was higher in women who were randomised to receive PIEB. Chua and Sia (3) showed that parturients who received an automated intermittent bolus had lower pain scores and shorter time to first manual epidural rescue bolus when compared to those receiving continuous epidural infusion of the same solution. Fettes *et al.* (4) found that patients required a lower total drug dose and fewer manual bolus injections when epidural labour analgesia was maintained with automated intermittent boluses of ropivacaine compared to a continuous infusion. Similarly, Bhavani-Shankar *et al.* (5) demonstrated a lower incidence of breakthrough pain and higher patient satisfaction with intermittent epidural boluses compared to continuous infusion. Moreover only patients who received continuous infusion had motor weakness. In one study (6) we demonstrated, in primiparous women, that the maintenance of epidural analgesia with PIEB when compared with CEI decreased maternal motor block and the incidence of instrumental vaginal delivery while providing equivalent labor analgesia with less analgesic solution consumption, less requests for additional PCEA rescue boluses and longer time to first epidural bolus request. The reasons for the success of intermittent boluses when compared to continuous administration may be that solutions injected into the epidural space tend to spread more evenly when injected as a bolus, as compared to a continuous infusion. (7,8). Large volumes and high injectate pressures near the site of injection are needed to obtain the most uniform spread of the solution, which in turn, may contribute to the better quality of analgesia. (5-8) This has been confirmed by a recent study (9) that reported that extending the programmed intermittent bolus interval and volume from 15 minutes to 60 minutes, and 2.5 mL to 10 mL, respectively, decreased bupivacaine consumption without decreasing patient comfort or satisfaction. The use of a microprocessor-controlled infusion pump is not the guarantee of perfect analgesia and of entirely reduced manpower, due to the possible occurrence of the need for additional rescue doses administered by the anaesthetist. We must be aware that although technology may help to increase the efficacy of labour analgesia, to facilitate organisation and to reduce human manpower, the constant presence of the obstetric anaesthetist in the labour and delivery floor is inimitable to provide quality and safety.

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POST-CAESAREAN SECTION ANALGESIA: DRUG SELECTION TOWARDS AN OPIOID FREE TECHNIQUE

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The goals for post-caesarean section (post-CS) analgesia are to provide adequate pain relief, encourage early ambulation, enable the care of the newborn, and minimize side-effect profiles in both the mother and the baby.

Management of postoperative pain relieves suffering and leads to earlier mobilization, shortened hospital stay, reduced hospital costs, and increased patient satisfaction. Pain control regimens after a caesarean section (CS) should not be standardized; rather, they are tailored to the needs of the individual patient, taking into account that the pain depends on many factors: individual (medical, psychological, and physical condition, patients level of fear and anxiety, personality, degree of desire of the newborn, socioeconomic status, personal preference, response to agents given...), surgical (technique used, capacity and skill of personnel performing the CS) and also anaesthetics, because our performance before, during and after the CS conditions the final pain resulting. We must also remember that the patient could requested other no pharmacologic or conventional alternatives (e.g., aromatherapy, acupuncture or acupressure...)

1. Individual factors:

These factors are difficult to evaluate. We have limited time contact with the patient. We do not follow the complete gestation as the obstetricians do, so it is sometimes impossible to prevent an increased risk of suffering more pain than in other circumstances. The only thing we can do here is to adopt general measures destined to reduce postoperative pain, and if we suspect that a particular parturient is in risk of developing an accentuated pain after the CS, to reinforce those measures.

2. Surgical factors:

There is little we can do in this aspect also. The anaesthesiologist cannot select the obstetric team to perform the CS in the great majority of hospitals (as they cannot also select us). A fast, elegant and low haemorrhagic CS will probably be accompanied with lower pain scores than a long, not enough skilled and traumatic surgery.

The CS technique can also influence on the final pain score, i.e. a vertical abdominal incision vs. horizontal Pfannestiel, or the uterine exteriorization. The closure vs. non-closure of both visceral and parietal peritoneum could be

other factor to be considered. While Kapustian et al.¹ reported that the time from incision to delivery was comparable in the no closure and closure groups, Tuncer et al.² described that the mean operating and anaesthesia time were significantly longer in closure group than in non-closure group. Visual analogue scale (VAS) showed no difference in postoperative pain comparing closure to no closure of the peritoneum but patients of the closure group required significantly more postoperative opioids.

3. Anaesthetic factors:

Pain of labour is described as one of the most severe pain that a woman experiences during her lifetime.³ Neuraxial epidural and spinal techniques are the most effective means of providing pain relief for labour, and provide unparalleled pain relief in labour with a minimum of maternal and neonatal side effects. Both techniques are considered to be the gold standard for labour analgesia and anaesthesia. The analgesics may be administered via epidural, spinal, or a combination of both routes, and continued after CS. Pain post-CS is more intense a 24-36 hr. after surgery and has variable intensity among women.

There are various classes of analgesics used for epidural and spinal block that include local anaesthetics, opioids, adrenergic agonists, and cholinergic agonists. But sometimes, regional techniques fail, are contraindicated (e.g., coagulation disorders) or simply because we have to realize a general anaesthesia for an emergent CS. Postoperative analgesia in these cases is usually administered by the intravenous route although we have other alternatives to improve the postoperative analgesia after a CS in our patients.

The Roman military writer Vegetius said in his *Epitoma rei militaris*, book III, preface: "*Igitur qui desiderat pacem, praeparet bellum*", meaning "If you want peace, prepare for war". In the same way, the major goal in the management of postoperative pain is minimizing the dose of medications to lessen side effects while still providing adequate analgesia. This goal is best accomplished with multimodal and preemptive analgesia.⁴ Postoperative pain may have at least two components, somatic and visceral. A multimodal approach seems to provide the most effective post-CS analgesia. Such an approach often includes administration of a non-steroidal anti-inflammatory drug (NSAID).

3.1. Preemptive analgesia for CS:

Surgical pain is due to inflammation from tissue trauma (ie, surgical incision, dissection, burns) or direct nerve injury (ie, nerve transection, stretching, or compression).⁵ Tissue trauma releases local inflammatory mediators that can produce augmented sensitivity to stimuli in the area surrounding an injury (hyperalgesia) or misperception of pain to non-noxious stimuli (allodynia). Other mechanisms contributing to hyperalgesia and allodynia include sensitization of the peripheral pain receptors (primary hyperalgesia) and increased excitability of central nervous system neurons (secondary hyperalgesia).⁵

Preemptive analgesia is the administration of analgesics prior to onset of noxious stimuli. Preemptive analgesia modifies peripheral and central nervous system processing of noxious stimuli, thereby reducing hyperalgesia and allodynia and postoperative opioid use and opioid side effects.

The patient senses pain through the afferent pain pathway, which can be altered by various pharmacologic agents. Effective preemptive analgesic techniques use multiple pharmacological agents to reduce nociceptor (pain receptor) activation by blocking or decreasing receptor activation, and inhibiting the production or activity of pain neurotransmitters.

3.1.1. Preemptive local anaesthetic wound infiltration:

Local anaesthetics can be injected prior to surgical incision and may promote preemptive analgesia. This is an important annotation, because the popular practice of infiltrating bupivacaine at time of incision closure does not offer any benefit in the control of pain (e.g., after laparoscopy).⁶ A meta-analysis of randomized trials found significantly decreased analgesic consumption and increased time to first rescue analgesic request, but no significant differences in postoperative pain scores in patients who had preemptive local anaesthetic wound infiltration.⁷ Some randomized trials have shown that local anaesthetic injection around small incision sites reduces postoperative somatic pain, but is inadequate for visceral pain as has been reported for postoperative pain in gynaecologic laparoscopy (bupivacaine 0.5% has been reported as efficient,⁶ not so ropivacaine⁸). However, there are no good results in hysterectomy pain control: pre-incisional ropivacaine⁹ and bupivacaine¹⁰ failed to reduce postoperative pain.

Sekhvat et al. reported the use of pre-incisional lidocaine 2% for caesarean delivery pain relief, concluding that is a simple and efficient mode with few side effects that may reduce pain and opioid requirements in women undergoing CS.¹¹

Bamigboye et al.¹² described that 30 mL of 0.75% ropivacaine used for the wound infiltration and peritoneal spraying during CS under general anaesthesia reduces severe pain and need for opioids, diclofenac and tramadol/paracetamol.

A positive effect reported as reduced the amount of morphine usage and prolonged onset time to require the first dose for pain relief has been described for subcutaneous infiltration with 30 mL of 0.33% bupivacaine with adrenaline 1:300,000 before suturing the skin incision in CSs.¹³

The combination of bupivacaine 0.25% (20 mL, subcutaneously) and dexamethasone 16 mg (4 mL, s.c.) appears to be effective and prolong the analgesia during 48-72 hours postoperatively. It may be an option for longer pain relief after CS.¹⁴

3.1.2. Ketamine local infiltration:

Pre-incisional subcutaneous infiltration of low-dose ketamine (30 mg) at the site of incision on the postoperative pain management after CS decreased locally postoperative pain scores with a significant decrease of analgesics consumption. This method was associated with no systemic or local side effects.¹⁵

3.1.3. Systemic:

Other drugs such as ibuprofen, ketorolac, gabapentin, COX-2 inhibitors have been used in different trials looking for the best combination to reduce the postoperative morphine consumption.

Ketamine 0.5 mg/kg IV had no effect on morphine consumption during 2 to 24 hours after CSs and did not elicit a preemptive analgesic effect.¹⁶

Attenuation of central sensitization with NMDA-active drugs such as S-Ketamine 0.5 mg/kg IM may play a role in postoperative analgesia and prevention of neuropathic pain. S-Ketamine reduced morphine consumption at 4-8, 8-12, and 12-24 hours after surgery.¹⁷

Gabapentine was found to be useful in reducing morphine consumption in hysterectomy¹⁸⁻²⁰, but there are no reports of its use in CS.

3.2. Pharmacological treatments

3.2.1. Opioids:

Different opioids and regimens have been used for post-CS analgesia. A multimodal one that includes oral non-steroidal anti-inflammatory drugs (NSAIDs) may be more effective than opioids alone.

However, opioids used for analgesia after CS pain may have side effects like sedation, nausea, ileus and respiratory depression.

Other non-invasive routes of administration have been studied, such as transnasal butorphanol 1 mg followed by a repeat dose of 1 mg at 60 min, (compared to 2 mg intravenous butorphanol) in 186 patients experiencing moderate to severe post-CS pain, reporting good clinical results, without nasal mucosa irritation, or cardiovascular or respiratory depression.²¹

3.2.2. Tramadol:

This atypical opioid has been used in various trials to relieve postoperative pain after CS, alone or in combination with acetaminophen²², or diclofenac²³. The parenteral association of tramadol and diclofenac resulted in more prolonged and pronounced postoperative analgesia and reduced sensory sensitization compared with the single drugs, with no increase in side effects.²³

Compared with piroxicam 20 mg IM, tramadol 100 mg IV obtained the same efficacy and side effects were similarly minimal with both treatments.²⁴

Tramadol 100 mg has also been injected epidurally and provided adequate postoperative analgesia without respiratory depression in patients after CS.²⁵

3.2.3. NSAIDs:

3.2.3.1. Diclofenac:

The effect of diclofenac has been studied in various regimens and routes of administration.

A single administration of 100 mg diclofenac suppository is effective in reducing post-CS epidural local anaesthetic/opioid requirements by 33% for the first 24 hr. post-operatively (n=88).²⁶

Diclofenac (100 mg rectal immediately after CS followed by 100 mg every 8 h for the first 24 h) was compared with pethidine (25 mg immediately after CS then 25 mg every 8 h for the first 24 h) in 122 women, with significantly lower visual analogue score for pain in diclofenac group.²⁷

Rectal diclofenac 100 mg rectal diclofenac immediately after CS followed by 50 mg at 12 hours and 100 mg at 36 hours after the surgery provided effective analgesia and also diminished the patients opioid requirements with a corresponding reduction in the opioid related side-effects.²⁸

Repeated IM injections of 75 mg diclofenac sodium (maximum 2 injections per day) could relieve postoperative pain after CS and significantly reduce opioid analgesic requirements without significant effects on uterine relaxation or bleeding during the first postoperative 48 h.²⁹

3.2.3.2. Ketoprofen:

When associated to low spinal morphine doses, ketoprofen (100 mg IV) was similar to diclofenac (75 mg IM) in providing postoperative analgesia in the first six hours following CS under spinal anaesthesia³⁰.

3.2.3.3. Tenoxicam:

Intraoperative injection of 20 mg tenoxicam IV decreased the demand ratio for patient-controlled analgesia (PCA) and 24-hour morphine consumption by approximately 30%, and profoundly reduced the intensity of uterine cramping pain after CS, but had no additional effect on wound pain at rest, with movement, changing position, sitting, and walking³¹.

3.2.3.4. Piroxicam:

Piroxicam 20 mg IM (single dose therapy) was found to relieve postoperative pain after CS in 150 women as well as tramadol, and it could reduce opioid analgesic requirements with less adverse side effects during the first postoperative 24 h²⁴.

3.2.3.5. Naproxen:

Although similar in terms of pain scores, oral naproxen might be more effective than oral tramadol for pain relief after CS (120 women). Naproxen seemed to have a better adverse-effects profile, and therefore might be more suitable for mothers. Administration at fixed intervals might be more efficacious than administration on request³².

3.2.4. Cyclooxygenase-2 Inhibitors:

Parecoxib (bolus of 40 mg IV as a loading dose post-operatively and then 2 bolus doses of 20 mg at intervals of 24h) with PCA morphine can be used for post-CS analgesia with the same efficacy as ketorolac (loading bolus of 30 mg IV post-operatively and then 90 mg) for an opioid-sparing effect³³.

3.2.5. Acetaminophen:

Paracetamol 1g IV every 6 hours for 24 hours, is a safe and effective treatment option in post-CS pain for combination with tramadol PCA IV, as it produces effective analgesia and reduces tramadol consumption³⁴.

3.2.6. Dextromethorphan:

Postoperative pain after CS under spinal anaesthesia was not reduced by the addition of oral dextromethorphan to a multimodal approach including intrathecal morphine³⁵.

3.3. Regional blocks:**3.3.1. Subfascial infusion:**

Subfacial 0.25% levobupivacaine infusion for 24 hours at 4 ml/hour infusion with the ON-Q pain pump system diminished postoperative pain and the need for tramadol use following CS in 50 women, without complications³⁶.

3.3.2. Bilateral ilioinguinal nerve blocks:

The effects of bilateral ilioinguinal nerve block and wound infiltration with 0.5% bupivacaine on postoperative pain and analgesic requirements in 62 patients undergoing CS were compared. Both ilioinguinal block and wound infiltration reduced significantly the pain scores and analgesic requirements in the immediate postoperative period ($P < 0.05$) without differences between both groups³⁷.

3.3.3. Ultrasound-guided transversus abdominis plane (TAP) block:

Ultrasound-guided TAP block with bupivacaine 0.25% improved postoperative analgesia, reduced morphine consumption more than 60%, induce less nausea and vomiting, and improved patients' satisfaction regarding analgesia after CS³⁸.

3.3.4. Epidural or spinal drug administration:

Regional techniques (epidural, spinal) provide unparalleled pain relief in labour with a minimum of maternal and neonatal side effects. Relatively small doses are needed because the agents exert their effects locally, thus systemic drug concentrations are low. The analgesics may be administered via epidural, spinal, or a combination of both routes. The various classes of analgesics used for epidural and spinal block include local anaesthetics, opioids, adrenergic agonists, and cholinergic agonists.

3.3.4.1. Local anaesthetics and opioids:

Local anaesthetics inhibit neural conduction by reversibly blocking axonal sodium channels. Opioids exert their effect by reversibly binding to opioid receptors in the dorsal horn of the spinal cord. Different local anaesthetics and opioids, alone or in combination have been used via intrathecal or epidural for management of post-CS pain.

3.3.4.2. Alpha2-Adrenergic Receptor Agonists:

Alpha-2 adrenergic agents interact with alpha-2 adrenergic receptors in the spinal cord. Epidurally administered clonidine 400 mcg decreased need for supplemental morphine^{39,40}, but continuous infusion of 20 mcg/h clonidine infusion is required for analgesia of more than 6 h duration. The side effects

reported were decreased heart rate (one patient required atropine for asymptomatic bradycardia) and transient sedation⁴⁰.

Synergy between fentanyl and clonidine could not be demonstrated. Nonetheless, a reduced dose of fentanyl and clonidine can be combined for excellent analgesia⁴¹, as happens with epidural morphine: a low dose of clonidine such as 75 mcg doubled the duration of analgesia produced by 2 mg of morphine⁴².

Addition of intrathecal clonidine 50 mcg causes some sedation in the postoperative period, but it provides adequate analgesia and motor paralysis at lower dose of bupivacaine. It also significantly prolongs postoperative pain relief⁴³. Intrathecal clonidine 75 mcg added to bupivacaine improved intraoperative spinal analgesia. The combination of clonidine and fentanyl further improved analgesia but moderately increased sedation and pruritus⁴⁴. Intrathecal clonidine 150 mcg combined with bupivacaine had a postoperative antihyperalgesic effect expressed as a significant reduction in the extent and incidence of periincisional punctate mechanical hyperalgesia at 48 h after elective CS⁴⁵.

3.3.4.3. Magnesium Sulphate:

Magnesium is an NMDA antagonist that may alter pain signalling following nociceptive stimulation. Spinal magnesium 0.5 mL preservative-free sulphate 10% increased duration of analgesia after CS without adverse events⁴⁶.

3.3.4.4. Neostigmine:

Cholinergic agonists produce analgesia by increasing the concentration of acetylcholine proximate to muscarinic and nicotinic receptors in the superficial layers of the dorsal horn of the spinal cord. Intrathecal neostigmine has been reported to produce a dose-independent reduction in postoperative morphine use, 10 h of post-CS analgesia without adverse foetal effects⁴⁷.

Intrathecal neostigmine 25 mcg produced postoperative analgesia for CS similar to that of intrathecal morphine 100 mcg, but with a high incidence of nausea and vomiting. The combination of intrathecal neostigmine 12.5 mcg and morphine 50 mcg may produce better postoperative analgesia with fewer side effects than intrathecal neostigmine 25 mcg or intrathecal morphine 100 mcg alone⁴⁸.

3.3.4.5. Epinephrine:

The addition of 0.2 mg of morphine plus 0.2 mg of epinephrine to hyperbaric bupivacaine improves the intra- and postoperative analgesia without an added risk⁴⁹.

3.3.4.6. Midazolam:

Intrathecal midazolam 2 mg provided a moderate prolongation of postoperative analgesia when used as an adjunct to bupivacaine in patients undergoing CS. Intrathecal midazolam, 1 mg and 2 mg, decreased postoperative nausea and vomiting⁵⁰.

3.3.4.7. Other drugs:

Although used in other surgeries, there are no references in post-CS analgesia with adenosine, K⁺ channel openers (nicorandil, sildenafil), gabapentin, verapamil or ziconotide.

3.4. Multimodal analgesia:

It employs a number of different agents that work through various mechanisms and minimizes the reliance on opioids⁵¹. Obstetricians should consider the instillation of local anaesthetic at the surgical incision site as part of multimodal therapy, particularly in selected patients who have sensitivities to opioids or who did not receive neuraxial opioids.

3.5. Non pharmacological treatments:

Reports of the use of complementary and alternative medicines in obstetric and gynaecologic patients have had mixed results⁵². The value of these therapies in multimodal analgesic techniques is unclear, sometimes due to methodological concerns. Nevertheless, no pharmacologic interventions, including transcutaneous and percutaneous electrical nerve stimulation (TENS and PENS), acupuncture, and massage, have gained popularity because of the belief that they may provide effective analgesia with minimal side effects.

3.5.1. Acupuncture:

The application of acupuncture and electro-acupuncture could definitely delay the time of requesting pain relief medication after CS and decrease the PCA doses used within the first 24 hours⁵³.

3.5.2. Electric stimulation:

Morphine requirements were reduced by 50% to 80% in women undergoing gynaecologic surgery or CS who received electrical stimulation via percutaneous intradermal electrodes placed on each side of the lower abdominal surgical incision⁵⁴.

4. Breast-feeding issues ⁵⁵:

Finally, we should remember always the possibility of interference with breast-feeding. Women are sometimes quite reluctant to take analgesics for fear of affecting the newborn. The two most important items needed to determine the potential neonatal risks of maternal drug administration are the amount of medication excreted in breast milk and the therapeutic effect of that medication when given to the infant.

Acetaminophen and NSAIDs are considered safe to take during breast-feeding. Indomethacin (case reports of neonatal seizures and nephrotoxicity) and naproxen (a case of neonatal anaemia, rectal bleeding, and haematuria) should be used with caution during breast-feeding, especially when suitable, effective alternatives such as ibuprofen are available.

Ketorolac may have potential adverse effects on the foetal circulation.

Meperidine administration has been associated with neonatal neurobehavioral depression. Morphine and hydromorphone are alternatives to meperidine for PCA. Breast milk oxycodone levels could be as high as 10% of the therapeutic dose in infants.

There are no studies of the breast milk concentrations of maternally administered ketamine.

Conclusions: The epidural combination of local anaesthetics and opioids is considered to be the gold standard of postoperative caesarean section pain. The addition of other drugs, such as NSAIDs, has been probed to reduce the analgesic requirements. Sometimes, however neuraxial techniques are contraindicated, so we have to use other approaches for pain management. These techniques are also used to reduce the adverse effects of neuraxial-administered drugs, especially the opioids. Another point to remark is the approval in our respective countries of epidural route for "unusual drugs" (those not opioids or local anaesthetics) and even sometimes our proper reluctance to administer these drugs. Finally, we have also to consider the kind of CS: elective, urgent or emergent. It is easy to see there are some techniques that are only indicated in elective CS (i.e. TAP block, pre-incisional infiltration, epidural drug administration...).

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TOPPING UP AN EPIDURAL CATHETER FOR C-SECTION

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One of the benefits of placing an epidural catheter for labour analgesia is that, the catheter can be used to provide surgical anaesthesia when needed. Currently, the most common technique for pain relief in labour is provided by using a low-dose epidural mixture of a local anaesthetic with a lipid-soluble opioid. However, in the case where a woman receiving this mixture needs to undergo an emergency C-section, a more potent mixture will be required to convert epidural analgesia to epidural anaesthesia. When the C-section decision is made, the choices are either extending the block or converting it to general anaesthesia according to the urgency of the situation. Although it has been shown that top-up of a well functioning epidural is almost as fast as general anaesthesia (1,2), a rapid sequence induction general anaesthesia is still the choice for many anaesthetists in urgent situations (3).

A conversion rate to general anaesthesia for C-sections amongst women with epidural catheters in-situ was found to be as 9.4% and The Royal College of Anaesthetists has stated that < 3% of cases would require a conversion to general anaesthesia (4).

In these cases, extension of the epidural block may be the preferred option provided that adequate speed of onset and adequate surgical anaesthesia are obtained, with minimal side-effects for the mother and neonate. Considering the risk of increase of preparation time and other potential problems of additives, the use of pre-prepared solutions might be recommended in emergencies (5).

A maximum decision to delivery interval should be 30 minutes for urgent C-sections (6). It's been shown that, both general anaesthesia and extension of existing epidural block are found to be acceptable modes of anaesthesia and do not delay delivery of the fetus (1). The preparation and onset times are important when assessing an epidural top-up solution and addition of adjuvant drugs to local anaesthetics can increase the preparation time. If local anaesthetic solutions with additives such as epinephrine or bicarbonate are prepared just before emergency C-section, any possible reduction in onset time that they might afford may be offset by the additional preparation time. Also, it would be prudent to consider using simple solutions, unless good evidence is provided for the benefits of these additives (7).

Epidural catheter function during labour predicts anaesthetic efficacy for subsequent C-section. The anaesthetic factors for unsatisfactory anaesthesia for C-section using an epidural catheter previously placed for labour analgesia have been studied. Factors associated with failure of the epidural block have been asserted as: an increase in the requirement for supplemental local anaesthetic boluses during labour in order to provide adequate analgesia, and the possibility for the attending anaesthesiologist for the caesarean delivery, not being a specialist in obstetric anaesthesia (8). More recently, a retrospective review identified the predictors of failed epidural. These were initiation of labour analgesia with plain epidural technique (compared to combined spinal-epidural), episodes of breakthrough pain during labour and prolonged duration of neuraxial labour analgesia (9).

Different drugs and combinations have been studied extensively to find the ideal solution to convert labour epidural analgesia to surgical anaesthesia for C-section, however; none of them has been commonly agreed upon. Earlier, no advantage was found in using 2% lignocaine with adrenaline to extend low-dose epidural analgesia for emergency C-section (10).

Due to a lower risk of cardiotoxicity, some practitioners have pointed out to the levobupivacaine as the drug of choice for topping up epidurals for C-section (11). In a review, epidural top-up with levobupivacaine 0.5% and fentanyl was recommended to be the anaesthetic of choice for women who have been receiving labour epidural analgesia. If epidural top-up fails to provide bilateral light touch anaesthesia from S5 - T5, a combined spinal-epidural anaesthesia with small intrathecal dose (0.5% 1 ml hyperbaric bupivacaine) of local anaesthetic could be a convenient choice (12).

According to a recent metaanalysis which involves 779 patients, in eleven randomized controlled studies; not a high-level evidence supporting an optimal top-up solution to convert labour epidural analgesia to surgical anaesthesia for C-section has been obtained. Lidocaine and epinephrine, with or without fentanyl resulted in a significantly faster onset of sensory block; bupivacaine and levobupivacaine were associated with a significantly increased risk of intraoperative supplementation. The addition of fentanyl to a local anaesthetic resulted in a significantly faster onset but did not alter the need for intraoperative supplementation. Bupivacaine or levobupivacaine 0.5% have been revealed the least effective solutions. In the case the speed of onset is the primary concern, a lidocaine and epinephrine solution, with or without fentanyl, appears as the optimal solution. In the case the quality of epidural block is paramount, then 0.75% ropivacaine is suggested (13). This meta-analysis did not include trials evaluating 3% 2-chloroprocaine, which is widely used as an epidural top-up solution in North America. Chloroprocaine provides a rapid onset, but a short duration of action, and unfortunately is not available in Europe.

A survey in UK shows that 68% of the obstetric anaesthetists would give the full dose of the local anaesthetic mixture in the delivery room, whilst 12.5% initiate the top-up in the delivery room and give the remainder of the dose in theatre (14).

High blocks have been reported when spinal anaesthesia is used for C-section following inadequate labour epidural analgesia. Bolusing an epidural for caesarean delivery with surgical doses, realizing its inadequacy, then administering a normal spinal dose soon thereafter followed by supine positioning, all of which may significantly increase the risk of a high spinal. An inadequate epidural should be recognized to avoid the need for further interventions (15).

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DEEP BLOCKS: LIMITATIONS OF ULTRASOUND

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Background and aims: Since the introduction of peripheral nerve stimulators and ultrasound-guided nerve localization, a growing interest in the field of regional anesthesia has been established with more deep and unconventional nerve blocks being performed safely. The sciatic nerve is the largest nerve in the body, it is formed from the ventral rami of the fourth lumbar to third sacral spinal nerves and is a continuation of the upper band of the sacral plexus. It contains fibers from both the anterior and posterior divisions of the lumbosacral plexus. It leaves the pelvis through the greater sciatic foramen, below the piriformis muscle, and descends between the greater trochanter of the femur and the ischial tuberosity. Therefore it can be represented by a line drawn from just medial to the midpoint of the line from the ischial tuberosity to the apex of greater trochanter. The nerve ends at the upper aspect of the popliteal fossa by dividing into the tibial (medially) and common peroneal nerve (laterally). The sciatic nerve innervates the skin on the posterior aspect of the thigh and gluteal regions, it supplies the major innervation to the lower extremity below the knee. The lumbar plexus (LP) is a nervous plexus in the lumbar region of the body which forms part of the lumbosacral plexus, which is formed by the first three and the greater part of the fourth lumbar ventral rami (L1-L4), a contribution of the 12th thoracic nerve is common. The nerves of the lumbar plexus pass in front of the hip joint and mainly support the anterior part of the thigh. It lies within the substance of the psoas major muscle (at the junction of the posterior third and the anterior two thirds of the muscle), and anterior to the transverse

processes of the lumbar vertebrae. Although it is also described between the quadratus lumborum and psoas major muscles. It descends vertically in the mass of this muscle it is contained in a closed anatomical space within the psoas muscle called the psoas compartment. The branches of the LP are close to each other at the level between the transverse processes of the L4 and L5 vertebrae, they are as follows: femoral, obturator, lateral cutaneous nerve of the thigh, iliohypogastric, ilioinguinal and genitofemoral nerves.

Lumbar plexus block: Complete blockade of the afferent sensory nerve fibers supplying the lower limb can be achieved by subarachnoid and epidural local anesthetic. LP block is a favorable choice when selective anesthesia or analgesia of one leg is required. Selective anesthesia of the entire lower limb requires the blockade of 5 nerves (sciatic, femoral, lateral cutaneous nerve of thigh, obturator, and genitofemoral). The latter 4 nerves are branches of the LP and can be blocked by the posterior LP block. The main advantages of it over neuraxial anesthesia are unilateral blockade, resulting in greater hemodynamic stability, an improved ability to ambulate, and absence of urinary retention. Psoas blocks have been shown to provide superior pain relief and decrease blood loss when compared with other forms of pain relief. It has proved successful in the first 24 hr postoperatively, and are therefore part of any multimodal postoperative analgesia regime¹. Total hip replacement surgery produces significant postoperative pain, and it is a proven regional technique for analgesia and anaesthesia during and after total hip replacement conferring a number of benefits to the patient.

Blockade of the LP anesthetizes not only the 2nd-4th lumbar roots, but potentially the lumbosacral trunk derived from the 4th and 5th lumbar roots, which would contribute to sciatic and superior gluteal nerve innervation, depending on the volume injected.

Methods: Technique psoas block Conventionally, percutaneous techniques have been used to produce this block with the original posterior approach described by Winnie (1974)².

Anatomical surface landmarks are used traditionally to determine the needle entry point. The spinous processes, iliac crests, and posterior superior iliac spines define construction lines for locating the lumbar plexus. However, the intersection of construction lines does not always correspond to the actual location of the plexus.

It was Chayen in 1979, and his group who first used the term "psoas compartment block"³. The local anesthetic is deposited, blocking all lumbar plexus nerves and some roots of the sacral plexus, as explained above. Thus, a single injection of an anaesthetic agent which blocks the contents of the psoas muscle produces what is called a "3-in-1" block. The femoral 3-in-1 block, however, has been shown to be inconsistent in achieving block of the obturator nerve. The posterior approach works best and results in consistent block of the obturator nerve and more extensive anesthesia of the iliohypogastric, ilioinguinal, genitofemoral, lateral cutaneous femoral nerves, it has a much higher success rate in achieving anesthesia and analgesia of the LP. A number of slightly different approaches for posterior LP block have been described to improve the quality of blocks. In fact, with these new approaches the success rates did not increase. The risk/benefit ratio is in favor of other analgesia techniques such as the 3-in-1 block or epidural analgesia, and that the psoas compartment block requires further study and evaluation.

Many psoas compartment block and perineural catheter insertion techniques use loss of resistance, paresthesia, and/or electrical stimulation. Chayen et al used a loss of-resistance technique with a 20-mL syringe containing air to locate the psoas compartment³. As the needle advances through muscle, light tapping on the plunger elicits resistance. When the needle tip enters the psoas compartment, loss of resistance is elicited and 20 mL of air is injected into the space to dilate the compartment. This was followed by the injection of 30 mL of anesthetic solution to block the plexus. Nerve stimulation techniques to aid localization have been described but the depth of the psoas muscle makes this difficult. These techniques have a common limitation, external landmarks do not accurately predict lumbar plexus depth.

Advancing the needle or catheter past the plexus and psoas muscle may result in significant injury, because immediate anterior structures include the ovarian/testicular artery/vein, ureter, retroperitoneal space, peritoneum, and the kidney. Thus, multiple techniques describe first locating the transverse process with the needle, and then directing either cephalad or caudad, advancing the needle up to 3 additional centimeters because the distance between the transverse process and lumbar plexus is relatively constant (3 cm). Unfortunately, the skin-to-transverse process distance is highly variable.

Compared with the traditional methods of lumbar plexus block, ultrasound may be advantageous. The LP anatomy can be clearly identified and ultrasound can guide the needle to the posterior part of the psoas muscle

where the lumbar plexus is located. This may translate into higher success rates and reduced needle-related complications.

Single-injection sciatic nerve block using a posterior approach in the gluteal or subgluteal area produces anesthesia in both (common peroneal and tibial) nerve distributions and may be used for surgery of the lower extremity. However, the limitations to blockade of the sciatic nerve via a single-injection technique include prolonged and variable latency of the block with resultant failure to achieve complete sensory and motor anesthesia before incision.

Psoas compartment block was the technique used for continuous analgesia, it is gaining interest in providing anesthesia and analgesia for major knee and hip surgeries. For continuous analgesia, the posterior approach offers less chances of catheter dislocation when compared to the anterior approach, since the paravertebral muscle allows better fixation of the catheter⁴.

The ability to extend analgesia beyond the first 24 hours by means of a continuous catheter technique has obvious benefits. These include minimal morphine consumption; earlier ambulation improved patient satisfaction; lower incidence of nausea/vomiting, urinary retention and itching; and accelerated recovery after surgery.

Take into account ultrasound imaging of the proximity between nerve and catheter tip is difficult in deep blocks due to ultrasound physics.

Complications: However, traditional techniques used to produce this block require increased theatre time and has been associated with a number of serious complications.

The frequency of complications after this block is not well known. A few authors have reported central complications such as extended spinal anesthesia, acute cardiac or neurologic toxic accidents, or renal subcapsular hematoma⁵. The relatively common occurrence of epidural spread (up to 27% in adults and up to 92% in children depending on the approach) often limits the usefulness of LP block, particularly when long-acting local anesthetics are used. Psoas compartment is continuous medially with the intervertebral foramina of L4 and L5. This may explain the spread of injectate and/or the penetration of the needle or catheter to the epidural or intrathecal spaces.

In a prospective survey of major complications of regional anesthesia reported cardiac and respiratory arrests associated with LP block⁵. These patients were found to have a high dermatomal block before the arrest, strongly suggesting either epidural or spinal spread of local anesthetic as the underlying cause of these complications. They hypothesized that a forceful injection during LPB may drive the local anesthetic through the foramina toward the epidural space or contralateral side.

Apart from that previous spinal anomalies make landmark identification less reliable and predispose patients to such complications.

Role of ultrasound: The use of spinal sonography to guide regional anesthesia techniques in or close to the neuroaxis is growing rapidly. Ultrasound imaging is potentially even more useful when performing lumbar plexus blockade in patients with abnormal or distorted spinal anatomy.

However, there are very few practitioners of ultrasound-guided lumbar plexus block, probably reflecting the skill required to perform the block. It has therefore been suggested that this block only be performed by anaesthesiologists with the appropriate level of training and skill.

Although ultrasound has been established as a useful adjunct during the insertion of infraclavicular and femoral nerve blocks, limited studies are available examining its value in performing a posterior LP block. Incorporating the use of a stepwise scanning approach to central neuraxial and lumbar plexus ultrasound imaging may serve to facilitate successful block performance in patients with both normal and abnormal spinal anatomy, and in the process, add to patient safety and comfort.

Kirchmair et al performed posterior paravertebral sonography and were able to reliably trace the psoas muscle, the quadratus lumborum muscle, and the erector spinae at L2-3, L3-4, and L4-5 in 19 of 21 examined volunteers⁶. Ultrasonography could not be performed in 2 patients because of obesity and in 2 males at the L4-L5 level because of tall iliac crests. This study failed to delineate the lumbar plexus.

In 2008, an ultrasound-guided lumbar plexus approach was described in five patients undergoing emergency lower limb surgery⁷. A longitudinal scan including the transverse processes at L2, L3, and L4 identified what the authors described as a 'trident'. The psoas muscle was identified in the acoustic window between transverse processes in all patients, and the authors were able to identify a distinct lumbar plexus. An in-plane block was performed with the needle directed from caudal to cephalad between the L4 and L3 levels. The distance between the internal border of the psoas muscle and the median sagittal plane is 2.73 +/- 0.63 cm. Therefore, any attempt to reach

the plexus by a more medial approach or a medially directed needle may result in bilateral epidural/spinal anesthesia. Even more they were unable to visualize the lumbar plexus in two out of five adult patients. In addition, it was noted that the lumbar plexus was difficult to distinguish from intramuscular tendon fibers that have a similar hyperechoic linear appearance.

There are two ways of ultrasound guidance: a real time or assisted technique. Ultrasonography of the spine may be used to assist the practitioner with neuraxial and lumbar plexus blockade in assisted ultrasound guidance. It should be performed a preprocedural ultrasound scan, to provide information on the interspace level; the location of the spinous processes, midline, and transverse processes. It shows the optimal needle puncture point and the optimal angle for needle insertion, the estimated depth of epidural space, psoas major muscle, lumbar plexus. The area is imaged by scanning lateral to the lumbar spine in either a longitudinal parasagittal or transverse plane. The transverse processes and surrounding structures of interest (lower pole of the kidney, peritoneum, aorta and inferior vena cava) are usually identified too.

Results: Once we have this information, the block procedure is performed in a manner similar to conventional surface landmark-guided techniques. Real time ultrasound guidance refers to needle insertion under direct ultrasonographic visualization. Using this way to direct a needle tip to the lumbar plexus in adults is technically challenging given the limited ultrasound image resolution/quality at the typical psoas muscle depth. Apart from that, visualizing the needle shaft and tip is often difficult when the ultrasound beam and needle are at an acute angle as is necessary for deep targets. Imaging becomes progressively more difficult with increasing depth. Then it is needed a curved array ultrasound transducer with a lower frequency in the range of 2 to 5 MHz optimizes tissue penetration and the ultrasound image.

Real-time ultrasound-guided lumbar plexus is an extremely challenging and advanced technique that needs to be further refined and validated with additional studies.

The optimal technique is unclear there are multitude possibilities (in plane, out of plane, lateral to medial, medial to lateral, transverse or longitudinal view of spine). Recently it has been describe a study with four different approaches⁸. In all of the cases, final needle tip position was confirmed by an appropriate quadriceps motor response to neurostimulation and not by ultrasound visualization of needle-to-nerve contact.

Conclusions: The posterior LP block is a useful technique for selective anesthesia and analgesia of the lower limb. Knowledge of the anatomy and landmarks is vital to ensure safe outcome. In contrast to the "3-in-1" block, the posterior LPB is more reliable in blocking the main branches of the lumbar plexus and in particular the obturator nerve. Thus, although a psoas compartment block is a valuable technique, it is challenging and takes up theatre time to optimize the accuracy of the block.

Surface anatomical landmark-guided techniques do not reliably predict the location and depth of the transverse processes and lumbar plexus. Preprocedural ultrasound imaging may therefore be of benefit in delineating the important anatomy relevant to the lumbar plexus and can potentially reduce many of the complications associated with current landmark-guided techniques. In particular, ultrasound imaging allows the location and depth of the desired transverse process to be ascertained and the depth to the approximate location of the lumbar plexus to be estimated.

Further work is needed to determine the best approach to the psoas compartment and the future role of ultrasound in guiding needle and catheter placement.

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RADIOFREQUENCY TREATMENT OF PAIN DUE TO CHRONIC PANCREATITIS

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Introduction: Chronic pancreatitis is defined as a progressive inflammatory response of the pancreas that has led to irreversible morphological changes of the parenchyma (fibrosis, loss of acini and islets of Langerhans and the formation of pancreatic stones) as well as of the pancreatic duct (stenosis, pancreatic stones).¹ The most common symptoms are exocrine pancreatic insufficiency and pain.²⁻⁵

Innervation of the pancreas consists of sympathetic fibers from the nervi splanchnici and parasympathetic fibers from the nervi vagi. The intrapancreatic acinar plexus contains both sympathetic and parasympathetic fibers. Parasympathetic fibers stimulate exocrine as well as endocrine secretion. Sympathetic fibers mainly have an inhibiting effect on this release. A rich sensory network is located in the pancreas around the acinar cells.⁶⁻⁸

Pain is one of the most important symptoms of chronic pancreatitis. The pathogenesis of this pain can only partly be explained and it is therefore often difficult to treat this symptom. Pain in pancreatitis may be caused by different mechanisms.

1. Nociceptive pain
2. Neuropathic pain
3. Neurogenic inflammation

Nociceptive pain occurs after the activation of primary afferent neurons that respond to a chemical or mechanical stimulus. The pain is proportional to the degree of stimulation. Chronic pancreatitis involves inflammatory infiltration of sensory nerves. In human and animal models with chronic pancreatitis, perineural infiltrates are found with a high percentage of eosinophils in which the degree of infiltrative disorders correlates with the severity of the pain.⁹ In case of inflammation, ischemia, increased pressure and release of, for instance, bradykinins, prostaglandins and substance P, the nociceptors are activated to generate action potentials and nociceptive pain thus develops.¹⁰

Factors that may cause nociceptive pain in chronic pancreatitis include: obstruction of the duodenum or ductus choledochus, infiltration of the retroperitoneum, pseudocyst formation with compression of the surrounding organs, obstruction of the ductus pancreaticus due to fibrosis/stones/protein plugs, pancreatic ischemia due to atherosclerosis, gastric or duodenal ulcers, meteorism due to malabsorption.^{11,12}

Neuropathic pain involves a change of the sensory nerves or the central nervous system itself. This change or damage is caused by (but is not dependent on it afterwards) nociceptive activation. It has been shown that changes occur in the neurons innervating the pancreas that are located in the ganglia spinalia (dorsal root ganglia, DRGs).¹³ Patients with chronic pancreatitis appear to show generalized hyperalgesia, possibly based on deep sensitization.¹⁴

Cell death and tissue inflammation cause changes in the pH and the release of ions and inflammatory side products such as cytokines and ATP. These inflammatory substances have direct as well as indirect effects on the nerve fibers and their ganglia when neuropathic pain develops. Neurogenic inflammation itself induces the production and increased release of neuropeptides, which then reinforces the inflammatory reaction in the tissues.¹⁵

Physical examination usually does not reveal more than pressure pain in the epigastrium.

Fever or a palpable mass suggests a complicated course of chronic pancreatitis (pseudocyst).

Anesthesiological pain treatment

Relevant anatomy

The sympathetic innervation of the abdominal organs starts from the anterolateral horn in the spinal cord. Preganglionic fibers of Th5 to Th12 leave the spinal column after merging with the ramus ventralis. Together with these communicating rami they course in the direction of the truncus sympathicus (sympathetic chain). The fibers do not form synapses in the sympathetic chain, but run through it. The formation of synapses occurs more peripheral to the level of the ganglia: ganglion coeliacum, ganglion aorticorenale, ganglion mesentericum superius.

Preganglionic nerves confluence into three nervi splanchnici (major, minor, imus) that course along the paravertebral border. (Table 1)

TABLE 1. Nervi splanchnici and preganglionic fiber level

Nervus splanchnicus division

Preganglionic fiber level

Nervus splanchnicus major

Nervus splanchnicus minor

Nervus splanchnicus imus

Th5-Th9

Th10-Th11

Th11-Th12

Just below the level of the crus of the diaphragm, the nervi splanchnici confluence with the vagal preganglionic parasympathetic fibers, sensory fibers of the nervus phrenicus and postganglionic sympathetic fibers to the plexus coeliacus that are draped around the aorta abdominalis, especially at the anterior side. Figure 1 provides an image of the innervation of abdominal organs.

The nervi splanchnici are localized in a narrow pyramid of which the medial edge is formed by the lateral border of the vertebra, the lateral edge by the medial pleura and the crus of the diaphragm forms the basis of the triangle. The anterior side is formed by the posterior wall of the mediastinum and the posterior wall by the attachment of the pleura parietalis on the lateral wall of the vertebrae.



Figure 1: innervation of the abdominal organs

Nervus splanchnicus block

The specific anatomy in which the nervi splanchnici are located in a narrow compartment allows a targeted denervation. The use of neurolytic agents - in patients with non-malignant pain - has gradually been abandoned because of possible complications. Radiofrequency(RF) thermolesioning, in which denervation only takes place at the tip of the electrode, seems more suitable for this indication.

The use of RF nervus splanchnicus treatment has been described in two patient series.^{16,17} Raj¹⁶ reports on 107 patients who underwent RF treatment of the nervi splanchnici as a treatment of upper abdominal pain. The involvement of the nervi splanchnici was confirmed by means of a diagnostic block with a local anesthetic. Seventy-three patients were followed prospectively. Thirty-eight patients only received a block with a local anesthetic and 31 received RF treatment. In both groups a pain relief of > 50% was found in 40% of the patients.

Garcea¹⁷ describes 10 patients who underwent RF nervus splanchnicus denervation as a treatment of chronic pancreatitis with a mean follow-up of 18 months (12-24 months). A significant pain reduction was observed, accompanied by a clear decrease in the need for opiates and acute hospitalization. Moreover, the parameters of the quality of life improved as well.

Conclusions: The primary management of chronic pancreatitis consists of life style adaptation. The use of medical treatment may be complicated by the fact that these patients may have addictive habits. Therefore the use of anesthesiological treatment may be considered. The splanchnic nerve blocks have been demonstrated to be effective in the management of abdominal pain due to pancreatic cancer. Neurolytic solutions are however to be avoided in non-cancer pain patients. Therefore the use of radiofrequency denervation of the splanchnic nerves may be considered.

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THE PERIPHERAL NEUROMODULATION FOR CHRONIC VISCERAL ABDOMINAL PAIN

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Ba Visceral abdominal pain intermittently affects over 25% of the population. Frequently, diagnosis is complex and difficult. In a large proportion of patients, no firm diagnosis is possible. This non-specific abdominal pain incurs over £100 million in expenses in the UK, which is spent investigating and treating this condition. The interventional and surgical treatments of Visceral Abdominal Pain (VAP) secondary to Irritable Bowel Syndrome (IBS), or chronic pancreatitis are frequently unsatisfactory and only provide short duration pain relief.

Neuromodulation, an emerging option for the treatment visceral abdominal pain, is minimally invasive, reversible and, according to available data, quite effective. The first application of neuromodulation, the conventional SCS for severe abdominal pain caused by mesenteric ischemia, was initially reported by Ceballos A et al. [1] Krames and Mousad applied SCS for treatment of IBS, reducing severe diarrhoea and also pain, but for a limited period. [2] Subsequently, Khan Y, Raza S and Khan E reported five cases of successful treatment of chronic pancreatitis with SCS. [3] The first, larger report was published by Kapural and colleagues features 28 permanent implants in treatment of chronic pancreatitis followed by the survey lead by Kapural of 76 cases from various centres in US. [4, 5]. In the latest report on 30 patients, Kapural and his colleagues have concentrated specifically on a benefits of SCS for visceral pain from Chronic Pancreatitis [6].

A modification of SCS with an anterior lead position and low frequency stimulation, introduced by Baranidharan and Simpson, offers an interesting alternative with encouraging results. [7]

Peripheral Neuromodulation in the management of visceral abdominal pain is not fully explored, but it is an attractive and emerging option. In theory, there are several neural structures which can be considered as a possible stimulation target. Usually, a sympathetic chain is used.

In an interesting new development, Goroszeniuk T and Khan R reported almost complete pain reduction in chronic pancreatitis following the permanent implantation of two leads targeted at Splanchnic/coeliac plexus. [8] The same group; Goroszeniuk, Khan and Kothari, has also successfully treated the loin haematuria pain syndrome with the permanent implantation of leads targeted at the lumbar sympathetic chain. [9]

The data available on the usefulness of the peripheral approach is still limited, but encouraging. The mechanism of the action of SCS and PS in pain relief needs to be investigated further. More long term results are needed. Peripheral technique needs to be further refined and the specific equipments developed. Neuromodulation techniques as a modality for the treatment of chronic abdominal pain are relatively new, but there is a very promising option for the treatment of chronic visceral abdominal pain.

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SPINAL CORD STIMULATION FOR PERSISTENT ABDOMINAL PAIN LEONARDO KAPURAL, MD, PHD PROFESSOR OF ANESTHESIOLOGY, WAKE FOREST UNIVERSITY, SCHOOL OF MEDICINE

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Introduction: Abdominal pain is one of the most frequent complaints to a primary care physician, accounting for nearly 2.5 million office visits a year.¹ In many patients who present with abdominal pain, a definitive diagnosis can be made; but in 35% to 51% of patients, no identifiable cause is found.² There are approximately 2 million patients in the United States who currently experience severe abdominal pain. Most of them undergo a multitude of imaging studies and consultations with gastroenterology and surgery before being referred to a chronic pain specialist.^{3,4} Despite adequate evaluations by multiple physicians, the etiology of some abdominal pains remains unknown.

Characteristics of visceral pain have been described extensively in literature as poorly localized, referred to somatic structures, and not evoked by all viscera.⁵ Spinal and vagal afferent fibers convey sensory information from the upper gastrointestinal tract to the central nervous system. Vagal afferents transmit predominantly physiological information, whereas spinal afferents transmit noxious information.⁶ The dorsal root ganglia of the spinal nerves contain cell bodies of both vagal and spinal afferents. Vagal afferents enter the brainstem, whereas spinal afferents enter the spinal cord, making synaptic connections with second-order neurons, thereby conveying visceral information to the central nervous system. The ascending spinal pathways project to the thalamic nuclei. Afferent fibers with visceral and somatic information converge onto spinothalamic and spinoreticular pathways.

The role of the dorsal column pathway in transmission/amplification of visceral pain has been described more recently by Palacek and Willis⁷ and Palacek,⁸ and its role as participating in the neuromodulation of visceral painful information by spinal cord stimulation (SCS) has been hypothesized.⁹ Still the spinothalamic tracts are considered to be the major pathways for visceral nociception.¹⁰

Spinal sensitization process following tissue injury is characterized as a leftward shift in pain sensation/behavior (hyperalgesia) and enlargement of receptive fields within cutaneous areas able to activate the dorsal horn neuron (allodynia). This pattern is analogous to the change in functional bowel disorders, where a leftward shift in the stimulation-pain curve and enlargement of the somatic referral area occur.¹¹ The expansion of convergent cutaneous fields after repetitive distension of a viscus indicates the presence of a central mechanism contributing to the alteration of excitability of central neurons.¹² Brain-gut axis abnormalities can manifest as gastrointestinal motility and functional disorders. Because the neural activity plays a major role in these disorders, interventions aiming to modulate these processes can possibly improve the symptoms.

Spinal Cord Stimulation in Visceral pain: Possible mechanisms of pain relief

Several possible mechanisms may be involved in the phenomena of chronic abdominal pain relief produced by SCS. Published studies used the model of visceral hyperalgesia by colorectal distention in rats. Suppression of lumbosacral spinal neuron responses to the noxious colorectal stimuli by SCS could be produced by placing the electrical lead either near the lumbar or cervical dorsal column.^{13,14} It was suggested that such suppression of the visceromotor reflex (VMR) by SCS may be the result of antidromic activation of primary efferent fibers within the dorsal column.^{13,14} Spinal gating mechanisms¹⁵ might also be operant as an explanation for the reduction in pain transmission of small-diameter visceral fibers by stimulating large afferents using relatively low-intensity electrical stimulation.¹⁵

Although interruption of the recently described midline dorsal column pathway relieves visceral pelvic pain in cancer patients,^{7,8,10,11} at this time it is not clear if this visceral pathway can be modulated, excited, or suppressed by SCS.

Suppression of the sympathetic nervous system could play a significant role in control of the abdominal visceral pain.¹⁶ Chemical or surgical neurectomy/sympathectomy involving the superior hypogastric or celiac plexus can suppress chronic abdominal pain.^{16,17} Suppression of the sympathetic nervous system has been proposed as an important mechanism of pain control in intractable angina.¹⁸ It may be that such sympathectomy by SCS plays a role in suppression of chronic visceral abdominal pain.¹⁹

Clinical Experience in Using Spinal Cord Stimulation for Chronic Visceral Pain

Compelling data suggest that SCS may decrease pain and improve functional capacity in patients with various visceral chronic pain syndromes.

The first case report on SCS for the treatment of abdominal pain described the case of a 78-year-old male with chronic, unrelieved severe postprandial pain caused by mesenteric ischemia. The patient experienced full pain relief after a SCS lead was placed epidurally at the T6 vertebral level.²⁰ The only case report dealing with irritable bowel syndrome (IBS) described a female patient who suffered from 11 to 14 diarrheal episodes per day and extreme pain from IBS and who, after placement of a thoracic SCS system, became immediately diarrhea free. However, her initial reduction in pain relief was not sustained.²¹

Khan, Raza, and Khan²² described five successful cases of patients with nonalcoholic pancreatitis who received both single and dual leads placed at the T5-T7 vertebral height in the posterior epidural space. This report was followed by several others describing improvements in pain and function in patients with severe chronic pancreatitis²³⁻²⁵ (see Table 12-1).

Tiede and associates²⁶ described improvements in pain scores of patients with gastroparesis, whereas Jackson and Simpson²⁷ reported improved pain control and swallowing in a patient with a rather complicated history of esophageal problems. A most recently published report describes two cases of familial mediterranean fever (FMF) in which painful abdominal intermittent attacks responded positively to SCS at T8-T9 and T7-T8, respectively.²⁸

Despite initial enthusiasm for a novel modality for treatment of severe abdominal pain, interpreting such limited published experience was further complicated by the fact that there was considerable variability in patient selection, lead positioning, and type of the hardware used in these reports. Consequently, it remained unclear whether a reasonable fraction of the patients may have long-term benefit from stimulation.

Recently much larger clinical experience using SCS for treatment of chronic abdominal pain has been published.²⁹ In this study 35 patients were trialed with SCS over 4 to 14 days. Consistent with most previous reports, SCS lead tips were positioned at T5 (n=11) or T6 (n=10) height within the epidural space. Thirty patients (86%) reported at least 50% pain relief on completion of the trial. Among 28 patients who received permanent implant, 19 were followed at least a year. Their visual analog scale (VAS) pain scores remained low (3.8 ± 1.9 cm; $p < 0.001$) at 1 year, as was opioid use (138.3 ± 134 to 38 ± 48 mg morphine equivalents. This report for the first time suggested that SCS may provide consistent long-term improvements as a very useful therapeutic option for patients with severe visceral pain.

To initiate pain, physicians' consensus on patient selection and technical aspects of SCS for abdominal visceral pain, a national survey directed to physicians who implant SCS for such pain, was conducted recently and collected 76 case reports.³⁰ Considering so few cases reported by the physicians responding to this survey, SCS for abdominal visceral pain is still rarely used, despite possibly high therapeutic success rate. Causes for this

include very few studies describing basic mechanisms of neuromodulation for long-standing visceral pain, comfort levels by the physicians, and issues with coverage of such treatment by the payors.

The technical aspects of SCS for the treatment of abdominal visceral pain seem to be uniform among physicians who use such technology across the United States and are also consistent with our larger retrospective study described previously.^{29,30} In most patients the SCS leads were positioned with their tips at the level of the T5 (26 patients) or T6 vertebral body (15 patients; see Fig. 12-2). Pain relief exceeded 50% in 66 of 70 patients reported. VAS pain scores before an implant were 8 ± 1.9 cm, whereas after the implant they were 2.49 ± 1.9 cm. The opioid use before an implant was 158 ± 160 mg; at the last office visit after the implant, it was 36 ± 49 mg. The weakness of this survey was that the subgroup of responding physicians may not adequately represent the population of all of the physicians who trialed SCS for chronic visceral abdominal pain but rather those who had largely positive results; therefore results may be biased. However, the aim was to examine technical aspects of SCS for chronic abdominal pain, and this was not an efficacy study.³⁰

Spinal Cord Stimulation in the Algorithm for the Treatment of Chronic Abdominal Pain

The definite place for SCS within a pain treatment continuum for the treatment of chronic visceral abdominal pain is still unclear. Following a multidisciplinary evaluation, possibly within a comprehensive abdominal pain center, an interdisciplinary treatment plan should be established. Such treatments include cognitive and behavioral therapies, pharmacological pain management, adjuvant therapies for co-morbidities, including the management of sleep disturbances; and interventional diagnostic and therapeutic nerve blocks, including retrograde epidural differential block; splanchnic, celiac plexus and hypogastric blocks; and radiofrequency ablation. Based on the limited human experience reported in the literature, SCS might be indicated when conservative therapies fail to improve analgesia and function. Psychological evaluation for implantable devices and case discussion within the interdisciplinary medical team should precede SCS trialing. Only after trial is completed can a decision be made if SCS is an appropriate next step in the therapeutic continuum. Following such a rigorous algorithm would likely produce a smaller group of candidates for an implant. In our published study, only 28 patients received SCS implant from 237 initial candidates.²⁹ The data in support of SCS for visceral pain presently are encouraging. However, randomized controlled trials need to be initiated to support the role of SCS for long-term treatment of visceral pain.

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ENHANCED RECOVERY AFTER SURGERY - THE WAY FORWARD

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What is ERAS?

Enhanced recovery after surgery (ERAS) is a process that shortens post-operative recovery by minimising the physical and physiological trauma of

the surgery, by removing non evidence-based traditions and by encouraging early mobilisation and feeding. ERAS differs from previous 'fast track' and 'accelerated recovery' programmes in that it is not exclusive to the young, fit and healthy and is not dependent on a patient's suitability for inclusion. Programmes, if conducted properly, should benefit every patient.

The overall strategy is that *firstly*, patients' are given partnership of and responsibility for their care, *secondly*, that their health is optimized prior to surgery and *thirdly*, that they receive evidence-based care and rehabilitation throughout their hospital stay.

What are the key components?

ERAS involves the use of a number of **evidence-based interventions as a model of care**, enabling patients to recover faster following surgery. Success requires a 'buy-in' from all professionals involved in patient care, including general practitioners, hospital consultants, allied health professionals and hospital managers (Figure 1). ERAS programmes involve changes in every step of the patient care process, from the referral from primary care through to the post-operative phases and follow-up. Successful implementation requires the formation of a **multidisciplinary team** that focuses on all aspects of the perioperative period and meets regularly to audit and redesign patient pathways for its own hospital.

This team approach requires leadership that ensures best practice is achieved by each and every clinical department, similar to the role of the conductor of an orchestra. An autocratic approach along the traditional 'Pyramid System' with a 'closed mind' in charge is much less likely to succeed, if at all.

In primary care, pre-operative optimisation should target specifically anaemia, diabetes and hypertension. In addition smoking and alcohol are both associated with adverse outcomes, warranting advice on cessation and/or consumption.

Central to the whole process is **empowerment of the patient** by which they realize they are the 'main player' in their care with prime responsibility for their own recovery and discharge. Surgery by itself is not a disease, and therefore patients should be encouraged to feel that the operation has not made them ill. Therefore, the level of information they receive is very important as this will define their expectations and facilitate adherence to the pathway. Crucially, specific tasks and targets, e.g. postoperative oral intake or mobilisation, are given to the patient at this stage in the pathway, ideally both in verbal and written formats. Some units have prepared their own DVD's for patients.

Formal preoperative assessment should occur before surgery, including further optimisation of medical problems and risk stratification that may include for example, cardiopulmonary exercise testing. Together with full information about the planned operation, this will assist in consent and informed decision processes by the patient. Patients should be given a realistic planned day of discharge based on the unit statistics.

Admission before the day of surgery can be avoided if the patient has been fully prepared for surgery in the pre-hospital period of their care. Traditional pre-operative preparations, such as overnight fasting or bowel preparation, are both unnecessary and harmful, in contrast to the wide-held view of being beneficial.

Both prolonged starvation and bowel preparation have adverse effects on the level of hydration and electrolyte balance and moreover this may increase morbidity especially post-operative ileus. A Cochrane review supports reducing fasting to two hours pre-operatively for clear fluids in elective surgery, although a six-hour fast is still recommended for solid food. Pre-operative carbohydrate drinks should be given to minimise postoperative protein catabolism, negative nitrogen balance and insulin resistance that occurs and which results in loss of lean muscle mass.

In summary ERAS involves a positive attitude by all staff together with a clear description of what is about to happen before surgery with an emphasis on early mobilisation and encouragement to the patient to be an independent, major and active participant in their own recovery **'The drip stand'**.

Special mention is required of the need to avoid what have become perhaps the iconic emblems of traditional perioperative care, the drip stand and the urinary catheter. The majority of drip stands are large, heavy and difficult to steer and as such may be a major reason why many patients, particularly the elderly, arthritic and/or infirm do not wish to mobilise, despite good analgesia and a successful operation. Similarly urinary catheters may be both painful and highly embarrassing for certain patients and are also associated with their own inherent morbidity. Prolonged fluid therapy is unnecessary for the majority of patients and by avoiding this, via procedure-specific goal directed therapy, the need for postoperative catheterisation can be minimized.

What specialties have implemented ERAS?

A literature review reveals that, although the bulk of the research data into outcomes comes from colorectal and orthopaedic surgery, ERAS programmes have in fact been implemented across almost every specialty.

Colorectal surgery There is now good evidence that ERAS programmes have led to major improvements in the perioperative care of patients undergoing colorectal surgery (Lassen 2009, Eskicioglu 2009). Summarising these data, ERAS results in superior pain control, a reduction in the duration of ileus, improved pulmonary function, a trend towards reduced thrombo-embolic and cardiovascular events and does not affect anastomotic dehiscence rates. The patient's quality of life is improved in the first 6 months after surgery. The utilisation of 'minimally invasive surgery' (MIS) via laparoscopic techniques or when this is either not available or not feasible, 'maximally invasive anaesthesia' (MIA) using central neuraxial blockade, notably thoracic epidural analgesia (TEA) has led to significant reductions in the length of hospital stay, probably as a result of a reduction of the stress response. A recent study in open colorectal surgery, comparing an opioid based fast track programme with one in which opioids were avoided completely, showed significantly better analgesia, faster extubation times, less confusion, less postoperative nausea and vomiting and reduced length of hospital (Omar 2009).

Orthopaedic surgery There has been a widespread acceptance of the benefits of early mobilisation in reducing the incidence of DVT and pulmonary embolism (Husted 2010). Furthermore, two recent review articles on regional anaesthesia for hip and knee surgery respectively, highlight the improvements made over the last two decades in perioperative care and emphasise that future studies should combine surgical, nursing, anaesthetic and analgesic protocols in order to demonstrate improved perioperative outcomes [Macfarlane 2009 a) and b)]. The combination of an intraoperative spinal with either intra-articular catheters or low-dose PNB appears to provide the "ideal" analgesia for these procedures. In addition, by avoiding perioperative systemic and intrathecal opioids, the incidence of both urine retention requiring catheterisation and postoperative nausea and vomiting is less, thus allowing earlier ambulation and discharge. Except in rare circumstances relating to patient-specific comorbidity, there is now little justification for the avoidance of regional anaesthesia and analgesia for major joint replacement in both upper and lower limb surgery. The recent National Audit by the Royal College of Anaesthetists confirms that spinal anaesthesia, performed and managed properly, is associated with minimal morbidity in the overwhelming majority of cases (Cook 2010).

The recent Musculoskeletal 'snapshot' audit commissioned by the Scottish Executive and performed during a 12-week period from June to August 2010 outlines the current position of ERAS for lower limb arthroplasty in all Scottish orthopaedic centres and the scope for its evolution and development (<http://www.18weeks.scot.nhs.uk/how-to-achieve-and-maintain-18-weeks/service-re-design-and-transformation/enhanced-recovery>). An extensive perioperative database was established for all elective primary total hip and knee arthroplasties. A total of 636 THR and TKR procedures were performed. *Those hospitals that had higher transfusion rates, prolonged administration of IV fluids and patient-controlled analgesia had lower early mobilisation rates and longer lengths of post-operative length of stay.* These findings are very similar to the results of a recently published nationwide survey in Denmark (Husted 2010).

In an ongoing prospective series beginning in January 2007 of over 5000 patients undergoing knee arthroplasty within an ERAS programme at the Golden Jubilee Hospital in Clydebank, Scotland, patients were shown to have very low morbidity and earlier discharge compared with patients prior to establishment of the programme. The success rate for the technique is 94%. Of these patients, 96% can mobilise within 24 hours of surgery with median pain score less than 3. Postoperative fluids are only required in 5% of patients and only 7% require urinary catheterisation. The median PONV score is zero and median postoperative stay has reduced from 6.5 to 3.8 days. Notably, joint infection remains low at 0.9% and the need for blood transfusion is very low - 2% for THR and 0.6% for TKR compared with the national average of 20%.

Thoracic surgery Thoracotomy induces severe postoperative pain and impairment of pulmonary function. It is possible to fast-track patients following lung resection using a programme of minimally invasive surgical techniques with video-assisted and muscle sparing incisions, normovolemia, normothermia, good oxygenation, euglycemia, the avoidance of unnecessary antibiotics and systemic opioids-free via epidural patient-controlled analgesia, early ambulation and oral feeding (Campos 2009). In oesophageal and gastric surgery, patient-controlled epidural analgesia leads to a reduction in

respiratory complications and the need for postoperative mechanical ventilation after oesophagectomy, thereby reducing the length of stay both in ICU and hospital (Cense 2006, Saeki 2009).

Major vascular surgery Recently, an ERAS programme developed for patients undergoing open infrarenal aortic aneurysm repair showed that TEA reduced postoperative medical complications, the need for assisted postoperative ventilation and reduced the median length of stay in ICU (Muehling 2009).

Cardiac Surgery Outcomes following this type of surgery, with its associated high morbidity and mortality, have been successfully reduced over the last three decades with the application of fast track techniques. However, further reductions in the need for mechanical ventilation and ICU stay and postoperative outcomes have been achieved with an enhanced recovery programme (Bracco 2007).

What is the role of the anaesthetist?

The anaesthetist plays a pivotal role in the patient's journey through hospital. Not only is our specialty responsible for ensuring optimal anaesthesia and analgesia, but we are also responsible for ensuring patients are appropriately worked up for their surgery. Furthermore we are the main prescribers for many of the perioperative medicines including antibiotics, fluid management, antibiotics, thromboembolic prophylaxis and antiemetics. Finally, we also manage the main non-surgical complications and supervise care in ICU and HDU. Thus, on the one hand the potential to cause harm has always been a concern, but there is now a real need to become members of the ERAS team and coordinate perioperative care by all the specialties. The concept of quality of recovery is now becoming topical and there are several examples of a correlation between good perioperative care and patient recovery correlating with quality of life later on (Carli 2002, Myles 2006). Thus anaesthetists have much to contribute to ERAS programmes.

Is regional anaesthesia essential for ERAS programmes?

Good analgesia and the avoidance of postoperative nausea and vomiting (PONV) are prerequisites for early ambulation and patient compliance with postoperative protocols. Regional anaesthesia, both neuraxial and peripheral blocks, is superior to systemic opioid analgesia at all time points in the first three days following surgery and by avoiding opioids the risk and incidence of opioid analgesia is removed (Wu 2005, Richman 2006).

However, per se, good analgesia by whatever means has not been shown to improve other postoperative surgical outcomes (Liu 2007) and recent evidence suggests that pain management has only a limited influence on functional recovery beyond the first postoperative day after arthroplasty (Holm B 2010). Many factors contribute to a patient's ability to mobilise including patient personality fears and motivation, staff attitudes, ward ambience, hypotension, a prolonged nerve block, stiffness, dizziness, PONV and the development of surgical complications. Thus analgesia may be regarded as a quality issue that is a basic human right. The future of postoperative care is in day-case surgery or enhanced recovery. A recent review article on the place of RA in ERAS has concluded that 'the future *may* be bright for regional anaesthesia, provided that the positive effect on perioperative pathophysiology is used when combined with the fast-track methodology' (Carli 2011). Therefore the role of the acute pain service (APS) is essential in delivering both quality analgesia (with the prevention of the development of a chronic pain state) and mobilisation. The role of a service that merely provides pain relief is now questionable and APS teams should be incorporated into the overall ERAS strategy in order to minimise the role of the above 'other' factors.

Importantly, regional anaesthesia has more to offer patients undergoing major surgery than just superior analgesia and for orthopaedic surgery, central neuraxial blockade (CNB), by itself has been shown to reduce blood loss, thromboembolism and surgical site infection (Chang 2010). For thoracoabdominal surgery it also provides sympatholysis that reduces the surgical stress response that has been shown to promote catabolism, immunosuppression and infection (Wilmore 2002).

The main practical consideration for the regional enthusiast is not the risk of epidural haematoma or infection that are both mercifully rare (though these are devastating when they do occur), but in ensuring a high success rate and low failure rate for everyday blocks. This applies to abdominal wall blocks and paravertebral blocks if preferred over CNB. Historically, the interpretation of all published PRCTs that have compared RA v GA has been seriously hindered by either failure to achieve or document a successful block or high failure rates. As a specialty we must improve on current published failure rates if we are to ensure low morbidity. However, the important message is that any successful nerve block is better than no block for major surgery.

How successful is ERAS?

Unsurprisingly, the results are positive in every published study to date (Table 1). The success of any programme depends on the level of expertise and engagement of the staff involved. There are benefits to both patients and the health service as a whole from this approach. In primary care, appropriate preoperative care and preoperative assessment will result in waiting time reductions. In hospital, patients recover more quickly. Pain and postoperative morbidity are minimized allowing near immediate mobilisation. Consequently, patients spend less time in hospital and develop fewer hospital-associated infections. They are therefore able to return to their own activities of daily living (ADL) including work, more swiftly.

Significant reductions in median length of stay have been achieved and it has been estimated that as much as 140,000 - 200,000 patient bed days may be saved throughout the UK each year. ERAS is continued following discharge meaning that patients continue to receive specialist advice and services when they are discharged home. Furthermore, it is often possible to treat minor complications by visit back to the ward without the need for an overnight stay. Thus, the overall time spent in hospital is reduced and there is no evidence of an increase in the rate of serious complications.

The partnership between clinicians and patients improves the experience of patients going through these pathways. The shorter time spent in hospital, reduced waiting times and fewer staff required to provide the necessary care all have secondary financial benefits to the health service.

Finally, there is the potential for better relationships between primary care and hospital trusts and superior multidisciplinary team dynamics within the healthcare team, thereby improving the working conditions of everyone involved in patient care. Optimal pain management beyond discharge remains a significant problem that reduces quality of life for many types of surgery and closer collaboration between surgical units and primary care teams should help to reduce this problem.

An Enhanced Recovery Partnership Programme (ERPP) has been developed in the UK between the Royal Colleges, NHS Cancer Action Team, NHS Improvement, NHS Institute of Innovation and Improvement and the Department of Health. If the ERPP is implemented across the NHS in colorectal, musculoskeletal, urological and gynaecological surgery, it has been estimated that the NHS could make an annual saving of up to £50 million pounds.

What are the main reasons for not doing ERAS?

‘...there is no more delicate matter to take in hand, nor more dangerous to conduct, nor more doubtful in its success, than to set up as a leader in the introduction of change...’ Machiavelli 1469-1527.

Recently, the overall success of ERAS in colorectal surgery has been shown to be less effective in audited clinical practice than under the conditions of a PRCT (Ahmed 2010). Comparing 95 PRCT patients with 100 subsequent consecutive ERAS patients outwith the trial demonstrated fewer patients in the audit group received preoperative oral carbohydrate loading (61.0 vs 96 % $p < 0.001$), a transverse incision (25.0 vs 39 % $p = 0.037$), early fluid and diet reintroduction (73.0 vs 99 % $p < 0.001$) and non-opiate postoperative oral analgesia (70.0 vs 99 % $p < 0.001$).

The main reason for these differences is that perhaps inevitably, clinicians in all specialties will deviate from agreed pathways unless there is a lead clinician maintaining tighter control of all aspects of care.

Change is inevitable, yet as in other walks of life, so many people involved in health care are uncomfortable with and resistant to changing their clinical practice, unless there is overwhelming evidence to do so and sometimes despite good evidence. Accordingly, for many years clinical audit of what we do has become routine practice in most NHS centres and such audit will always highlight areas within any clinical programme that have become obstructive or redundant to the patient journey. The term ‘Enhanced Recovery’ implies improvements in perioperative care and the principles are founded on evidence-based practice. Similarly, any reductions in clinical morbidity and patients’ length of stay will inevitably lead to financial benefits.

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has decreased in parallel and the number-needed-to-treat to avoid major respiratory complication has increased from 3-5 to more than 30 (in other words you need to use an epidural in 30 patients to avoid one respiratory complication) (3).

Patients being more and more aged, they carry a significant amount of co morbidities that could benefit of the use of epidurals for per and postoperative management (4, 5). Unfortunately, the most recent prospective trials, including a significant number of patients, have failed to confirm the beneficial effect of epidural anaesthesia on postoperative morbidity and mortality after major abdominal or orthopaedic surgery most of the time (6-11).

The impact of epidural analgesia on postoperative outcome should be assessed, based on the surgical procedure. Postoperative complications are indeed different after orthopaedic, thoracic, and abdominal surgery.

After, scheduled orthopaedic surgery, several trials and metaanalysis have failed to document a decrease in the incidence of cognitive dysfunction, respiratory and cardiovascular complications in patients receiving epidural analgesia (9-11). Nevertheless in orthopaedic surgery, regional analgesia may also provide a functional benefit allowing a better physiotherapy. This may result in a significant shortening of convalescence after total knee replacement (12). A recent cohort study has assessed the impact of regional versus epidural anaesthesia on the outcome of inpatient mortality and the secondary outcome of respiratory and cardiovascular complications in 18,158 patients undergoing hip fracture repair in 126 hospitals in New York in 2007 and 2008 (13). Twenty nine percent lower adjusted odds of mortality among patients receiving regional anaesthesia was documented associated with a 24% decrease in the odds adjusted of pulmonary complications. This study highlights the opportunity to improve outcome through the use of regional (mainly spinal) anaesthesia although other factors such as the delay before surgery and the postoperative management are also critically important.

In colon surgery Basse et al. (14) combining epidural analgesia with local anaesthetic, general anaesthesia with short acting agents, restriction of fluid intravenous administration during surgery, careful and less damaging as possible surgical dissection, prevention of postoperative nausea and vomiting, lack or restricted use of nasogastric tube, drains and bladder catheters, oral feeding with complementary protein intake and early mobilization, they were capable of managing patients in-hospital over less than two days after uncomplicated colon resection. The superior quality of pain relief provided by epidural analgesia combined with parenteral analgesia has indeed a positive impact on out-of-bed mobilization, bowel function and consequently food intake, that results in a significant improvement in postoperative quality of life (15, 16). In abdominal surgery nothing compares to epidural in terms of quality of analgesia provided. In addition epidural analgesia using local anaesthetics offers several advantages such as a more rapid recovery in bowel function and early deambulation. Nevertheless this objective is also achieved by less invasive techniques such as a continuous intravenous lidocaine infusion (17). In addition, when using epidural anaesthesia during surgery, there is a need for increased intravenous fluids infusion that may compromise respiratory function and eventually the recovery of bowel function after surgery. Epidural analgesia remains considered as the cornerstone of rehabilitation programme supporting recovery after abdominal surgery. It has nevertheless demonstrated that the duration of hospital stay and postoperative morbidity are comparable with and without epidural analgesia provided applying a multimodal rehabilitation programme (18). In agreement after reviewing of studies concerning colon surgery, our group has demonstrated that hospital stay was comparable with and without epidural analgesia but it was shortened when a rehabilitation programme was used (19). In a recent case-matched study, Lovely et al. documented that an enhanced recovery pathway including limited intravenous fluids and opiates and early feeding, but without epidural, duration of hospital stay was shorter (20). Eventually continuous epidural analgesia was demonstrated to be less cost effective than continuous wound infiltration after abdominal surgery (21). Consequently one must confess that it is not the use of epidural analgesia but the application of the rehabilitation programme that is susceptible to improve the quality of recovery after abdominal surgery. Eventually, a qualitative analysis and three multicentre large trials, dedicated to abdominal surgery did not documented that patients receiving epidural analgesia benefit from a more rapid hospital discharge (18). Consequently, one is committed to consider that epidural analgesia has no effect per se on postoperative morbidity, but as part of a multimodal rehabilitation process it may facilitate recovery from surgery. For laparoscopic surgery, the use of epidural analgesia could be restricted to patients at risk of complications due to comorbidities, and balanced with the own risk of epidural-related complications (22).

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REGIONAL ANAESTHESIA IN FAST TRACK SURGERY AND REHABILITATION

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Epidural analgesia has long been considered as an integral part of rehabilitation protocols in patients scheduled for major surgery, aiming to decrease postoperative morbidity and mortality while shortening hospital stay. More than 10 years ago, a metaanalysis of 141 studies, performed over a 20 years period concluded that epidural analgesia prevented postoperative major complications and decreased postoperative mortality (1). These results and conclusions were extensively criticized already because one considered that changing medical practice made it impossible to compare studies over such a long period of time. At this time, epidural was, for example, no more considered as an effective mean to prevent thromboembolic complications knowing that other means such as the use of lower molecular weight heparin were much more effective. Since 2000, there has been a considerable development in endoscopic mini invasive surgery that makes it easier and shorter postoperative hospitalization and consequently questions the use of epidurals. Epidural analgesia remains indeed an invasive technique with its own side effects and complications. The question is therefore: is it worth still performing epidural analgesia for postoperative management of patients especially after intermediate or major surgery? The preventive effect of epidural analgesia on postoperative pulmonary complications is mainly demonstrated in studies published in the seventies and the eighties, when this risk was especially high (2). Nowadays, due to prophylactic antibiotherapy, active physiotherapy, cessation of smoking before surgery, and less invasive surgery, the incidence of major pulmonary complications has dramatically decreased after abdominal and thoracic surgery. The preventive role of epidural analgesia

After abdominal aortic surgery, several studies have tried to highlight a reduction in cardiovascular complications in patients treated by epidural analgesia per and/or postoperatively, but they have failed to achieve this goal (23-28). Nevertheless, in a selected sub-group of patients, scheduled for abdominal aortic surgery, epidural analgesia may occasionally reduce postoperative morbidity through a reduction in respiratory and cardiac complications, as stressed above.

During thoracic surgery, epidural anaesthesia and analgesia is considered as the gold standard for years. Epidural anaesthesia is especially reported to improve respiratory function after surgery and to decrease the incidence of pulmonary complications. Nevertheless over the past ten years, paravertebral block has gained a growing interest. Continuous infusion of a local anaesthetic solution on a paravertebral catheter has been demonstrated, indeed, to provide comparable analgesia to the benefit of fewer side effects (29). The UK pneumonectomy study was a prospective observational cohort study in which all UK thoracic surgical centres were invited to participate in 2005. Data were analyzed for 312 patients having pneumonectomy at 24 UK thoracic surgical centres (30). Epidural analgesia was used in 61% of the cases but the odds for major complications were 2.2. This may be explained by the risk of epidural related side effects but it needs to be demonstrated in a multicentre prospective trial.

In the specific settings of cardiac surgery, epidural analgesia does not really decrease postoperative morbidity except for respiratory complications (31), and conveys a risk of epidural haematoma that makes numerous staff reluctant to use it (32). Nevertheless a metaanalysis of 28 randomized studies including 2731 patients documented a reduction in the relative risk for mortality (0.81), for myocardial infarction (0.80) and for stroke (0.59) but this difference was not significant due to the extremely low incidence of these events (33). The risk ratios for respiratory complications and arrhythmias were 0.53 and 0.68 respectively. It therefore appears that for major events the clinical benefit of thoracic epidural analgesia is limited but the risk of major complication of the procedure itself including epidural haematoma may preclude its use (34).

In conclusion more than epidural itself it is the rehabilitation process that decreases postoperative morbidity and mortality. This is to be considered when confronting less and less invasive surgical procedures to a less and less important clinical benefit achieved with the use of epidurals. The balance between benefits and drawbacks must be consequently periodically revisited for each surgical procedure.

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SAFER ALTERNATIVES TO COMMON BLOCKS IN FAST-TRACK SURGERY

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Introduction: Fast-track surgery implies rapid post-operative mobilization and shortened length of stay (LOS) in the hospital. One of the main obstacles to obtain these goals is post-operative pain. Peripheral nerve blocks are very effective reducing or eliminating this pain. However, the common blocks for shoulder or knee surgery affect motor neurons paralyzing respiratory or weight bearing muscles. Therefore, intensive research is going on safer alternatives to common blocks. In particular alternatives to interscalene block, which paralyzes ipsilateral diaphragm and femoral nerve block, which weakens the quadriceps muscle. This lecture aims to present latest studies on this subject.

Shoulder surgery: It is a common knowledge that block of the brachial plexus via interscalene approach results in hemidiaphragmatic paresis in 100% of patients [1]. Several case reports of total spinal anaesthesia and permanent damage to the spinal cord have been published [2-4]. What is less known is the high incidence of postoperative neuropraxias and/or nerve conduction abnormalities after shoulder fractures and/or surgery performed under general anaesthesia [5-7]. Nerve conduction studies in patients with postoperative neurological damage usually can not localise the precise site of injury. Therefore, limiting analgesia to the shoulder by application of more selective nerve blocks is highly desirable.

Shoulder joint is mainly innervated by the suprascapular and the axillary nerves, which also innervate the supra- and infraspinatus muscles as well as the deltoid. Blocks of both nerves using ultrasound and/or nerve stimulator guidance are very simple and provide good analgesia after surgery [8-10]. They may be performed on awake or anesthetized patients. Neither brachial plexus nor phrenic nerve are affected. Multimodal oral analgesia may be

instituted in recovery room and the patient is discharged home with pain under control. The disadvantage of these blocks is the short duration.

Knee surgery: Continuous femoral nerve block is often used for post-operative analgesia after major knee surgery. However, this block weakens quadriceps muscle and increases risk of falling [11]. Therefore, an alternative to femoral nerve block, which provides analgesia without motor block has been sought. Lund et al. [12] reported, in a preliminary study, favourable results of an adductor canal block after major knee surgery. Reduced post-operative pain and improved ambulation were confirmed by a randomized study after total knee arthroplasty [13]. Recently completed study in volunteers [14] confirmed that the adductor canal block compared with femoral block only minimally reduced quadriceps strength. After adductor canal block all subjects could be mobilized and had a significantly better ability to ambulate.

Conclusions: Blocks of suprascapular and axillary (circumflex) nerves seem to be good alternatives for analgesia after major shoulder surgery and adductor canal block may provide similar advantages after major knee surgery. These blocks may also reduce undesirable side-effects of interscalene and femoral blocks.

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FAST-TRACK POSTOPERATIVE PROTOCOLS-HOW EFFECTIVE ARE THEY?

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Multimodal, enhanced-recovery (ER) protocols have been promoted to improve postoperative outcomes. Such protocols have been proposed for a variety of surgical procedures, the ones for colorectal surgery are perhaps the most studied. This abstract takes up the role of regional anaesthesia techniques as a component of 2 ER protocols: epidural analgesia for colorectal surgery and Local Infiltration Analgesia (LIA) for hip and knee replacement surgery. **Colorectal surgery and ER programmes.** ER programmes for colorectal surgery consist of a multidisciplinary approach involving surgeons, anaesthesiologists, ward nurses, dieticians and physiotherapists. The perioperative care includes preoperative counselling, no bowel preparation, no premedication, carbohydrate-loaded energy drinks, i.v fluid optimization, epidural anaesthesia, multimodal, opioid-sparing postoperative analgesia. In the postoperative period drains and nasogastric tubes are avoided and early oral nutrition, enforced mobilization and removal of urinary catheter are encouraged. The use of thoracic epidural analgesia using a mixture of low-dose local anaesthetics and opioids for 48h has been recommended as one of the key elements of ER pathways (1). Impressive reduction of hospital stays from 6-10 days down to 3-4 days or less has been demonstrated without increasing morbidity with ER programmes (2). However, the results have not been widely reproduced (3).

Few studies have used prospectively defined discharge criteria for assessment of length of hospital stay, in general the studies are not of high quality. There are a large number of ER protocols for colorectal surgery. The number of "evidence-based" components for such protocols can range from 4(4) to 20 (1,5), all claim enhanced recovery and shorter stay when compared with "traditional care". However, the components of traditional care are not clearly defined either and also vary considerably in the published studies. Furthermore, currently several of ER components such as omission of bowel preparation and drains, early feeding and mobilization are also incorporated into "modern" traditional care (3). A systematic review of ER programmes concluded "However, despite the current enthusiasm and implementation into daily practice, this systematic review shows that, to date, there are few data available" (6). A more recent metaanalysis with 452 patients showed that the number of ER components ranged from 4 to 12. The authors concluded "...the implementation of four or more elements of the ERAS (enhanced recovery after surgery) pathway leads to a reduction in the length of hospital stay by more than 2 days and an almost 50% reduction in complication rates in patients undergoing major colonic/colorectal surgery" (7). Two obvious questions are: 1) why use 20 interventions when 4 are adequate? and 2) Which 4 interventions are critical? The role of epidural technique in this metaanalysis is unclear because it was not used in all patients. Furthermore, the failure rate for epidural was 28% (7). A recent review on improving outcome after major surgery omitted ER literature because of mediocre or low quality studies and heterogeneity of published results (8,9). A Cochrane review concluded "the quality of the trials and lack of sufficient other outcome parameters do not justify implementation of fast-track surgery as standard of care" (10).

Different groups have come to the same conclusion about ER protocols i.e. it is not possible to determine whether any of the protocol components have an independent influence on outcome (4,5). It is clear that all components of ER protocols are not equally efficacious, indeed some may be unnecessary or even harmful, the role of epidural has to be considered in this context. Some authors consider epidural analgesia a pre-requisite for the success of ER protocols (1,5). However, currently, there is no convincing evidence that epidural technique as a component of ER protocols provides any further benefits, this applies to open as well as laparoscopic colorectal surgery (11).

Local Infiltration Analgesia (LIA) technique: The LIA technique was introduced a few years ago by Kerr and Kohan for controlling postoperative pain after hip or knee arthroplasty as an integral component of their surgical approach (12). It is a 5-step process based on systematic infiltration of a mixture of ropivacaine combined with ketolorac and adrenaline. Using "moving needle" technique a large volume (upto 150 ml) of 0.2% ropivacaine is injected in the region subject to surgical trauma. A catheter is left in the joint for a single top-up at about 15-20h postoperatively. Surgery is performed under spinal anaesthesia. The LIA technique also includes compression bandage, cooling and splinting of the injection site. As with ER programmes for colorectal surgery, preoperative counselling, perioperative

interventions and postoperative rehabilitation protocols are strictly implemented. In a study of 325 patients undergoing hip or knee arthroplasty the majority of patients had low pain scores and could be discharged after a single overnight stay. Mean time to independent mobility was less than 25h for the entire cohort, and 20h for patients undergoing TKR (12). The LIA technique has received much attention particularly in the Scandinavian countries, UK and Australia. In Sweden 75% of all TKA were performed with LIA in 2009 (13). Several studies have been published showing impressive results and shorter hospitalisation times albeit longer than those reported by Kerr and Kohan (14-19). Nevertheless, hospital stays have been reduced from 6-10 days down to 3-4 days or less. A recent review of LIA concluded that LIA has a role in TKA but not in THA (20).

However, there are many questions that need to be addressed, these include: role of local administration of ketolorac and adrenaline, role of compression and ice packing and the role of the surgical technique (21). Furthermore, there is a need to define what precisely is meant by LIA technique, as with multimodal analgesic techniques and ER protocols for colorectal surgery, today there are just about as many modifications of LIA as the number of practitioners of the technique thus making meaningful comparison of results difficult (20,21). In particular the role of intraarticular catheter as a component of LIA is controversial.

How effective are ER programmes?

Although ER programmes have led to impressive reductions in hospital stays after colorectal and lower extremity joint replacement surgeries, a lack of standardized definitions and unclear role of individual interventions in these multi-component strategies makes it difficult to draw meaningful conclusions (21). The following issues need to be addressed:

1. What is the minimum number of critical ER interventions (introducing new interventions is a challenge in every institution)?
2. What is the role of individual ER components, are some interventions more important than others?
3. Regional techniques are recommended but which regional techniques are cost-effective? Is epidural necessary for patients undergoing colorectal surgery? Is intraarticular/periarticular catheter necessary for the LIA technique?
4. Need for a consensus nomenclature for multicomponent treatments such as multimodal analgesia, LIA and ER programmes for colorectal (and other) surgery to improve postoperative outcome. Current "anything goes" combinations are confusing.
5. What modifications are needed in ER protocols for the increasingly popular minimal invasive surgical procedures?
6. Need for better quality studies of ER programmes for colorectal surgery, current studies are of mediocre or poor quality.

In conclusion, in spite of confusion about the optimal number of components, the implementation of ER protocols has shown impressive reduction in hospital stays without increasing morbidity. This appears most likely due to use of checklists and strict adherence to protocolized perioperative care rather than the combination and number of applied ER components. The role of individual components of ER programmes (in the 2 examples given here) remains unclear at present. Regional techniques have a role in contributing to the improved outcomes but further studies are necessary to find the most cost-effective technique for individual surgical procedures.

(This abstract has been adapted from Rawal N. Local infiltration analgesia and other multicomponent techniques to improve postoperative outcome-are we comparing oranges and apples? *Reg Anesth Pain Med* 2011;36:417-420 (ref 21) and Rawal N. Epidural technique for postoperative pain. Gold standard no more? *Reg Anesth Pain Med* 2012;37:310-317 (ref 11).

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TRANSVERSUS ABDOMINIS PLANE BLOCK

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Introduction: The abdominal wall is a muscular structure which consists of lateral and anterior components. The lateral abdominal wall consists of three muscle layers (external oblique, internal oblique and transversus abdominis), which are encased in fascia. The anterior abdominal wall is a musculotendinous structure consisting of the rectus abdominis muscle, enveloped by the rectus sheath. The abdominal wall is innervated by the anterior primary rami of the lower 6 thoracic and first lumbar nerves. These mixed motor and sensory nerves course through the fascial plane between the transversus abdominis and internal oblique muscles. Deposition of local anaesthetic in the transversus abdominis plane (TAP) results in sensory blockade of the ipsilateral hemi-abdomen.

This talk will focus on the evolution of the TAP block, discuss procedure-specific indications for TAP block, identify block limitations and discuss the role of TAP in current and future clinical anaesthesia practice.

The 'Gold Standard' in analgesia following abdominal surgery: Pain following abdominal surgery is essentially derived from two sources: the viscera and the somatic abdominal wall. Visceral pain is transmitted along complex autonomic pathways to intra-abdominal para-aortic plexuses, spinothalamic tracts, thalamus and finally the sensory cortex. Somatic pain, derived from the abdominal wall is transmitted along the respective dermatomal nerves to the dorsal root ganglion, spinothalamic tracts, thalamus and the sensory cortex. Both visceral and somatic pain pathways converge at the level of the spinal cord, therefore this is an obvious target for analgesic intervention. Epidural analgesia targets both somatic and visceral pain at the level of the spinal cord and can be thought of as the 'gold standard' analgesic technique following major abdominal surgery.

Epidural analgesia is not without risks or adverse effects. While epidural analgesia appears to have favourable effects in terms of pain relief, perioperative blood loss and a lesser risk of thromboembolism, significant hypotension perioperative requiring intervention is not uncommon. Placing an epidural catheter in the bony neuraxis may result in direct trauma to local blood vessels, nerve roots, the spinal cord itself. Epidural placement may also serve as a portal for the introduction of infective or irritant agents. Thus epidural analgesia may result in a small number of cases of spinal cord injury with resultant significant morbidity. The ubiquitous use of modern antiplatelet agents, low molecular weight heparins and irreversible anticoagulants (dabigatran) further complicate the use of epidural analgesia in surgical populations.

The abdominal wall alone is undoubtedly an important source of postoperative pain. Strategies which isolate the abdominal wall and remove it as a source of post operative pain have been demonstrated to play an important role in multimodal analgesic regimen. The TAP block is one such strategy.

Where does the Local Anaesthetic Go?: Conceptually local anaesthetic injected between the internal oblique and transversus abdominis muscles, should spread within the TAP, bathe the nerves within the plane and result in conduction block. McDonnell & O'Donnell validated the blind two pop technique using cadaveric models followed by live human volunteers undergoing computed tomographic assessment. Spread of injectate was demonstrated within the TAP, extending from costal margin to iliac crest in the mid-axillary line. Recently, investigators have challenged the blind approach reporting an unacceptably high occurrence of intraperitoneal injection. Although these investigators did not report adverse outcomes, they propose that ultrasound guidance is mandatory for needle tip placement during TAP block.

The traditional access point using a blind two pop technique via the lumbar triangle of Petit appears to provide consistent block up to the umbilicus (T10-L1). Some reports have suggested blocks extending to T8. Anatomical constraints prevent the spread of local anaesthetic higher than T8. For abdominal incisions extending above T10, an alternative approach to the TAP should be sought. The sub-xiphoid approach was first suggested and validated by Hebbard et al from Melbourne, Australia. Using ultrasound-guidance, they demonstrated the feasibility of accessing the TAP and producing effective hemi-abdominal blockade up to the T6 dermatome.

TAP and Prostatectomy: TAP has been reported in radical open prostate surgery and a useful adjunct to multimodal analgesia. Recently, a RCT compared TAP with Epidural analgesia and unsurprisingly, epidural analgesia resulted in superior analgesia when compared with TAP.

TAP and Colorectal Surgery: TAP has been shown to have opiate sparing effects and analgesic efficacy in patients undergoing major colorectal surgery.

A meta-analysis of randomised controlled trials evaluating TAP in colorectal surgery suggests TAP results in lesser opiate consumption, lesser nausea and vomiting, with a trend toward lower pain scores.

TAP and Caesarean Section: The abdominal wall contributes significantly to pain on movement following caesarean section. TAP has been demonstrated to play an important role in providing pain relief following this common surgery. A recent meta-analysis suggested that TAP is more effective than oral opiates and less effective than intrathecal morphine. However adverse opiate side-effects were common with intrathecal morphine.

Adverse Effects: Thankfully, adverse events with TAP block are unusual. Needle related liver trauma has been reported following both blind and ultrasound-guided approaches. This reaffirms the attention to detail required in placing needles within the abdominal wall, as important structures lie within millimeters of the transversus abdominis plane. Serum levels of local anaesthetic have also been measured and found to be within ranges known to result in systemic toxicity (LAST). Although local anaesthetic systemic toxicity has not been reported with TAP block, caution is advised in dose selection and in using the technique in surgical populations at risk of LAST.

Summary: The TAP block is a useful component of a multi-modal approach to postoperative analgesia following many types of abdominal surgery. Although visceral pain may continue to be a problem following abdominal surgery, the use of a somatic block to the anterior abdominal wall may improve patients post operative pain experience and lessen the requirement for postoperative opiate use. Analgesia is an important component of post-operative care. Enhanced recovery programmes incorporate effective analgesic strategies alongside multiple parameters associated with patient recovery and readiness for independent hospital discharge. Studies that have compared TAP to epidural analgesia suggest epidural analgesia provides better pain relief. Epidural analgesia, while providing superior analgesia, is a resource-intensive analgesic modality which may not sit well within enhanced recovery programmes. Time and further evaluation will determine the role of TAP in analgesia following abdominal surgery.

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TAP-BLOCKS ARE SUPERIOR TO EPIDURAL ANESTHESIA AFTER ABDOMINAL SURGERY

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Background and aims: Optimal analgesia is essential in major abdominal surgery. It reduces postoperative stress response, accelerates recovery, facilitates effective chest physiotherapy and it is imperative for an early extubation, which may play a role in reducing postoperative respiratory complications. A poor pain control after extensive abdominal surgery is associated with a variety of unwanted post-operative complications, including patient suffering, distress, confusion, chest and heart problems, and prolonged hospital stay. Our aim is to claim the TAP block is a better option than epidurals taking into account the settings, safety and context around the patient in the actual climate.

Methods: There are three standard techniques to provide postoperative analgesia after a laparotomy: epidural analgesia, patient controlled analgesia (PCA) and TAP blocks. Although PCA with morphine can provide effective analgesia at rest (static analgesia), it fails to provide adequate analgesia on movement (dynamic analgesia). There is wide evidence that epidural analgesia provides better postoperative analgesia compared with parenteral opioids. It also enhances functional exercise capacity, health-related quality of life, and reduces hospital stay after colonic surgery. On the other hand epidural techniques can provide excellent analgesia but do not reduce postoperative mortality, and although rare, there are well-known side effects and potentially catastrophic risks to this technique (epidural haematoma and abscess).

Epidural analgesia remains the gold standard after major surgery involving abdominal wall incision, but it is also associated with a myriad of complications and there exists a subgroup of patients for whom epidural insertion is contraindicated.

When an epidural fails or is contraindicated, analgesia involves large doses of opioids which have side effects that may be poorly tolerated, causing side effects (nausea, vomiting, constipation, sedation) and serious complications (respiratory depression). The secondary effects of such strategies include hypotension and respiratory depression, respectively, and they have the potential to complicate the perioperative course in high-risk patients with cardiorespiratory disease.

Therefore, there has been an increasing need to find effective analgesic techniques that have lower risks. This is the case of TAP blocks. The use of such blocks of the anterior abdominal wall with local anaesthesia for postoperative analgesia is an attractive option, because of its simplicity, safety and low cost.

Results: The TAP block is an effective method of blocking the sensory afferents supplying the anterior-lateral abdominal wall². The nerve distribution in the plane has been previously described in cadaveric dissections, and these studies suggest that lumbar blocks would be more appropriate for lower abdominal surgeries.

Injection of aniline blue 20 mL into the lumbar TAP is likely to involve only the T10-L1 nerve roots, implying that the lumbar technique is best suited for infraumbilical incisions. Despite the cadaveric studies, debate remains with respect to the somatosensory block height that can be achieved with a single local anesthetic injection at the lumbar TAP level. Forero M et al shows continuous lumbar TAP block may have an analgesic role following abdominal incisions involving not only the infraumbilical region but also supraumbilical sites, given the extensive somatosensory block³.

US-guided TAP blocks with catheter insertion for continuous local anesthetic infusion may be an effective alternative to epidural lumbar anesthesia in patients with significant cardiovascular and respiratory comorbidities, even if it would be beneficial for patients with coagulation disorders in whom neuraxial anesthesia is contraindicated. The TAP block may have less complications and greater acceptability to patients than epidural analgesia. Few complications following TAP blocks have been reported and they provide both static and dynamic analgesia. There are minimal effects on the cardiovascular system, the motor and sensory function of the lower limbs is spared and the technique is non-sedating. These characteristics could enhance patient deambulation and speed recovery after major surgery. A recent study in paediatrics about the use of unilateral TAP catheters for analgesia following single-sided open lower abdominal surgery for whom regional analgesia was

desired but an epidural catheter could not be performed⁴. These series suggest that TAP catheters represent a feasible approach to alleviate pain after lower abdominal surgery in small children but further studies should be carried out to validate the efficacy and safety including the comparison of TAP blocks to epidurals and intravenous multimodal regimens.

There are several approaches described to the TAP plane, a lateral approach, an anterior approach and a lower subcostal approach.

Subcostal TAP catheters combined with PCA morphine have been reported to be a viable alternative option to epidural analgesia in patients undergoing upper abdominal surgery.

Single shot TAP blocks have also been used to provide analgesia in patients admitted to the ICU and as rescue analgesia for ineffective epidural analgesia and it has been shown to provide analgesia after lower abdominal surgery. On the other hand comparison of continuous infusions of TAP and epidural methods has been recently reported. The fentanyl requirements are expected to be less in epidural patients compared with those undergoing TAP as the latter covers only sensory dermatomes of the anterior abdominal wall. Another randomised controlled trial study has compared the analgesic efficacy of TAP blocks with catheter infusions versus epidural analgesia after major upper abdominal surgery. Tramadol consumption was significantly higher in the TAP group. This could be explained by the inability of TAP catheter technique to cover visceral pain. Another study has found no significant advantage of epidural analgesia over subcostal transversus abdominis plane TAP catheter bolus analgesia. It concludes that subcostal TAP catheters are an acceptable alternative to thoracic epidurals in patients undergoing upper abdominal surgery.

In another study published last year, three patients in whom TAP blocks were used in our intensive care unit to provide effective analgesia and facilitate chest physiotherapy. These case reports demonstrate that in situations where epidural analgesia is either contraindicated or ineffective, TAP blocks may be an effective alternative⁵. Its proponents suggest that analgesia provided by the TAP block is equal or superior to that provided by systemic opioids such as morphine. It is also claimed that postoperative opioid consumption and opioid-derived adverse effects can be reduced. Although the evidence is limited to date, a recent meta-analysis of randomized trials of abdominal surgery and the TAP block involving five studies and 236 patients, compare with no TAP block or saline placebo, showed that this technique reduced morphine consumption at 24 and 48 hours, but not at two hours. TAP blocks also prolonged the time until first request for additional analgesia in the first several hours postoperatively⁶. Clinical significance might be represented by reduced adverse opioid-related side effects, such as sedation, nausea and vomiting or pruritus, or greater patient satisfaction.

The TAP block raises some important questions, analgesia qualities of TAP blocks in previous studies are excellent, and systemic opioid demand was significantly decreased when compared with standard general anaesthetic.

Nevertheless, the clinical utility of transversus abdominis plane block remains to be compared with "gold standard" analgesia. No studies have compared TAP block with other analgesics such as epidural analgesia or local anaesthetic infiltration into the abdominal wound. No study investigates TAP block without general anaesthesia, and therefore no hard data are available regarding block qualities. For abdominal surgery, a comparison with epidural analgesia and with continuous lidocaine i.v. infusion is required.

A recent retrospective study included 15 patients with continuous infusions of TAP and 15 with thoracic epidural procedures⁷. There was no intergroup difference for pain score over time to 3 days for relief of either pain at rest or coughing. Patient satisfaction was similar between the groups. No analgesic difference was found between the two techniques. In conclusion, it suggested that TAP block provides comparable analgesia compared with the epidural technique, although a larger amount of supplemental fentanyl was required by the TAP block technique.

Unilateral block was recorded in two TAP patients and patchy epidural blockade in four, requiring a modest amount of opioid supplementation, apart from topping up. Hypotension was recorded in two patients with epidural block but in none with TAP.

Conclusions: Transversus abdominis plane (TAP) block indications for use of TAP block perioperatively as part of a balanced anaesthetic technique are expanding. It is affected by multiple variables, including local anesthetic volume, concentration, infusion time, and site of injection. Patient factors, including height and weight, are also likely to contribute. Large studies are required to address these questions. Recently, the use of TAP blocks with indwelling catheters has been described in the literature with promising results. Many relevant studies are currently underway or awaiting publication.

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BILATERAL-DUAL TRANSVERSUS ABDOMINIS PLANE (BD-TAP) BLOCK OR THORACIC PARAVERTEBRAL BLOCK (TPVB)? DISTRIBUTION PATTERNS, DERMATOMAL ANAESTHESIA AND LA PHARMACOKINETICS

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Background and aims: There seem to be at least 4 different types of the transversus abdominis plane (TAP) blocks¹⁻⁴ and also various approaches to perform the thoracic paravertebral block (TPVB)⁵⁻⁷. The blocks can be administered guided either by ultrasound (US) or with blind landmark-based techniques. The different types of TAP blocks can anaesthetize either part of or the entire antero-lateral abdominal wall, whereas the TPVB has the ability to anaesthetize both the abdominal wall as well as the thoracic area. Our primary aim with this study was to describe the differences between the ultrasound-guided (USG) BD-TAP block and the USG TPVB in relation to distribution patterns of the local anaesthetic (LA) (evaluated by MR imaging), the resulting dermatomal anaesthesia and LA pharmacokinetics. However, we have also included the Quadratus Lumborum (QL) block in this comparison, since the QL block is the third variant of abdominal blocks capable of anaesthetizing the entire antero-lateral abdominal wall. Actually, the QL block is a new name in this respect, since it is called The Blanco block on the LSORA homepage (www.lsora.com). The Blanco block is described as an USG block administered into the so-called quadratus lumborum space. Prof. R. Blanco described his technique on the 3th of May 2007 during his presentation in "Ultrasound guided blocks" at ESRA (GB&I) 2007, Annual Scientific Meeting, Exeter. Later, the QL block has been called "the posterior block" or "the posterior approach" by Carney et al.⁴

Methods: The studies were performed in accordance with the Helsinki II declaration, registered at ClinicalTrials.gov after the 2010 CONSORT guidelines, and approved by the Committees on Biomedical Research Ethics for the Capital Region of Denmark. Following written informed consent, 6 healthy male volunteers were included in the study. The studies were conducted as randomized, placebo-controlled, crossover, observer-blind trials. The studies were conducted on three separate days interspaced with a washout period of two weeks.

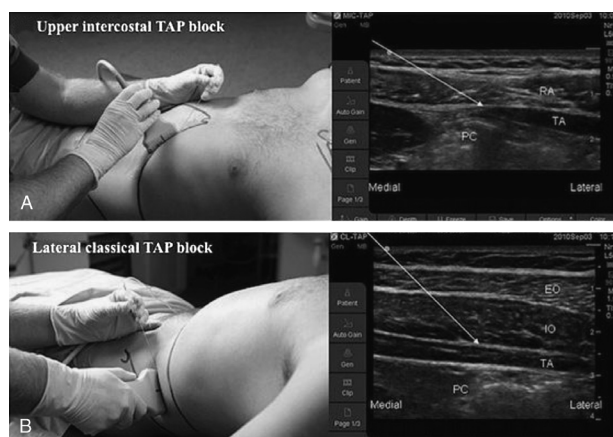


FIG. 1. [USG BD-TAP block]

The volunteers were randomized to the administration of a BD-TAP block, a bilateral TPVB or a bilateral QL block. The blocks were administered with the volunteers in the supine position for the BD-TAP and QL blocks (Fig. 1A, 1B, 2).

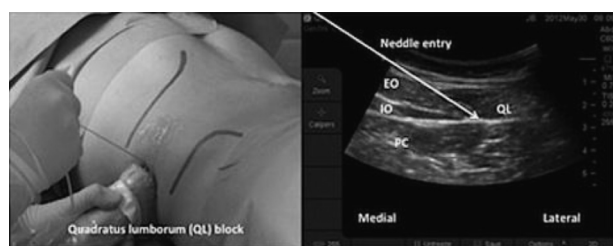


FIG. 2. [USG QL]

Volunteers were placed in the lateral decubitus position for the administration of the TPVB (Fig. 3). All volunteers were administered a total of 60 mL ropivacaine 0.375% (225 mg) on each of the three trial days.

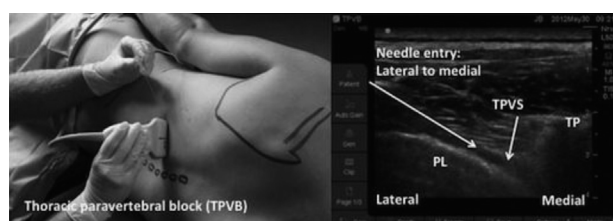


FIG. 3. [USG TPVB]

For the USG BD-TAP blocks the volunteers were administered bilaterally 15 mL LA at the upper intercostal TAP plexuses (Th6-Th9) and at the lower classical TAP plexuses (Th10-Th12) (Fig. 1A, 1B). For the USG TPVB the volunteers were administered bilaterally 30 mL LA at the Th9 level (Fig. 3), and for the USG QL blocks bilaterally 30 mL LA lateral to the quadratus lumborum muscles (Fig. 2) in the thoracolumbar fascia between the middle and anterior layer; i.e. the anterior layer is the thinnest of the layers and covers the quadratus lumborum, whereas the middle layer separates quadratus lumborum from the post-vertebral muscles. Sham blocks (needle entry in the subcutaneous tissue but no injection) were performed to ensure the blinding for volunteers and observers.

Primary outcome measure was number of dermatomes anaesthetized. Secondary outcome measures were MR imaging of the LA distribution, total area of skin-dermatomes (anterior and posterior) anaesthetized, number of myotomes anaesthetized and serum-ropivacaine pharmacokinetics.

Results: The results presented herein are only a selected few and preliminary in nature. Definite conclusions should therefore be avoided and must await the final statistical calculations and laboratory tests. However, we are able to

present some novel data highlighting the characteristics of the three different USG blocks.

Dermatome Anaesthesia: Sensory dermatome testing for the BD-TAP blocks exhibited similar results as previously described.³ The BD-TAP block consistently resulted in anaesthetizing the sensory afferent nerves of Th6-Th12 bilaterally in the anterior abdominal wall; i.e. dermatome anaesthesia was consistently present on the upper and lower *medial* quadrants of the anterior abdominal wall. No consistent dermatome anaesthesia was recorded on the upper or lower *lateral* quadrants of the antero-lateral abdominal wall. Sensory dermatome testing results were similar at 30 and 120 minutes post-injection. Sensory dermatome testing results were very different for the USG TPVB and the USG QL block. At 30 minutes the dermatome anaesthesia resulting from the TPVB was manifest from Th4-L1/L2. Both upper and lower medial and lateral quadrants of the antero-lateral abdominal wall were anaesthetized. For the USG QL block the on-set of dermatome anaesthesia was significantly slower; i.e. at 30 minutes only the lower lateral quadrants of the antero-lateral abdominal wall was anaesthetized, whereas the dermatome anaesthesia at 120 minutes was manifest from Th7-L1 in both upper and lower medial and lateral quadrants. In addition, dermatome anaesthesia was also manifest on the back.

Magnetic Resonance (MR) Imaging: It is clearly not possible to compare directly the distribution of the injected LA regarding the various techniques to anaesthetize the antero-lateral abdominal wall presented in this paper. However, it is very important to visualize the distribution of the injected LA if we are to understand how and where the nerves will come in contact with the injectate. Only then will we be able to understand better which approaches will be suitable for any given clinical situation. Carney et al.⁴ have previously mentioned that the site of deposition of LA into the TAP substantially influences its spread pattern within the plane, and that this is likely to result in differences in sensory blockade and analgesia. The preliminary results presented herein seem to confirm this notion.

The LA distribution for the USG TPVB is depicted using MR imaging in Fig. 4 and Fig. 5.

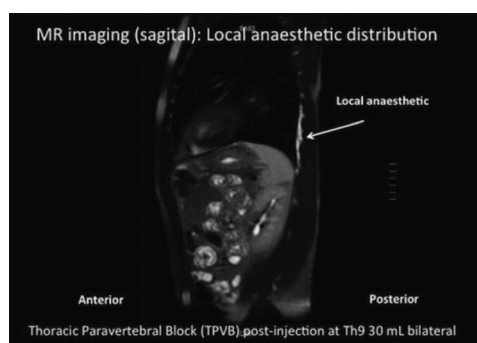


FIG. 4. [MR TPVB sagittal]

MR imaging in the sagittal plane (Fig. 4) found the distribution in the paravertebral space to reach cranial to Th6 and caudal to Th12. The level of injection of the 30 mL ropivacaine 0.375% bilaterally was at Th9. This distribution pattern did not change from 30 to 180 minutes.

MR imaging in the axial plane (Fig. 5) found the LA to be evenly distributed in the TPVS with the LA reaching the lamina of the vertebra seemingly without any epidural spread.

The LA distribution for the USG QL block is depicted using MR imaging in Fig. 6 and Fig. 7.

MR imaging in the coronal plane (Fig. 6) found the distribution of the injected LA evenly distributed lateral to the quadratus lumborum muscle with spread of the injectate in both cranial and caudal direction. MR imaging in the axial plane (Fig. 7) found the distribution of the injected LA progressing in a medial direction in the fascial layer (middle thoracolumbar fascia) between the quadratus lumborum muscle and the post-vertebral muscles.

With these preliminary data we have been unable to discover substantial spread of the LA ventral to the quadratus lumborum muscle. However, some of the LA injected lateral to the quadratus lumborum muscle also spread some distance along the abdominal muscles (Fig. 7). The injected LA could be detected cranially at the Th11-12 level and caudally at the L4 level.

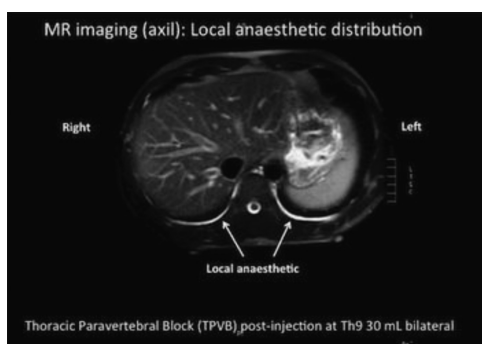


FIG. 5. [MR TPVB axial]

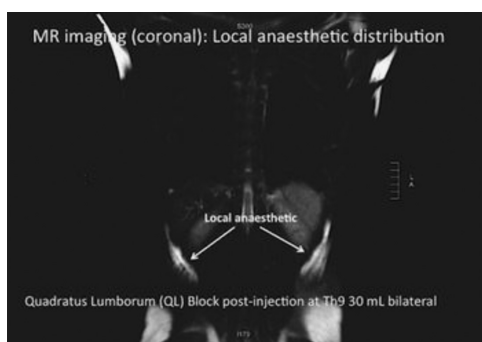


FIG. 6. [MR QL coronal]

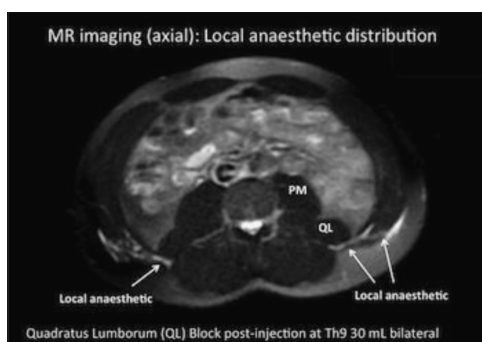


FIG. 7. [MR QL axial]

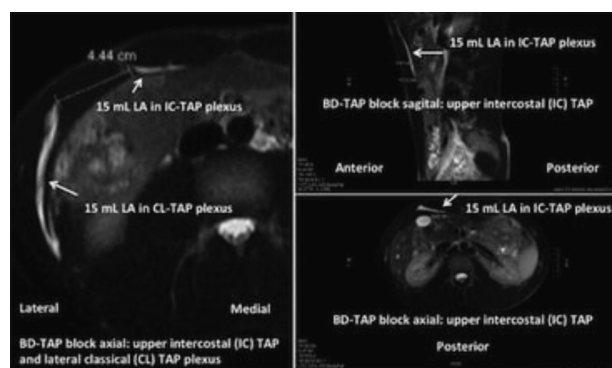


FIG. 8. [MR BD-TAP]

Further, we were unable to detect any local anaesthetic solution entering the thoracic paravertebral space via “the lumbar approach”.

The LA distribution for the USG BD-TAP block is depicted using MR imaging in Fig. 8.

These results have been previously presented³ over a 6-hour observation period. The results presented in this paper confirm that the injected LA in the upper intercostal TAP compartments and in the lateral classical TAP compartments do not merge but remain in their respective abdominal compartments (Fig. 8).

Serum Ropivacaine Pharmacokinetics: Blood samples were taken for analysis at 0, 10, 20, 30, 40, 50, 60, 90, 120 and 180 minutes post-injection for all three block techniques. Preliminary results will be presented at the ESRA 2012 Congress in Bordeaux.

Conclusions: USG BD-TAP blocks, TPVB and QL blocks were all able to consistently anesthetize major areas of the antero-lateral abdominal wall. This was true for both dermatomal anesthesia and myotomes affected. We have discovered significant differences in the resulting dermatomal anesthesia, block on-set time, block longevity and we have also observed significant differences regarding the total area of skin dermatomes affected. Time for block administration also showed significant differences. The statistical calculations and the final analysis have not been finalized as of yet. The USG BD-TAP block is a very fast and easy technique to perform, even though 4 separate injections are required.²⁻³ The block on-set time is under 30 minutes, but the block longevity may be shorter as compared with the other two techniques. The BD-TAP block consistently resulted in anesthetizing the sensory afferent nerves of Th6-Th12 bilaterally in the anterior abdominal wall; i.e. dermatomal anesthesia was consistently present on the upper and lower medial quadrants of the anterior abdominal wall.

The USG TPVB also exhibits block on-set time under 30 minutes, but the block longevity seems longer than the BD-TAP block. In addition, the USG TPVB seems to anesthetize a significantly larger area of skin dermatomes compared to the BD-TAP block. No negative side effects were recorded even though our technique relied on two single injections of 30 mL LA bilaterally at the level of Th9.

The USG QL block had considerably slower block on-set time compared to the two other techniques. However, the block seems to anesthetize a significantly larger area of skin dermatomes compared to the BD-TAP block. No negative side effects were recorded even though our technique relied on two single injections of 30 mL LA bilaterally at the lateral border of the quadratus lumborum muscle at the level of L4-L5.

We can conclude that all three techniques can be used as an important component in a multimodal anaesthetic regimen. All three techniques have their inherent pros and cons and it is easy to conclude that the techniques are more complementary than excluding when comparisons have been done.

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BREAKTHROUGH PAIN AFTER REGIONAL ANAESTHESIA. HOW TO HANDLE?

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Introduction: Following regional anesthesia (RA), two specific breakthrough pain syndromes should be taken into account, one that is not directly related to the RA but may be partly masked by the latter which is refractory pain related to a postoperative compartment syndrome and the second, related or not with the RA, which is neuropathic pain associated with perioperative nerve damage.

Care for intractable pain following a RA usually involves the management of a complication that is related to the RA-induced neuropathy (or not) by the technique of regional anesthesia. We will not discuss in this chapter the rebound pain related to the end of the sensory block. Similarly, we will not discuss the chronicisation of a pain present in the patient pre-operatively in relation to a cancer, degenerative, metabolic, neurological or medical state. Refractory pain is a pain that is resistant or unresponsive to conventional analgesics. It can also be of pathognomonic clinical aspects that go towards its etiology or its anatomical origin.

Refractory pain related to a compartment syndrome:*Incidence and postoperative follow up*

The use of regional anesthesia in patients at risk of compartment syndrome (upper limb injuries (forearm) and lower (tibia and fibula, up to 17% of injuries of the leg)) and the RA implications which may result on the delay in diagnosis is very controversial among surgeons and anaesthetists (1, 2). The most classic clinical signs are summarized in Table 1. None of these signs, however, is constantly present and the clinical interest lies especially when they miss to exclude the diagnosis (97% specificity and negative predictive value [NPV] 98% (3).

TABLE 1. Clinical symptoms and signs attributable to acute compartment syndrome

Pain (out of proportion to injury)
Paresthesia ("pins and needles")
Pain on passive movement (forced dorsiflexion of ankle or wrist of affected limb)
Palpation (tense, hard muscle compartment)
Paralysis (late sign)
Pulselessness (late sign)

The role of regional anesthesia and management of the damage

Currently, for obvious reasons of ethics no randomized controlled trials have been conducted to compare outcomes in patients at risk who received regional anesthesia and those who do not benefit. Clinical practice is based on case reports and retrospective case series (4). This lack of data has limited the development of strong national and international guidelines for best practice. A lack of clinical trials does not necessarily indicate that there is no consequences to the use of the RA. RA may mask clinical signs as most intense pain that is disproportionate and, both at rest and mobilization, paresis or paralysis and paresthesia. Vigilance is therefore required in case of post-operative pain after a bone fracture surgery under regional anesthesia, especially if the RA is continuous. The unreliability of clinical exam therefore requires confirmation of the clinical impression by measuring the compartment pressure whose major interest in the onset time before the fasciotomy (over 15 h) and thereby, allows a reduction in permanent sequelae (5). Under these conditions, the use of the RA seems no more a contra-indication, the choice of a short-acting local anesthetic and management of therapeutic windows allow proper monitoring. In all cases, a consultation with the surgical team and a monitoring protocol is essential.

Refractory pain related to the ALR (or not): Neuropathy:*Incidence and clinical follow up*

Although there are relatively few published reports of nerve damage related to the use of peripheral nerve blocks (PNB), it is likely that the commonly cited incidence (0.4%) (6,7) of severe neuropathy is underestimated due to underreporting. In France, the collective SOS ALR sought the 8150 French anesthetists which listed among others, 50,223 PNB. Among them 12 complications were reported, including 9 with nerve stimulation (8). A recent systematic review analyzed 32 studies published from 1995 to 2005 assessing the neurological complications of regional anesthesia (7). For PNB,

the incidence of neuropathy after interscalene block, axillary and femoral blocks was 2.84 for 100 (95% CI 1.33 to 5.98 for 100), 1.48:100 (95% CI: 0.52 - 4.11: to 100), and 0.34:100 (95% CI: 0.04 to 2.81 for 100), respectively. Only one permanent neurological damage was observed in 16 studies of PNB. The authors concluded that the incidence of neuropathy was 3/100 after PNB but permanent complications were really infrequent. In clinical practice, it is useful to keep in mind that a neurological complication is always possible. The PNB are associated with higher incidence of systemic toxicity (7.5 per 10,000) but a lowest incidence of permanent neurological damage. From a statistical perspective, neurological complications in the postoperative period occur much more frequently due to surgical or positional causes than because of the associated regional anesthesia. For example, in 1614 axillary blocks performed in 607 patients, 62 nerve injuries were detected, seven (11.3%) were attributable to anesthesia and 55 (88.7%) to surgery. Among 660 patients who underwent a shoulder surgery under interscalene block, 58 neurological disorders have been updated. The symptoms were essentially sensitive except for two patients, 31 lesions were related to the interscalene block. Damages are resolvable in 4 (2-16) weeks, except for the two patients with motor impairment. Currently, and in the absence of comparative studies on this topic which are unlikely in the future, the use of ultrasound does not seem to decrease significantly the incidence of neurological complications. The incidence of neuropathy after RA and ODA was 3.78:10.000 respectively (95% CI: 1.06-13.50 per 10,000) and 2.19:10.000 (95% CI: 0.88-5.44 per 10,000). The incidence of permanent neuropathy after spinal block and epidural anesthesia was 0-4.2:10.000 and 0-7.6:10.000 respectively. The authors conclude that the incidence of neuropathy is < 4:10.000, or 0.04% after neuraxial RA.

Neuropathic pain is defined by the International Association for the Study of Pain as a pain initiated or caused by a primary lesion or dysfunction of the nervous system (9). More recently it has been proposed to define it as a pain associated with a lesion or disease affecting the somatosensory system. The clinical signs of intractable pain are summarized in Table 2.

TABLE 2. Clinical signs attributable to neuropathic pain

Occurrence : specific: trauma, surgery; may be accompanied by a neural damage
Onset time between the lesion and the onset of pain
Description of pain: spontaneous pain (burns...) or paroxysmic (electric shock) association with pain caused by friction, cold, heat (allodynia)
Associated Sensations: Numbness, tingling, itching
Associated Neurological signs: thermo-algesic deficit, motor deficit, abnormal reflexes
Pain area: related to a territory compatible with a neurological lesion

The role of regional anesthesia and management of the achievement

The mechanism of injury depends on three main categories: damage resulting from partial or total rupture; stretching of the nerves in which the roots are put in a no physiological position; pressure, which seems a common mechanism (related to the position of the patient, the ulnar nerve and GA, intraneural injection of LA that exceeds the capillary closure pressure, and leads to nerve ischemia) (10). To cause neurological injury, the injection should be intrafascicular; the extrafascicular injections of the same compound does not usually cause nerve damage. (11) The extent of neurological damage after intrafascicular injection can range from neuropraxia with minimal structural damage to neurotmesis with severe axonal damage and myelin. The injury of neurons which is not detectable histologically, causes hypersensitivity to algogenic substances, the production of neuropeptides and intracellular signal transduction, both on the site of the lesion and in the cell body. All this leads to an increase in neuronal excitation and the onset of acute or chronic pain often experienced by patients with neurological damage.

The anesthesiologist must search to find the lesion by a painful neuropathic DN4 questionnaire. This questionnaire allows quickly to update this specific type of pain and to guide further investigations to be performed and the therapeutic management *Diagnostic tests.*

Diagnostic tests currently available include electrophysiology, high resolution ultrasound and magnetic resonance imaging.

a. the Electrophysiology: The electro-neuro-myogram (EMG)

The electromyogram is a fundamental technique. It can locate the site of injury. The damage assessment should be based on electrophysiological data, an essential element of the nerve damage. The neurophysiological examination, and bilateral comparison, can specify their topography, their prognosis

and guide the therapeutic approach. The EMG can be completed by the study of sensory and motor evoked potentials. Because the phenomenon of Wallerian degeneration, signs of active denervation of a nerve, appear only 3 weeks on average after the injury, in the form of spontaneous activity (fibrillations, denervation of slow potential):

- An initial examination should be performed as soon as possible for future reference (before the 3rd day),
- The second test must be conducted between the third and fourth week after injury.

- It is usually necessary to achieve a third EMG 3 months after injury, in order to judge the progress of the re-innervation and provide information for the prognosis. The nerve recovery is jeopardized if, 18 months after injury, no recovery is noted on electrophysiological studies. When the early neurophysiological reveal a pre-existing pathology (eg tomacular neuropathy), more specific tests should be considered. One problem is that if the only indication of EMG is a painful complaint, a nerve conduction study did not detect probably all lesions because myelinated axons, ie the fibers responsible for pain transmission, are not evaluated. If the initial study is normal, there is a strong likelihood that the patient have a neurapraxia which must be resolved over time. Therefore, the patient should be monitored clinically for the improvement of symptoms. The major drawback of the EMG is that it represents a painful procedure performed in an awake patient.

b. Doppler ultrasound

Doppler ultrasound provides both structural and functional information. It identifies the morphological changes of peripheral nerves. It can be used to evaluate a gap of continuity of a nerve, an inflammatory process or a compression syndrome. This can sometimes be an alternative to EMG. In most cases, it must be coupled to EMG because it is not a functional test. Obviously the potential depth of a lesion is a limitation to the factual realization of an ultrasound technique

c. Magnetic Resonance Imaging

Magnetic resonance imaging is an imaging technique that can reliably explore selective nerves. When properly implemented, the neurographic MRI is able to provide quality information on the nerve compression, nerve inflammation, nerve trauma, systemic neuropathies, and recovery of nerves from the beginning. It allows the distinction intraneural / extraneural lesion, and locate nerve compression before exploration. In some studies, MRI signal changes have been shown twenty-four hours after axonal nerve damage.

Nerve damage can be divided into two groups, those with minor deficits and those with large deficits.

Therapeutic management

For minor damages, mainly minimal pain, comfort is the key to alleviate patient anxiety. Followed up by telephone, weekly or bi-weekly allows early detection of more serious problems, and creates confidence with the patient. In patients with pain, analgesics should be started early to prevent neural sensitization. In case of an important neurological deficit, a neurological consultation is advised. In addition to a complete neurological examination, the neurologist will determine the most appropriate diagnostic test for the patient. For example, if a compression injury is suspected, an ultrasound or MRI of the plexus involved can be performed. Early consultation with the physiotherapist is a functional necessity to reduce the risk of muscle atrophy and prolonged disability. Anesthetists and surgeons should remain the main contacts of the patient since consolidation.

The treatment can be administered in cooperation with a chronic pain specialist or neurologist. The effectiveness of tricyclic drugs is well established in peripheral neuropathic pain. Most have an authorization in neuropathic pain: amitriptyline, clomipramine, imipramine. These treatments act primarily on systems of pain modulation, in particular the noradrenergic descending inhibitory controls, but they also have membrane stabilizing properties and probably also a direct effect on beta2-adrenergic receptors (13). They must be administered at low doses to start (10-25 mg at bedtime), then the dose may be increased in steps of 3 days according to efficacy and safety. Effective doses range from 25 to 150 mg, the median effective dose in clinical trials is 75 mg / day (13). Selective inhibitors of serotonin and norepinephrine (venlafaxine, duloxetine, paroxetine) are used in the treatment of peripheral neuropathies primarily related to diabetes. Effective doses of duloxetine is 60 to 120 mg / day, without demonstrated superiority of 120 mg. It is recommended to initiate treatment with low doses (30 mg) to avoid the risk of nausea and increase the dose after one week at a dose of 60 mg / day (14). Paroxetine seems the only selective serotonin reuptake inhibitor that may be effective in the treatment of neuropathic pain induced. The efficacy of gabapentin and pregabalin is well established in neuropathic pain of diabetes.

These treatments reduce the phenomena of central sensitization by acting on one subunit (alpha2delta) calcium channels. They also have effects on controls modulators of pain. Gabapentin is usually started at 300 mg daily with an increase to doses ranging from 1300 to 1800 mg/day in divided doses. Pregabalin has the advantage over linear pharmacokinetics of gabapentin for the detection of a dose / response (150 to 600 mg / d) not established for gabapentin. The most common side effects include dizziness, drowsiness, fatigue, weight gain, peripheral edema, headache and dry mouth (14). These treatments can be used as monotherapy, but secondarily associated with each other in case of partial efficacy (approximately 30 to 50%) and acceptable toxicity. Opioids use is controversial in this context. However, they may be effective for pain relief of nervous origin. In five randomized controlled trials, treatments using opioids for neuropathic pain have all shown benefits in controlling pain (15,16). Opioids commonly prescribed include oxycodone and fentanyl patches. Tramadol is a molecule with properties and mu opioid agonists inhibit the reuptake of monoamines. Tramadol is considered a rescue treatment for failure to tricyclics drugs or gabapentin. Given its beneficial effects on inflammatory pain, it could also be an advantage in combination of neuropathic and inflammatory mechanisms (14). Effective doses are 200 to 400 mg / day. The effectiveness of lidocaine plasters (Versatis®), has been shown in peripheral nerve lesions associated with allodynia (17). In the same area, the patches of capsaicin, an agonist of vanilloid receptors (TRPV1 receptor potential vanilloid 1) on the nociceptive fibers, can be used. Their interest is limited by the initial burning sensation before the onset of analgesic effects of this treatment on symptoms, including in particular the burning or mechanical or thermal allodynia, which on the basis of preclinical studies should be particularly sensitive to this treatment. Capsaicin patches are used for treatment of patients with localized peripheral neuropathic pain, refractory to conventional treatments.

Conclusion: The management of intractable pain in the aftermath of RA must always demonstrate the RA responsibility in the etiology of the damage, its association with other signs suggestive of neuropathic damage and will ensure a personalized and appropriate therapy for each patient.

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PHARMACOGENETICS AND PHARMACOKINETICS IN POSTOPERATIVE SETTING: ADVANCEMENT IN TAILORED OPIOID PAIN THERAPY

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Postoperative pain (PP) still represents a great problem for patients and also for the health-care system, since its poor management prolongs the hospitalization, increases costs and impairs patient outcome (Kehlet 2011). Moreover, PP may evolve in postoperative persistent pain (PPP) that requires frequent recurrence to medical interventions for extended periods of time (Bonnet et al., 2007). Even if PPP is a complex phenomenon difficult to predict, it may be prevented by understanding the mechanisms involved in the progression from acute to chronic pain (Lavand'homme 2011). Among the different factors involved in this mechanism, preoperative pain, severe immediate postoperative pain, and nerve damage represent validated and important predictors (Niraj and Rowbotham 2011).

The most used systemic postoperative pain therapy is constituted by the i.v. morphine patient controlled analgesia (PCA), which guarantees both good efficiency and low incidence of side effects (Palmer and Miller 2010). On the other hand, over-sedation and respiratory depression still continue to represent the most significant side effects of PCA deliveries (Mann et al., 2005). The knowledge of opioid pharmacokinetics might overcome these obstacles, guaranteeing an adequate opioid use and minimizing adverse effects (De Gregori et al., 2011). As opioid responsiveness is modulated both by opioid features and by patient characteristics, also genetic background must be considered as key predictor (Rollason et al., 2008).

The current available genotyping methods allow elucidating the genetic mechanisms directly related to the interindividual differences of opioid response in terms of both pharmacodynamics and pharmacokinetics. The analysis of the combined effect of the variability of several genes involved in opioid absorption, distribution, metabolism, and elimination (ADME), as opioid receptors, transporters, and genes encoding metabolic enzymes (Allegri et al., 2010; Chou et al., 2006; Dai et al., 2010; Hammoud et al., 2011,) will be useful, in a near future, to customize postoperative pain treatment. Accordingly, in perspective, a full genetic profiling for all these elements is needed to explain interindividual variability in the response to analgesic treatment.

To date, genetic correlation with acute postoperative pain and responsiveness to morphine has concerned three specific topics: activity of opioids (polymorphisms of opioid μ receptor), susceptibility to pain (polymorphisms of COMT, an enzyme involved in the catabolism of catecholamines and in central modulation of pain) and metabolism of morphine (polymorphisms of the hepatic enzyme UGT2B7 that is responsible of glucuronidation of morphine to its active and inactive metabolites).

The genetic analysis of the opioid receptor OPRM1 appears a promising tool for the clinician to individualize postoperative therapy and to prevent side-effects (Allegri et al., 2010). The gene of this receptor is highly polymorphic; one of the most frequent polymorphism, the single nucleotide substitution, the SNP A118G, in exon 1, causes a change in the corresponding protein, which seems to be associated with a reduced potency morphine-6-glucuronide (M6G) (Lötsch and Geisslinger, 2005), active metabolite of morphine.

The genetic variability of COMT gene represents another important biomarker for the postoperative pain treatment. COMT encodes for catechol-O-methyltransferase, and it is the most studied gene in relation to pain sensitivity modulation. Val158Met variant results in a threefold reduction in the enzyme thermostability and activity and affects pain perception. In cancer pain, Rakvag et al. found that the patients with the homozygous genotype Val158Val (about 22% of europeans) needed more morphine than the heterozygous Val/Met and the homozygous Met/Met (Rakvag et al., 2005). Other studies about COMT Val158Met variant failed to detect an association with pain sensitivity in noxious transient stimuli (Kim et al., 2004; Diatchenko et al., 2006); however, it is important to evaluate COMT variation in acute post surgical pain, because this type of pain involves different central nervous system (CNS) mechanisms.

Combining this variant with other three COMT SNPs localized in the promoter, in exon 1 and in exon 2 respectively, Diatchenko et al., identified three haplotypes directly associated with interindividual variability of pain sensitivity, classified as: low pain sensitivity (LPS), average pain sensitivity (APS) and high pain sensitivity (HPS), encompassing 96% of the human population (Diatchenko et al., 2005; Diatchenko et al., 2006). The five most common diplotypes were associated with different degrees of sensitivity to experimental pain: the HPS/APS were the most responsive to painful stimuli, while those with the LPS/LPS diplotypes were the least responsive ones.

The importance of the combined effect of the genetic variants for the opioid treatment has been already shown both in the chronic and in the acute postoperative pain: Reyes-Gibby et al., in 2007, demonstrated that the combination of SNP A118G of OPRM1 and the SNP rs4680, corresponding to Val158Met of COMT may predict the clinical efficacy of morphine for cancer pain (Reyes-Gibby et al., 2007). Concerning postoperative pain, Kolesnikov et al., recently revealed a significant association between centrally mediated morphine side effects (sedation and nausea) and genetic variation in COMT and OPRM1 genes, in the first 24 hours after lower abdominal surgery (Kolesnikov et al., 2011).

Morphine, hydromorphone, and oxycodone are mainly metabolized by UDP-glucuronosyltransferase enzymes (UGTs). In particular, morphine is converted in small amounts to morphine-6-glucuronide (M6G), more potent than the parent drug, by UGT2B7 enzyme. As far, there are still no clinical trials demonstrating that this variant is correlated with incidence of side effects or with differences in morphine analgesic activity during the postoperative period.

In conclusion, literature is even more indicating that multidisciplinary approach, including also pharmacogenetics and pharmacokinetics, seems to be promising and useful to obtain a personalized postoperative pain therapy, with the highest efficacy and safety.

Considered these data, we are developing a multidisciplinary clinical study including also pharmacogenetics and pharmacokinetics on patients undergone major abdominal and urologic surgery, managed with morphine delivered by PCA. We will try to clarify the importance of morphine pharmacokinetics in postoperative setting, because, as far, the research focused on the detection of an association between serum morphine and morphine-metabolite concentrations with pain relief have been contrasting (Faura et al., 1996; Quigley et al., 2003; Klepstad et al., 2003; Penson et al., 2005; Hammoud et al., 2011).

We are investigating genetic polymorphisms of COMT, OPRM1 and UGT2B7 and their possible combinations, directly related to morphine treatment, to address a specific postoperative therapy in patients undergone major abdominal or urologic surgery. Anesthesia is induced with Cisatracurium 0.15 mg/Kg, propofol 2 mg/kg (IV) and fentanyl 2 mcg/kg. Anesthesia is maintained with Sevoflurane and fentanyl if needed. At the end of surgery it is started analgesia with Patient Controlled Analgesia (bolus of 1 mg with lock out of 5 minutes, max dose: 20 mg in 4 hours).

The principal aim of this study is the possibility to predict morphine doses required to achieve postoperative analgesia by PCA and to evaluate the PCA efficacy by using the NRS pain scale. Analyzing the polymorphism A118G in OPRM1 our preliminary data suggest that there is a trend indicating that

patients carrying the G allele require more morphine than the other subjects. Moreover, it seems that the combined effect of COMT polymorphism, corresponding to the Val158Met substitution, with A118G of OPRM1 plays an important role on morphine requirement by PCA in the first 24 postoperative hours. Finally, our research could verify the importance of UGT2B7 genetic variability for morphine efficacy in postoperative clinical setting, by analyzing the correlation among polymorphic sites located at the 5' end of UGT2B7 gene, concentration of morphine (M), Morphine-3-Glucuronide (M3G) and Morphine-6-Glucuronide (M6G), and ratio between metabolites and morphine. Five out of the 7 UGT2B7 SNPs we analyzed are tightly linked, forming two common haplotypes. Although, as far, statistical analysis has not reveal any significant association between UGT2B7 variants and M3G/M and M6G/M, we have observed a trend for the metabolites' ratios and UGT2B7 haplotypes, suggesting that a particular UGT2B7 haplotype is possibly associated with more enzyme. The study complies with the declaration of Helsinki on Biomedical research involving human subjects and is approved by the Local Ethics Committee of Foundation IRCSS-Policlinico San Matteo Hospital of Pavia.

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STRATEGIES TO PREVENT PHANTOM LIMB PAIN: NEW EFFECTIVE THERAPY

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Phantom limb syndrome (PLS) is a postamputation syndrome characterized by pain in the stump, phantom limb pain, and phantom sensations¹⁻³ involving from 30% to 90% of amputees. It probably represents the greatest problem of the amputated patients and one of the most important obstacles to the return to an acceptable quality of life after the amputation. PLS onsets in the early postoperative period in 75% of the cases¹⁻⁴ with an average duration of 7 years after limb amputation. Risk factors include preamputation pain, loss of dominant upper limb, bilateral amputation, lower limb amputation, proximal amputation, the presence of stump pain, and depression.^{5,6}

Several studies have evaluated central and peripheral neural blocks for prevention and treatment of phantom limb syndrome. The precise mechanism for the development of phantom pain syndrome is unknown but there's increasing evidence that the abnormal sprouting of nociceptive and mechanoreceptive fibers in the cut nerves after the amputation has an essential role in determining those permanent structural changes in the dorsal horn of the spinal cord and in cerebral cortical structures (causing increased excitability of dorsal horn neurons, reduction in the inhibitory processes and activation of abnormal supraspinal impulses) observed in the amputee patients with phantom limb syndrome².

Epidural blocks have been evaluated for the prevention of phantom limb studies. Epidural analgesia was started in the different studies from 1 to 3 days before amputation, in relation to the preamputation pain is considered to be an important risk factor for the development of phantom limb pain, and continued up to 3 days after the intervention.

An observational study⁷ reported the absence of phantom limb pain 1 year after the limb loss in 11 patients after preemptive epidural analgesia started 3 days before the amputation. Epidural analgesia (24-48 hours before the operation) was compared⁸ with postoperative systemic opioid analgesia and reported a lower incidence of phantom pain and phantom sensations at 6 months after surgery in the preemptive epidural group. Katsuly-Liapis et al⁹ compared preoperative epidural analgesia with bupivacaine and morphine for 3 days before amputation and continued for 3 days after surgery to postoperative epidural analgesia for 3 days after surgery with preemptive group showing a significantly lower incidence of phantom pain at the 6-month follow-up evaluation. Still in two later controlled, randomized and blinded trials¹⁰⁻¹¹ no difference was found between epidural analgesia (started about 24 hours before amputation up to 3 days after) and standard opioid analgesic therapy in preventing phantom limb syndrome at any of follow-up evaluations (from 1 week to 12 months after amputations). According these data short-lasting (24 hours) preemptive epidural analgesia seems do not prevent phantom limb syndrome; more data are needed to evaluate if a longer preemptive analgesia period can be useful.

The efficacy of peripheral nerve blocks in preventing phantom pain was also evaluated. In the published studies¹²⁻¹⁵ there were important differences in local anesthetic, concentration and infusion rate (bupivacaine 0,1% 10 ml/h with clonidine, ropivacaine 0,325% 5 ml/h, bupivacaine 0,25% 10 ml/h, bupivacaine 0,5% 1 ml/h with morphine). In all these studies local anesthetic administration was prolonged for a maximum of 3 postoperative days. These studies showed no evidence that perineural blocks can prevent phantom limb pain syndrome compared to standard therapies when they're limited to the early postoperative period.

Only in our recent study¹⁶ the perineural local anesthetic infusion was evaluated for a longer period. The first experience¹⁷ with an prolonged perineural high concentration (0,5% ropivacaine 5 ml/h) local anesthetic infusion was a patient amputated 10 cm below knee for complex regional pain syndrome (already presenting an intrathecal morphine pump system for pain control), who developed almost immediately after surgery a severe (VAS pain score 100 mm) phantom limb syndrome. After failure of other combined therapies (continuous spinal infusion of morphine 0,3 mg/day, oral gabapentin 300 mg twice a day, sertraline 50 mg/day, diazepam) a perineural sciatic catheter was placed on day II and, after an initial bolus dose of 0,5% ropivacaine 10 ml, a continuous infusion of 0,5% ropivacaine 5 ml/h was started.

In less than 6 hours phantom limb pain and sensations disappeared (with no recurrence for all the hospital stay). Patient was instructed how the correctly manage the local anesthetic infusion at his home and discharged with the catheter system in situ and an elastomeric pump. An high concentration of ropivacaine (0,5%) was used with the idea to allow the patient to frequently discontinue infusion so that he could reload the elastomeric pump less often at home but after the first day the interruption of infusion even for few hours caused pain to reappear. With the agreement of the patient and considering the absence of side effects, the pump was constantly kept open infusing 0,5% ropivacaine at 5 ml/hour infusion rate.

The infusion was stopped every 7 days to evaluate the presence of phantom pain in absence of the local anesthetic effect. In the first evaluation periods phantom pain gradually decreased (VAS= 70 mm after 1 week, VAS= 40 mm after 2 weeks, VAS=0 but still unpleasant paresthesias after 3 weeks). After 4 weeks of infusion the patient reported no phantom pain and sensations and the infusion was stopped. The patient reported no recurrence of phantom pain at 6, 12, 24 and 36 month follow-up evaluation.

So in the sequent observational study¹⁶ 62 patients undergoing lower limb amputation received a 0,5% ropivacaine 5 ml/h infusion through a perineural catheter for a median duration of 30 days (range 4-83 days). According to the amputation level (foot, below-knee, above knee, hip amputation) the patients received a sciatic nerve block (27 pts), a combined femoral-sciatic block (31 pts) or a combined lumbar plexus-sciatic block (4 pts).

Perineural catheters were maintained after the discharge from the hospital and managed in an outpatient setting by local Analgesic Therapy Centers.

Patients were instructed to discontinue local anesthetic infusion every 7 days for a 48 hours period. In this period they evaluated the presence of stump and phantom pain through a verbal rating scale (VRS, 0=no pain, 1=mild pain, 2=moderate pain, 3=severe pain, and 4=intolerable pain) and the presence of phantom sensations (any unpleasant sensation in the absent limb except pain interfering with daily activities). If in the evaluation period the patients experienced no or mild (both stump or phantom) pain and no relevant phantom sensations the local anesthetic infusion was stopped;

otherwise infusion was restarted till the next evaluation period. This study protocol was successfully completed by 38 patients, partially by 20 (catheter removed with no relevant pain but relevant phantom sensations) and not completed at all by four patients (catheter removed despite significant pain).

After 1 year from the amputation only the 4 patients (6%) who not completed the protocol reported a significant (VRS>1) phantom pain. Three of them received a local anesthetic infusion after amputation for a short period (from 4 to 7 days with the catheter accidentally removed or removed by patient request). Only one of them received a long-lasting local anesthetic infusion (5 weeks). The other 58 patients (94%) who completed the protocol and did not report significant pain (VRS>1) at the end of the local anesthetic infusion did not report pain even in the following follow-up evaluations (till 1 year) showing no rebound effect after the discontinuation of perineural local anesthetic administration.

These observational findings suggest that the abnormal activity of peripheral fibers in cut nerves that leads to that structural changes in spinal cord and cerebral cortical centers, causing the phantom pain, may outlast the early postoperative period; a perineural local anesthetic infusion prolonged for the weeks following the amputation might block this late abnormal peripheral activity and prevent the phantom limb syndrome.

There are few data in the literature on the therapy of upper limb phantom limb syndrome. In our recent case report¹⁸ a long-lasting brachial plexus block was successfully applied for treatment of severe phantom limb pain (VAS > 70 mm) appearing in a 46 years-old woman after an interscapulo-thoracic amputation. In this patient a first catheter, inserted intraneurally by the surgeon at the moment of the amputation, showed totally ineffective due to early catheter dislocation. VAS score remained > 70 mm even after the introduction of IV high-dose morphine patient-controlled analgesia. A new catheter was inserted in third postoperative day using an ultrasound-guided posterior approach and a 0,5% ropivacaine continuous infusion was started according to the previously described protocol with periodic stops of infusion for pain evaluation. VAS score rapidly decreased after block to 20-30 mm. In the 3 sequent weeks the patient reported acceptable pain scores (VAS < 30 mm) when local anesthetic infusion was stopped. At the 4th week the patient reported no phantom limb pain or sensations and the catheter was removed. Follow-up period showed no reappearance of phantom pain symptoms. In this case the Ultrasound-guided technique demonstrates very useful; it can represent an invaluable tool when standard nerve-stimulation blocks are hardly performable due to preexisting amputations or anatomical changes.

Therefore, according to the existing literature, neural blockades, both central and peripheral, are very little useful in treating phantom limb syndrome when they're used in a "traditional" way and limited only to the early postoperative period (first 3 days). Peripheral neural blockades, prolonged for the weeks after the amputation even after the hospital discharge in an outpatient setting, could represent a new and very effective therapy.

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ANALYZING INTRATHECAL ANALGESIA AND RELATED SPINAL ANATOMICAL STRUCTURES

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Meninges are morphological and physiologically implicated in mechanical, immunologic, trophic, metabolic and thermal protection of the brain and

spinal cord. In relation to spinal drug delivery, the spinal meninges represent the main barrier against the transfer of drugs between the cerebrospinal fluid (CSF) and the spinal cord.

It is required to know if any of the meninges may cause some resistance or limitation to the free circulation of CSF, presenting a barrier effect or compartmental limitation.

The spinal dural sac contains the subarachnoid space with the trabecular arachnoid, the pia mater and the subpial tissue. All these are the structures that drugs need to cross before reaching the final target. Dura mater, arachnoid and pia mater are structures differentiated morphologically, with different properties and therefore must be analyzed independently.

Dural sac The dura mater is the most external layer of the dural sac and is responsible for 90% of its total thickness. This fibrous structure, although permeable, confers mechanical resistance. The remaining internal 10% of the dural sac is formed by the arachnoid lamina, which is a cellular lamina that adds very little extra mechanical resistance (1). The arachnoid lamina is semi permeable, and influences the passage of substances through the dural wall. The arachnoid limits the diffusion of injected drugs to the epidural space. Dura mater has a thickness of about 0.35 mm (0.25 to 0.40) (2) that it is fairly constant along the spinal cord, with some small variations. It is comprised of concentric dural laminae containing fibers distributed at random in all spatial directions (3-6).

The arachnoid lamina has a thickness of 50-60 microns (μm).⁷ Its barrier effect is due to arachnoid cells strongly bonded by specific membrane junctions. This cell layer represents a small thickness of about 10-15 μm (7) (Figure 1).

Trabecular arachnoid:

The origin of trabecular arachnoid comes from the stratum of inner cells of the arachnoid lamina. These cells surround bundles of collagen fibers that form the axis of the arachnoid trabeculas.

Near the spinal cord, the arachnoid cells of the trabecular structure are mixed with pial cells from the pia mater. Both types of cells share the same histochemical profile, positive EMA (epithelial membrane antigen). In the pial layer, collagen fibers and fibroblasts continue under the pial cells to form the subpial compartment.

The trabecular arachnoid surrounds the structures inside the subarachnoid space, including spinal cord, nerve roots and vessels that are found free within the space, providing cover sheaths to these structures (8-9) (Figure 2). These sheaths are very fragile and break easily when we try to dissect them.

The characteristics of the arachnoid sheaths in the cauda equina are variable; some are lax while others are formed by superimposed planes of the same components with a more compact appearance. The thickness of an arachnoid sheath ranges from 10-60 μm (8-9) (Figure 2). In some cases, one or more nerve roots are enclosed by a single arachnoid sheath and in others, the nerve root has no sheath at all (8-10).

It is possible that a micro catheter, with small diameter, could be introduced inside the arachnoid sheath. By contrast, a 20G catheter, used commonly in epidural techniques is more difficult to be introduced. If a drug is injected inadvertently or by accident inside the sheath, the drug would have a limited dilution with CSF and therefore could be potentially neurotoxic.

Taking into account the method of administering drugs, continuous injection of local anesthetic through a micro-catheter into these arachnoid sheaths could be potentially more devastating than a single injection. This is because repeated doses of small volumes may be accommodated inside the sheath leading to nerve damage. The injection of a single larger volume instead would promote leakage of the anesthetic outside the sheath decreasing its potential for injury.

Lumbar subarachnoid ligaments:

Trabecular arachnoid and subarachnoid ligaments may be related to embryonic tissue remnants found in the subarachnoid space, where the cellular component is progressively replaced by fibrous connective tissue. These ligaments anchor the lateral, anterior and posterior sides of the spinal cord to the dural sac (11-12). Subarachnoid ligaments are similar to trabecular arachnoid, although more abundant in collagen fibers, and therefore more resistant to mechanical forces. A number of 21 dentate ligaments hold from each side of the spinal cord to the dural sac. Each ligament is composed of a flat fibrous membrane between the anterior and the posterior nerve roots and its medial edge is in direct contact with subpial tissue covering the spinal cord. Laterally, these ligaments give rise to pyramidal projections that attach non-uniformly to the arachnoid lamina. The most

cephalic ligament is found opposite the margin of the foramen magnum between the vertebral artery and the hypoglossal nerve. The dentate ligament placed lowest is sited between the exit of the 12th thoracic and first lumbar spinal nerve roots; this ligament is a thin band stretching downwards from the medullary cone. Less commonly, posterior ligaments (*posticum*) are found giving shape to thin, inconsistent bands that attach the spinal cord to the inner surface of the dural sac (11-12). There are also less resistant fenestrated posterior-lateral ligaments, extending more laterally from the dorsal roots to the arachnoid lamina. Both posterior and posterior-lateral ligaments extend longitudinally from the cervical to the mid thoracic or lumbar level. The thinner ventral ligament is found in the anterior side of the subarachnoid space. These subarachnoid ligaments do not limit free flow of CSF in most of patients, due to the discontinuous characteristics along the dural sac.

Pia mater:

The structure of the pia mater includes a cellular layer and a subpial compartment. The cellular layer is made of flat overlapping pial cells with a smooth and bright appearance. Its thickness is made of 3 to 5 pial cells (10-15 μ m) at medullary level and 2 to 3 cells (3-4 μ m) at nerve root level. Amorphous fundamental substance is found around pial cells. The cells measure on average 0.5-1 μ m (13-14) (Figure 3).

The subpial compartment has large amounts of collagen fibers, amorphous fundamental substance, fibroblasts, and a small number of macrophages as well as blood vessels. The subpial compartment is enclosed between the pial cellular layer and a basal membrane in contact with neuroglial cells. The subpial compartment from low thoracic vertebrae has a thickness of 130-200 μ m and here, variations in measurements are more significant than in the pial cellular layer. The thickness of the pia mater is reduced to 80-100 μ m at the level of the medullary cone and continues to diminish down to 50-60 μ m in the origins of the cauda equina. At nerve root level, the thickness of the subpial compartment is 10 to 12 μ m (13-14).

At the level of the medullary cone, there are perforations or fenestrations over the entire surface of the cellular layer of the pia mater. These fenestrations have circular, ovoid, or elliptic shapes (Figure 3). While the dimensions of these fenestrations vary, most of them measure 12 to 15 μ m in length and 4 to 8 μ m in width. At nerve root level, the pia mater also shows similar fenestrations but smaller in size (1-4 μ m) (8, 13-14).

Surrounding the pial cells there are numerous macrophages. The macrophages and other inflammatory cells seen within the pia mater could possibly originate from subpial and subarachnoid blood vessels; although a small proportion of them could originate from immature pial cells as a result of an unknown stimulus. Probably the fenestrations found in the pia mater are related to the migration of some immature pial cells as part of an inflammatory response (15).

The number of cell junctions between pial cells is much lower than among arachnoid cells. For this reason, pia mater is a permeable structure allowing the passage of drugs through intercellular spaces. However, in the area of the conus medullaris the permeability could be higher if the fenestrations are present in the patient.

Cerebrospinal fluid The volume of the CSF has obvious relevance as a determinant of dilution of drugs in the subarachnoid space (16). About 500 ml of CSF is formed each day mainly by the choroid plexuses of the cerebral ventricles, with uncertain contribution from ependyma, pia and brain parenchyma. CSF flow is distributed from the cerebral ventricular system to the cisterns at the base of the brain. A small proportion of CSF leaves the skull and enters the spinal subarachnoid space, passing downwards, posterior to the spinal cord and returning upwards, anterior to the spinal cord (17). The rate of absorption through the arachnoid villi varies and is adjusted to maintain a pressure within normal range.

There are oscillations of the CSF pressure which are synchronized with intracranial arterial pulsations. These changes of pressure could help the dilution of drugs injected in the CSF to reach a homogenous concentration around nerve roots and spinal cord.

Their amplitude is about 9 mm per cycle in the cervical CSF and about 4 mm at the thoracic-lumbar junction, with minimal movement in the distal part of the lumbar sac (18). Pulsations probably increase with the elevation of intra-abdominal pressure. The role played by oscillatory CSF pulsations in the spreading of drugs after subarachnoid injection may require further investigation.

Magnetic Resonance Imaging (MRI) allows the estimation of CSF volumes from human axial images under physiological and pathological

conditions (19-22). There is a great variability of CSF volume between patients, although this variation also depends on the method used to study the CSF.

Sullivan (21) (2006) estimated a CSF volume of 35.8 ml $\pm$ 10.9 (range 10.6- 61.3 ml) between a perpendicular plane in the intervertebral midpoint of T₁₂- L₁ and the lowest limit of the dural sac.

Edsbacke (22) (2011) studied the complete spine and found a total volume of CSF of 81 $\pm$ 13 ml (52-103 ml). In the cervical region there was 19 $\pm$ 4 ml. In the thoracic region, 38 $\pm$ 8 ml. and 27 $\pm$ 8 ml. in the lumbosacral region.

We estimated in another study that the total volume of CSF from L₅-S₁ to T₁₁-T₁₂ intervertebral discs was 36.1 $\pm$ 6.7 ml. (23)

These individual differences of CSF volume affect the final concentration of a local anesthetic drug administered in the dural sac, even with the same dose, volume and concentration to different individuals.

Therefore, having considered other relevant factors such as position of the patient or vertebral level selected for subarachnoid injection; it may also be considered that doses below 7.5 mg of bupivacaine do not ensure an adequate level of blockade in all patients.

Nerve roots, CSF and subarachnoid catheters:

The relationship between CSF volume and nerve root at each vertebral level is an unknown subject that may be of interest when we consider the concentration of drugs in CSF and the amount of nerve tissue that has to cross. In the cadaver it is possible to measure the volume of each nerve root, but more difficult de amount of CSF related to each nerve root.

Recently we estimated the volumes in the segments from L₅-S₁ to T₁₁-T₁₂ (24). The total volume of CSF was 29.95 $\pm$ 5.66 ml (Table 1) and the volume of the nerve roots 10.38 $\pm$ 2.4 ml (Table 2). The total mean volume of CSF at each lower thoracic and lumbar level is around 5 mL per segment, but with a wide range of results between the different levels (24).

TABLE 1.

	Sacral	L5	L4	L3	L2	L1	T12
CSF mean $\pm$ sd	2.2 $\pm$ 0.6	4.8 $\pm$ 1.3	5.1 $\pm$ 1.1	4.9 $\pm$ 0.8	5.7 $\pm$ 0.9	5.8 $\pm$ 1.6*	4.7 $\pm$ 1.3*
Nerve root mean $\pm$ sd	0.1 $\pm$ 0.1	0.6 $\pm$ 0.3	1.3 $\pm$ 0.3	1.8 $\pm$ 0.5	2.0 $\pm$ 0.8	2.4 $\pm$ 0.5*	2.4 $\pm$ 0.6*

* Includes spinal cord volume Table 1. Cerebrospinal fluid volume and nerve root volume (mL.) per vertebral segment (24).

The catheters used to administer intrathecal drugs have different diameter, size of orifices and design characteristics (Figure 4). Epidural catheters, size 20G, have 3 orifices located in a lateral position at different places. This location probably facilitates a more homogenous distribution of injected solutions. A Spinocath catheter on the other hand, has one distal orifice with irregular edges (Figure 4). This irregular surface is caused when we try to withdraw the needle from inside the catheter since both are closely attached at the distal plastic edge. There are other catheters also designed for intrathecal use that needs to be introduced through a needle (Figures 5 and 6).

In the future may be of interest to analyze if a catheter placed for longtime in contact to the spinal cord or nerve roots can cause any damage to these structures (Figures 5 and 6). Until we obtain more data, it would be convenient to avoid the use of these devices in patients ASA I and II as alternative to postoperative pain management.

Conclusions: Several aspects may be involved in the mechanisms of drug diffusion across the meningeal membranes, as well as in their dilution with the CSF which will lead to the drug final distribution and availability for nerve roots and spinal cord.

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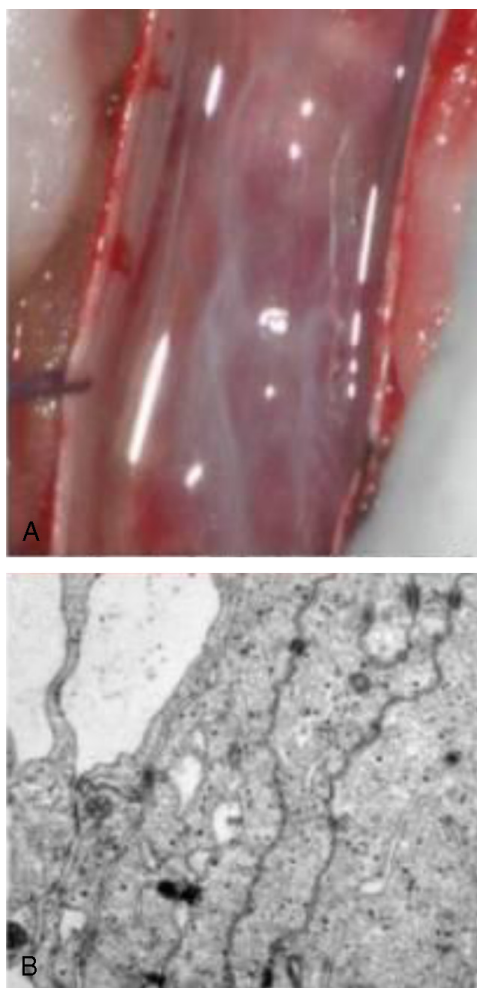


FIGURE 1. Human arachnoid lamina. A: Detail of dissection. B: Arachnoid cells. Magnification: x50000. Transmission electron microscopy. With permission of the author. Published in references 7.

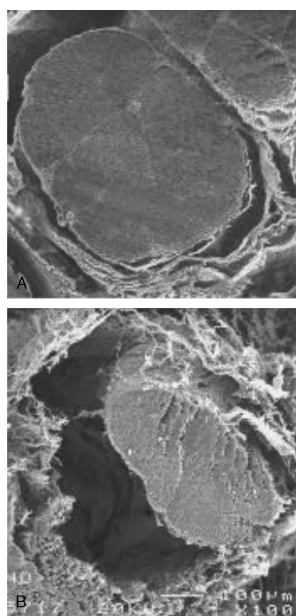


FIGURE 2. Human trabecular arachnoid lamina. A and B: Different samples of human nerve root with arachnoid sheath. Scanning electron microscopy. Magnification: A: x60, B: x100. With permission of the author. Published in references 10.

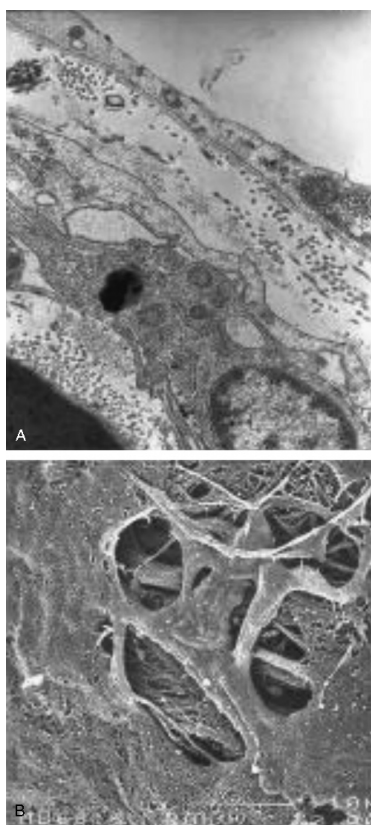


FIGURE 3. Human pia mater. A: Pial cells at spinal nerve roots level. Transmission electron microscopy. Magnification: x12000. B: natural fenestrations in pia mater at level of medullary cone. Scanning electron microscopy. Magnification: x2000. With permission of the author. Published in references A:13, B:14.

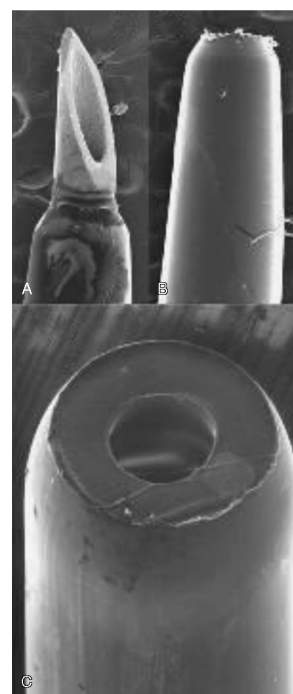


FIGURE 4. Catheters. A: Spinocath type. B: 20G epidural catheter. Scanning electron microscopy. Magnification: A: x50, B: x70. With permission of the author. Published in references.

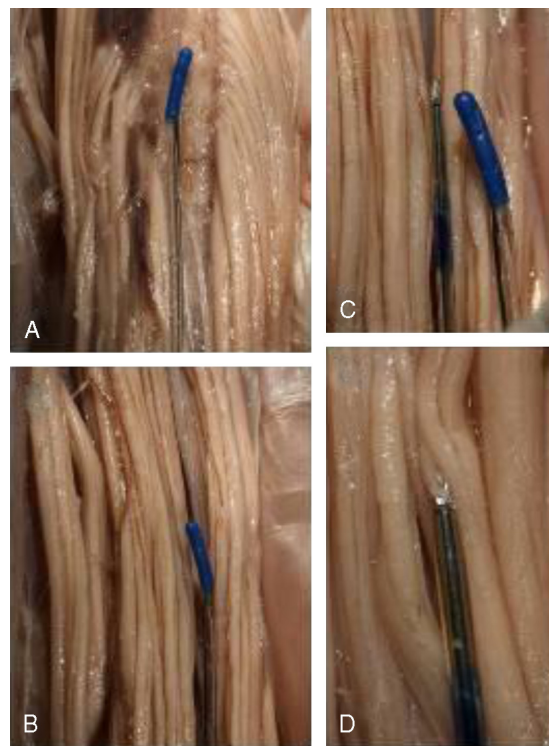


FIGURE 5. Catheters and human nerve roots. A: 20G epidural catheter at the level of the medullary cone. B: 20G epidural catheter at the level of the nerve roots. C: Comparison of spinocath and 20G epidural catheters at the level of the nerve roots. D: Possibility of paresthesia during a placement of spinocath catheter.

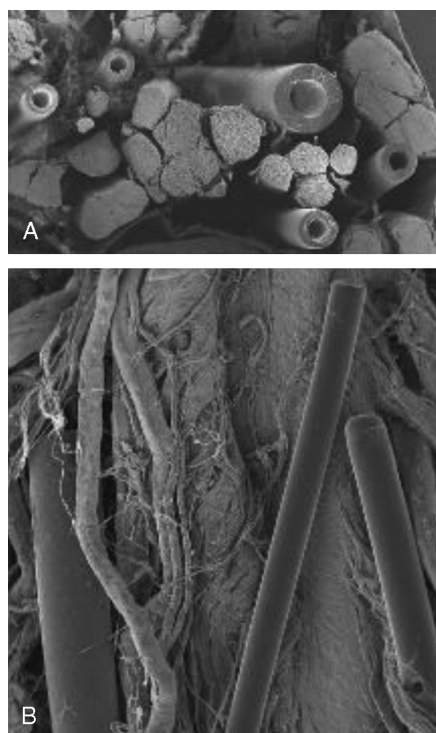


FIGURE 6. Different catheters placement in spinal subarachnoid space. A: At the level of the nerve roots. B: At the level of the medullary cone. Scanning electron microscopy. Magnification: A and B: $\times 10$.

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DRUG DYNAMICS IN CSF AND RELEVANCE OF FLOW RATE IN INTRATHECAL DRUG DELIVERY

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The intrathecal (IT) administration of drugs has become increasingly popular to treat refractory pain states whether due to malignant or non-malignant cause¹. Despite much smaller doses, the IT route has shown to be at least as effective as parenteral administration, with significantly less drug side effects². This therapy is used for long-term management of chronic pain syndromes that are refractory to conventional treatment options.

Currently, morphine, ziconotide (a recently approved conopeptide³) and baclofen are the only drugs approved for long-term IT administration though in routine clinical practice, more than half of the patients receive others drugs⁴. Yet, in patients with neuropathic or mechanical pain lack of efficacy remains a problem.

Implantable pumps can be programmed to deliver very small daily flow rates so that reservoir refilling can be limited to 3 or 4 times per year only. Though desirable from a clinical stand point, daily flow rates in the order of 10 to 50 μL imply the use of highly concentrated drugs, which carries an increased risk of neurotoxicity⁵ and may be associated with poor drug distribution in the cerebrospinal fluid (CSF)⁶.

There is limited knowledge regarding the pharmacokinetics, neurotoxicity and stability of a large number of drugs, let alone the drug combinations that are used in clinical routine⁷.

Much of what we know about how drugs spread in the CSF is derived from the field of spinal anaesthesia. Considering the established fact that there is no net CSF flow⁶, the fluid dynamics implications of the speed, the volume and the pattern of IT injection is very different whether large bolus doses (few milliliters over a few seconds) or low continuous infusions (few microliters per day) are administered⁸.

Anecdotal and unpublished observations, predominantly in patients treated with IT baclofen for the management of intractable spasticity suggest that, for a given daily dose, the effect of treatment decreases with lower infusion rates of higher baclofen concentrations. Similarly, bolus adminis-

tration of very low doses of local anaesthetics proved surprisingly effective in controlling pain⁹.

Using an elegant pig model Bernards et al showed that the distribution of drugs is very limited with low-flow continuous infusion⁶, but the drug spread can be improved by increasing the flow rate. Since this has been measured in vivo, it is reasonable to assume that it will occur in humans as well. As microdialysis cannot be used in patients to measure to what extent a drug spreads in the CSF, a surrogate-measure of drug distribution is the therapeutic effect and it is implicitly assumed that changes in pain intensity do reflect the variation of distribution of the drug in the CSF.

A study in 20 chronic pain patients produced counterintuitive results, suggesting that for a given daily dose, the increase of the flow rate does not improve the effect of therapy and results in a significant worsening of the quality of life¹⁰. Similarly, no correlation could be found between flow rate and therapeutic effect in a small cohort of patients treated with IT baclofen for dystonia due to severe CRPS¹¹.

In conclusion, using continuous IT drug administration with the implantable devices currently available on the market, a modification in the daily flow rate without altering the dose is unlikely to produce a predictable change. A number of clinical observations suggest that the administration of iterative boluses may be beneficial though there is no controlled study yet to support this statement. Furthermore, as our understanding of the fluid dynamics of the cerebro-spinal fluid remains incomplete^{12,13}, the importance of flow rate or pattern may vary from one drug to another depending on lipophilicity, baricity or other factors.

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WHY DRUG CHOICE AND CATHETER POSITION MATTER

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Does drug choice matter?

When drugs are to be administered intrathecally, specific safety aspects have to be considered. First, the drug or the combination of drugs should be chemically stable for several months when stored within a pump reservoir at 37°C. Second, the drug, the degradation products, and the additives must not be neurotoxic. Preclinical studies have demonstrated altered nerve growth and cellular vacuolation after intrathecal administration of local anesthetics, and in humans high concentrations have been associated with neurotoxicity (1,2,3). Third, the drug solution should not change the physiological properties of the CSF. Large infusions of morphine have been found to decrease pH in the CSF (4), this may interfere with essential biochemical processes in the CNS and interact with or inactivate other drugs.

Clinical guidelines for intraspinal infusion from the PolyAnalgesic Consensus Conferences of 2000, 2003 and 2007 (5,6,7) present a hierarchy, where drugs are separated into different lines according to the scientific data and clinical experience. None of the drugs within the first lines are designed for only one specific type of pain (either neuropathic or nociceptive). The first-line drugs; morphine and ziconotide, which are broadly investigated, are FDA approved for intrathecal use in the US. In Europe only ziconotide has received approval from the European Agency for the Evaluation of Medicinal Products. Due to the wide clinical experience and acceptable safety profile hydromorphone is also recommended as a 1. line drug. Fentanyl, which seems to have a lower risk of granuloma formation, has been upgraded to a 2. line drug.

Although continuous drug infusions provide a constant concentration in the CSF, the particular pharmacokinetic properties within the CSF have to be considered. The distribution within and elimination from CSF, influence the onset time and duration of action. This is highly relevant when infusions of baclofen (being poorly lipid- and slightly water-soluble) have to be adjusted due to increased spasticity or when intrathecal opioids are administered as boluses for breakthrough of pain. Lipid-soluble opioids such as fentanyl and sufentanil are associated with a more rapid onset of analgesia (8), and with their rapid elimination from the CSF, also a shorter duration of action. The limited rostral distribution also lessens the risk of supraspinal side effects. Hydrophilic opioids like morphine and hydromorphone have prolonged half-lives in CSF and thereby delayed analgesia. Rostral migration can increase the risk of sedation and respiratory depression (8). Whether these hydrophilic opioids are more effective in the treatment of widespread pain remains to be shown.

For spinal anesthesia small boluses of a local anesthetic are routinely injected into the CSF to provide a nerve block affecting a large part of the body. The extent and duration of the anesthesia seems to be determined by the dose of the drug (mg) and is (over a broad range) independent of concentrations and volumes (9). The drug distribution in the CSF is, however, not fully understood. In a double blinded, randomized setting, adding bupivacaine to an intrathecal morphine infusion gave no benefit (10). However, when bupivacaine in another study was given as boluses, patients reported improved analgesia (11). This indicates that low flow rates, as opposed to boluses, do not provide adequate mixing or distribution in the CSF, even when the drug is hydrophilic. With low flow rates the drug concentration in the CSF has been found to differ largely from one location to another. In ambulatory pigs, who received small intrathecal morphine infusions (1 mg/mL at 20 µL per hour) over 14 days, the morphine distribution was surprisingly limited, with a 5-10-fold decrease in the spinal cord 5-10 cm from the infusion point (12). When Siddal et al (13), however, in 15 patients injected boluses of morphine and clonidine at the lumbar level; they oppositely measured elevated morphine levels 6 hours later as far as the cervical level.

In the clinics, drug choice is not always based on scientific evidence and pharmacological profiles. Both the practitioner's familiarity with specific drugs and patient's comorbidity are important factors in the decision process.

Opioids may lead to intolerable side-effects (pruritis, nausea, vomiting, and urinary retention) even at low doses (8). Clonidine and local anesthetics have hemodynamic effects which may be harmful for patients with coronary artery disease. Also spinal abnormalities have to be taken into consideration. Vertebral and epidural tumors, spondyloarthritis, leading to spinal stenosis, and loss of epidural fat in cachexia may hamper the CSF circulation or reduce the flow of the injected solution, and thereby compromise the analgesia (13). In patients with an impending cord compression, a large intrathecal injection or infusion can even precipitate complete cord compression.

Does catheter position matter?

The minimal drug distribution in the CSF at low flow rates (see above) indicate that catheter tip position is critical, and challenges previous recommendations of lumbar catheter placement for morphine administration. In a rat model where small doses of lidocaine were infused, lateral catheter tip position was associated with clear differences between the two sides (14). Limited distribution and a high morphine concentration around the catheter tip can also explain why inflammatory masses usually occur close to the catheter tip.

Selective positioning of the intrathecal catheter has been shown to facilitate segmental spasmolysis when the catheter tips are placed just caudal to the spinal segments innervating the spastic muscles (15). Catheters for intrathecal baclofen delivery are also placed at low thoracic levels to limit the cisternal drug concentration. However, in a cohort of 166 children, the investigators did not find any correlation between the position of the catheter and the clinical response to the spasticity (16). In a study including teenagers and adults, cervical placement also resulted in equal control of spasticity in the upper and lower extremities and did not increase complications related to the catheter position (17).

Optimal placement of the catheter is, however, important. Clinical reports have described spinal myoclonus (18) and meningismus associated with malpositioned catheters implanted for intrathecal drug delivery (19). In a prospective study the position of intrathecal catheters were examined radiologically (20): Among 50% of the patients, the catheters had moved in a cranial direction, in 34% they remained at the level of the puncture site, and in 16% the catheters were directed caudally. Intrathecal position of the catheters does not depend on the level of lumbar puncture, but is highly dependent on the position of the patient during insertion of the catheter, and on the depth of insertion. For this reason subarachnoid catheters should be placed under fluoroscopic guidance with confirmatory injection of a contrast agent, and with the patients in a sitting position.

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NEW ORAL ANTICOAGULANTS AND THEIR INDICATIONS

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ARE NEW ANTICOAGULANTS NECESSARY?

Traditional methods of anticoagulation and thromboprophylaxis have involved vitamin K antagonists (VKA) (such as warfarin or acenocumarol), heparins (LMWH, and UFH) and fondaparinux [1]. Despite their proven efficacy, these drugs have significant limitations that have prompted the development of new agents with more efficacy and a better safety profile

[2, 3]. New drugs have focused their development on the characteristics of the ideal anticoagulant that have been described as follows [4]:

- possibility of oral (one tablet, once daily) and parenteral (once daily) administration;
- high effectiveness in reducing thromboembolic events;
- low rate of complications (focus on bleeding);
- possibility of reversal if necessary (specific antidote);
- predictable pharmacokinetics, predictable dose response;
- rapid onset of action;
- no need for routine monitoring or platelet count;
- wide therapeutic window;
- no dose adjustment required;
- no interaction with other drugs;
- low nonspecific plasma protein binding; and
- inhibition of both free and clot-bound activated coagulation factors.

Recently, new direct oral anticoagulant (DOAC) agents have been developed and, some of them have received approval for thromboprophylaxis after hip or knee arthroplasty, with other medical and surgical indications being accepted or investigated in several ongoing studies. Many reviews have been made during the last years about these drugs, some of highly recommended lecture [5-7]. This review highlights on the indications of DOAC.

APIXABAN

Apixaban (Eliquis®, Bristol-Myers Squibb/Pfizer EEIG, United Kingdom) is an orally bioavailable, highly selective, reversible, and direct acting factor Xa inhibitor. After oral intake apixaban has more than 50% bioavailability and reaches peak plasma concentration in 30 min to 4 hours, with a terminal half life round 12 hours. The drug is absorbed in the gastrointestinal tract. It is metabolized in the liver and it is eliminated through both the renal (30%) and the faecal routes (70%) [8]. Food does not interfere with apixaban absorption [9]. The most important pharmacology characteristics are summed up in table 1 [10].

Apixaban is not recommended in patients with creatinine clearance < 15 mL/min, in patients undergoing dialysis, or with severe hepatic impairment. No dose adjustment is either required because of body weight, gender, or elderly. The use of apixaban is also not recommended in patients receiving concomitant systemic treatment with strong inhibitors of both CYP3A4 and P-gp inducers, such as azole-antimicrotics and HIV protease inhibitors [10].

The first studies have been rolled in thromboprophylaxis after orthopaedic surgery, and from the results of them apixaban has recently been approved by the EMA to prevent venous thromboembolic events in adults following hip or knee replacement operation:

- In ADVANCE-1 [11], investigators compared apixaban 2.5 mg twice daily, starting 12-24 hours after knee replacement, with postoperative enoxaparin 30 mg twice daily; the study did not meet statistical criteria for non-inferiority, although reduced bleeding was reported with apixaban.
- In ADVANCE-2 [12], apixaban 2.5 mg twice daily has been compared with the widely use regimen of enoxaparin 40 mg per day; it showed that apixaban was more effective for prevention of VTE, without increasing bleeding risk.
- ADVANCE-3 [13], conducted in patients undergoing hip replacement, showed that thromboprophylaxis with apixaban (2.5 mg twice daily), as compared with enoxaparin (40 mg per day), was associated with lower rate of venous thromboembolism, without increasing bleeding.

Apixaban has been involved in studies for other indications:

- In AVERROES, apixaban 5 mg bid vs ASA, reduced the risk of stroke or systemic embolism without significantly increasing the risk of major bleeding or intracranial hemorrhage in atrial fibrillation patients who have failed or are unsuitable for vitamin K antagonist treatment [14].
- The phase 3 study APPRAISE 2 observed a dose-related increase in bleeding more pronounced than the reduction in ischemic events with the addition of apixaban to antiplatelet therapy in patients with recent acute coronary syndrome [15].
- Nowadays, other studies are being conducted: ARISTOTLE, a study to compare apixaban and warfarin in atrial fibrillation patients [16]; AMPLIFY compares apixaban (10 mg twice daily for 7 days, followed by apixaban 5 mg, twice daily for 6 months) to a standard strategy (enoxaparin and VKA) in patients with acute VTE; and ADOPT, compares Apixaban with enoxaparin for the prevention of VTE in hospitalized medically ill patients.

DABIGATRAN

Dabigatran (Pradaxa®, Boehringer Ingelheim International GmbH, Germany) is an oral direct thrombin inhibitor. There are three intravenous

agents currently available (lepirudin, bivalirudin and argatroban) [17]. Dabigatran etexilate is a prodrug that is converted to dabigatran, the active molecule, by esterases. Peak plasma concentration occurs 30-120 minutes after oral administration, with a bioavailability of 5-6%. Because its absorption requires an acidic environment, the oral capsule contains tartaric acid. The dabigatran half-life extends to 8 h after a single-dose administration and up to 17 h after multiple doses. As much as 80% of the drug is excreted unchanged by the kidneys and 20% by the biliary system after being conjugated (table 1). Therefore the drug is contraindicated in patients with creatinine clearance less than 30 mL/min and it is not recommended in patients with elevated liver enzymes more than two times the upper limit of normal [18,19]. The dose has to be adjusted to half dose (150 mg daily) in patients with moderate renal insufficiency (CrCl 30-50 mL/min), elderly (aged 75 or more), and patients on amiodarone treatment.

As Dabigatran is a substrate for the P-glycoprotein transport system, it is not recommended in patients treated with quinidine, a potent P-glycoprotein inducer, although the interaction with other P-glycoprotein substrates, such as atorvastatin [20] or digoxin [21], seems not clinically relevant. Not relevant is the interaction of dabigatran and ranitidine and other proton-pump inhibitors [22].

Dabigatran has been compared with enoxaparin in some studies in major orthopaedic surgery. It has been licensed for the thromboprophylaxis in THR and TKR surgery, with an accepted dose of 220 mg once daily (150 mg if indicated). The first dose is given orally in the postoperative period, between 1 and 4 h after the end of surgery, as a half dose (110 or 75 mg). Main studies are:

- RE-NOVATE [23] in patients undergoing THR: treatment with either dose of dabigatran etexilate had efficacy similar to that of enoxaparin (220 mg dabigatran, 6.0%; 150 mg dabigatran, 8.6%; enoxaparin, 6.7%), and the incidence of major bleeding did not differ significantly among the 3 groups.
- RE-MOBILIZE [24] in patients undergoing TKR: treatment with either dose of dabigatran etexilate for was statistically inferior to a similar duration of treatment with enoxaparin (220 mg dabigatran, 31%; 150 mg dabigatran, 34%; enoxaparin, 25%), with an incidence of major bleeding similar in the 3 groups.
- RE-MODEL [25] in patients undergoing TKR: dabigatran had efficacy similar to that of enoxaparin and the incidence of major bleeding did not differ significantly among groups of study.

Other trials involving dabigatran out of venous thromboprophylaxis are:

- Patients with acute venous thromboembolism (VTE) (RE-COVER) [26]. After the initial anticoagulation with heparin, the study compared oral dabigatran 150 mg twice daily with warfarin adjusted to achieve an INR 2-3. Dabigatran was as effective as warfarin, with a similar safety profile and it did not require laboratory monitoring. The program for this indications is being completed with another ongoing trials: RE-COVER II, RE-MEDY, for the secondary prevention of VTE during 3-6 months, and RE-SONATE for 6-18 months.
- The RE-LY study evaluated the efficacy and safety of two doses of dabigatran (150 mg and 110 mg, both given twice daily) relative to warfarin in patients with atrial fibrillation [27]. The study concluded that dabigatran at a dose of 110 mg was associated with rates of stroke and systemic embolism similar to warfarin, and lower rates of major hemorrhage. The dose of 150 mg was associated with lower rates of stroke and systemic embolism, but similar rates of hemorrhage. As a result of these data, the FDA has approved dabigatran 150 mg twice daily for stroke prevention in atrial fibrillation. Furthermore, a report of the American College of Cardiology Foundation/American Heart Association Task Force on practice guidelines has recently given a Class I/level of evidence B recommendation [28]. Also, the EMA adopted a positive opinion about the indication of dabigatran for prevention of stroke and systemic embolism in adults with nonvalvular atrial fibrillation with one or more risk factors.
- For secondary prevention after an acute coronary syndrome, the RE-DEEM trial (Phase II) revealed that dabigatran, in addition to dual antiplatelet therapy, was associated with a dose-dependent increase in bleeding events and significantly reduced coagulation activity [29]. Although the total number of patients suffering ischaemic cardiovascular events during the study was low, with minor differences between the treatment groups, the net clinical benefit of dabigatran need to be evaluated in a phase III study.

RIVAROXABAN

Rivaroxaban (Xarelto®, Bayer HealthCare AG, Germany) is an oral direct FXa inhibitor. It has predictable pharmacokinetics with high oral bioavailability (about 80%) and a rapid onset of action. The peak level is reached at 2-4 h, being slightly enhanced by food intake. Its half-life is 5-9 h. Ap-

proximately 66% of the administered dose undergoes metabolic degradation, with half then being eliminated by renal clearance and the other half through the fecal route. The final 33% of the administered dose undergoes direct renal excretion as unchanged active substance in the urine, mainly through active renal secretion [30, 31] (table 1).

For patients receiving rivaroxaban in the first approved indication (thromboprophylaxis), it is not necessary to adjust the dose in the presence of mild or severe renal impairment (creatinine clearance 15-80 mL/min). Rivaroxaban is contraindicated in hepatic disease with coagulopathy and clinical bleeding risk, and it should be used with caution in cases of moderate hepatic impairment (Child Pugh B).

About drug interactions, with the above cautions mentioned, rivaroxaban is not recommended in patients treated with potent inhibitors of CYP3A4 and P-gp, as azole antimycotics or systemic HIV-protease inhibitors [32]. Not of clinical significance was the interaction with moderate inhibitors such as clarithromycin, erythromycin or rifampicin [32]. No effect in bioavailability and pharmacokinetic was noted when rivaroxaban was co-administered with antacids and H₂ receptor antagonists [33].

Rivaroxaban has been compared with enoxaparin for the thromboprophylaxis in major orthopaedic surgery, and with warfarin for other indications:

- The first indication approved for rivaroxaban was thromboprophylaxis in patients undergoing hip or knee arthroplasty, after the 4 studies RECORD, RECORD 1 and 2 in THR, RECORD 3 and 4 in TKR [34-7]. The recommended dose is 10 mg daily, starting 6-8 h after wound closure. In all these trials, the results showed superiority of rivaroxaban against enoxaparin in terms of efficacy, with a tendency of having increased bleeding, but without reaching significance in any trial.
- Rivaroxaban (15 mg twice daily for 3 weeks, followed by 20 mg once daily) was evaluated for the treatment of acute symptomatic deep vein thrombosis (EINSTEIN-DVT) [38]. The study showed that rivaroxaban alone is more effective than standard therapy (enoxaparin followed by VKA), with similar safety. After these results, on September 2011 the Committee for Medicinal Products for Human Use (CHMP) of EMA has adopted a positive opinion about this indication. When treatment is continued (EINSTEIN-Extension) (rivaroxaban 20 mg once daily for an additional 6 to 12 months), rivaroxaban is effective in preventing recurrences and has an acceptable risk of bleeding [38]. A study for the treatment of pulmonary embolism (EINSTEIN-PE, NCT00438777) is ongoing.
- The ROCKET-AF trial suggests, based on preliminary results, the efficacy and safety of rivaroxaban (20 mg once daily) as an alternative to warfarin for the prevention of thromboembolism in high-risk patients with atrial fibrillation [39], together with the acute treatment of VTE, the EMA adopted apposite opinion about this indication on September 2011.
- In ATLAS-ACS 1 (Phase II), a trial of patients with recent acute coronary syndrome, rivaroxaban increased the risk of clinically significant bleeding in a dose-dependent manner when compare to placebo, while leading to a non-significant reduction in the primary composite efficacy endpoint. As a result, a Phase III trial (ATLAS-ACS 2; NCT00809965) is comparing two doses of rivaroxaban, 2.5 and 5 mg twice daily.

TABLE 1. Pharmacokinetic properties of DOAC.

	APIXABAN	RIVAROXABAN	DABIGATRAN
Mechanism of action	Direct Xa inhibitor	Direct Xa inhibitor	Direct IIa inhibitor
Protein-binding (%)	35	40-60	>90
Half-life (h)	8-15	5-9	14-17
Substrate of transporters (P-gp)	Yes	Yes	Yes
Substrate of CYP enzymes	Minor (CYP3A4)	Major (CYP3A4, CYP2J2)	NO
Elimination	70% Unchanged 30% Inactive metabol	50% Unchanged 50% Inactive metabol	100% Unchanged drug+ active metabol
Route of elimination	25% Urine 70% Feces	70% Urine (40% inactive) 30% Feces	80% Urine 20% Feces

NEW ORAL ANTICOAGULANTS AND REGIONAL ANAESTHESIA

The performance of regional anesthesia in patients receiving anticoagulant drugs must be managed taking into account the type of anesthetic-analgesic

technique to be carried out, the characteristics of the anticoagulant, the procedure-related risk factors and additional personal risk factors [40-42]. Recently, Rosencher et al. [41] proposed that safety time intervals should be based on the pharmacological profile (pharmacokinetics and pharmacodynamics) of each specific drug, mainly the time required to reach maximal concentration, the half-life and the dose regimen. The rules based on the pharmacokinetics can be summarized as follows:

(1) The first dose of the anticoagulant after a neuraxial puncture must be administered so as to ensure an interval of at least 8 h between the end of surgery and the peak plasma level of the drug.

(2) The removal of a deep catheter must be delayed at least two half-lives of the anticoagulant following the last peak plasma level (when there is only 25% of the circulating drug remaining).

(3) The safety interval between the removal of the catheter and the next anticoagulant administration must be delayed by a period calculated from the haemostasis time minus the peak plasma level of the drug (the longer the peak level, the shorter the time delays).

Based on the above pharmacokinetics, a summary of the main recommendations for new anticoagulants is shown in Table 2 [5, 43].

TABLE 2. Reco anticoagulants and regional anaesth.

	Half-life (h)	Time to peak level (h)	Safety time regional anesthesia-anticoagulant (h)	Safety time anticoagulant-catheter removal (h)	Safety time catheter removal-anticoagulant (h)
LMWH	4-6	3-4	4-6	10-12	4-6
Fondaparinux	12-21	1-2	6	36	12
Apixaban	8-15	3	6	20-30	6
Dabigatran	14-17	2-4	2-4	Not recommended	2-4
Rivaroxaban	5-9	2.5-4	4-6	18	6

Continuous peripheral nerve blocks (CPNB)

Upon performing CPNB, bleeding complications are usually less important than those associated with neuraxial blocks. But, an eventual bleed derived from a CPNB can lead to a mechanical compression of the nerve with nerve palsy and could even lead to life-threatening bleeding [25] if undiagnosed. Recently, ultrasound-guided peripheral nerve blockade has become a valuable tool, nevertheless, it cannot be assumed in clinical practice as the new gold standard for peripheral regional anesthesia in absolute terms of efficacy and safety.

The proposal for the practice of CPNB [5] states that for the performance of peripheral nerve blocks it seems necessary to maintain caution, although it is not necessary to maintain so high level of caution; the same recommendations as for neuraxial anaesthesia should be in mind if the block is made in a non-compressive area (posterior lumbar plexus, sciatic parasacral or infraclavicular blocks).

Conclusions:

New drugs for thromboprophylaxis are each day less future and more present. The new oral anticoagulants that have all began as thromboprophylaxis in orthopaedic surgery, offering an alternative to parenteral heparins, are nowadays widespread in medical settings. This chapter must be considered a review of the pharmacology of these drugs and a temporary update of their indications.

As new drugs, great care should be taken in the management of new direct oral anticoagulants, in a special way in patients with hepatic or renal impairment, with concomitant drugs or with indwelling epidural catheters. In this setting, this chapter (together with the one about bridge therapy) tries to give the basis, but new indications are being approved, more patients and more type of patients are being included, different dosage are being studied, so the scenario is changing and will be changing the next years.

Maybe, the most important point will be to keep in mind the pharmacokinetic basis. In fact, the different guides and recommendations are based on pharmacokinetics to propose the time intervals. Nevertheless, as there is no experience, the clinician should be cautious till the time and the experience tell us the correct way to go.

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NEW ANTICOAGULANTS: ARE WE GOING TO CHANGE OUR PRACTICE IN RA? MONITORING ISSUES

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What's new?

New agents for perioperative thromboembolism prophylaxis and for therapeutic anticoagulation include selective factor Xa and selective thrombin inhibitors. Binding to these target structures results in an inhibition of proteolytic properties, without antithrombin or other cofactors being necessary. Direct thrombin inhibitors (DTI) also inactivate thrombin-bound fibrin thus inhibiting thrombus growth. Bivalent DTI inhibit both the catalytic center and exosite 1, univalent DTI inhibit only the active center. The recombinant hirudins desirudin (Revasc®) and lepirudin (Refludan®) are first generation irreversible bivalent DTI for s.c. or i.v. administration. Half-life: 2-3 h (prolonged in renal insufficiency). Argatroban (Argatra®) is a reversible monovalent DTI for i.v. injection and is exclusively eliminated through the liver. Half-life: 35-45 min. Dabigatran (Pradaxa®) is an oral reversible monovalent DTI. The prodrug dabigatran etexilate is metabolized by plasma esterases into dabigatran. Half-life: 12-17 h (prolonged in renal insufficiency).

The new oral anticoagulant (NOAC) rivaroxaban (Xarelto®) acts through direct inhibition of factor Xa. Half-life: 5-9 h (prolonged in older patients). Apixaban (Eliquis®) is also an oral, reversible, direct factor Xa inhibitor. Half-life: 10-15 h. Edoxaban is the newest oral, reversible, direct factor Xa inhibitor (not yet on the market).

Laboratory drug-monitoring

For new anticoagulants (NACs) and NOACs no drug-monitoring is necessary according to the manufacturer's instruction. However, there may be clinical situations where laboratory testing of the degree of anticoagulant effects could be helpful for decision making:

- (suspicion for) overdosing
- overt bleeding
- non-elective surgery
- severe co-morbidity
- (suspicion for) impaired elimination with accumulation
- (suspicion for) drug-drug-interactions
- obesity, cachexia, pregnancy
- testing patient compliance

For selecting the adequate specific test, future clinical studies are needed to determine the low therapeutic window for avoiding thrombotic events and the high therapeutic window for avoiding bleeding complications. Blood withdrawal 24 h after peroral administration of NOACs represent trough levels, 4 h after ingestion the peak levels. Adequate interpretation of laboratory results requires communication of clinical details to the lab physician (e.g. on the timing of blood withdrawal after last NOAC ingestion). Vice versa need clinicians reliable information from the central laboratory (e.g. on the specific test reagents used).

Factor Xa inhibitors rivaroxaban, apixaban and edoxaban: aPTT is not suited for drug-monitoring [1-3] but PT and anti-Xa activity using the specific NOAC as calibrator could be an option for assessment of factor Xa inhibitors.

DTI dabigatran: aPTT is not suited for drug-monitoring [4-7] because of the non-linear dose-response-curve and the heterogeneity of (> 200 commercially available) aPTT-test reagents with highly variable sensitivity [8,9]. Thrombin time or the Haemoclot assay could be an option for the assessment of dabigatran.

DTI argatroban: Drug-monitoring using the aPTT has been recommended for critically ill patients with or without renal replacement therapy (aPTT 2 h after argatroban start: if > 100 s stopp of argatroban-infusion for 2 h and aPTT-control; target range: 1.5-3 times normal). Drug-monitoring using aPTT is not possible if aPTT is prolonged already before argatroban infusion (e.g. in critical illness with increased levels of lupus anticoagulans or coagulation factor deficits) [10]. In case of therapeutic doses such as during cardiopulmonary bypass activated clotting time (ACT) or ecarin-based tests are used. When switching from argatroban to vitamin K-antagonists (after referral of platelet counts in patients with heparin-induced thrombocytopenia HIT) the laboratory test of PT/INR is used [11]. Differences in sensitivity for argatroban between PT test reagents of the Quick-type compared to the Owren-Type need to be considered.

Pharmacokinetic effects of NACs and NOACs can be determined by chromogenic substrate assays and prothrombinase-induced clotting time (PiCT) tests [12-14]. In contrast, whole blood tests such as thrombelastometry ROTEM or TEG detect the sum of pharmacodynamic effects including also influencing factors other than anticoagulants. For goal-directed therapy of acquired perioperative bleeding ROTEM/TEG are suggested helpful [15]. While ROTEM/TEG cannot quantitatively assess NOAC effects [16], test modification implementing the PiCT-assay showed a strong correlation with anti-Xa concentration [17].

Co-existing bleeding disorders and laboratory tests

As in all our patients assessment of bleeding history and medication history by a standardized questionnaire is a prerequisite for pre-operative patient evaluation. If bleeding symptoms are present, diagnosis (and treatment) of bleeding disorders are recommended. For diagnosis, first-level tests may include routine coagulation tests such as aPTT, PT, fibrinogen concentration and primary haemostasis capacity (including platelet function and von Willebrand factor:Antigen and ristocetin cofactor) [18]. If test results are pathological or inconclusive, second-level test should be indicated by a specialist in haemostaseology and may include coagulation factor activities. Effects of NACs on coagulation tests need to be considered.

Timing of RA in patients on NACs

There are no clinical studies available on the ideal timing of peripheral RA in patients on NACs. National and international guidelines exist on the timing of neuraxial blocks in patients on NACs [18,19]. The Austrian Task Force on Perioperative Coagulation of the Austrian Society of Anaesthesiology, Resuscitation and Intensive Care (ÖGARI) published a practice-guidance on the timing of NACs in patients scheduled for peripheral blocks; blocks were divided into 2 categories according to the management of eventual bleeding complications. If amounts of bleeding can be controlled by direct compression and no vital structures are endangered, management was categorized as simple. However, risk for secondary complications of haematoma need to be considered (e.g. infection). Accordingly, e.g. axillary plexus block and femoral block are considered minor blocks, while e.g. psoas compartment block is considered a major block. Arbitrarily, for major blocks the ÖGARI recommends the same time intervals for NACs as for neuraxial blocks. However, for minor blocks no time intervals are obligatory only in case of a normal patient's bleeding history [20].

Currently timing of RA is performed according to the pharmacokinetics of the anticoagulant and considering the individual risk for bleeding and thrombosis. Time intervals after the last dose of the anticoagulant are usually derived from the half-life (after 2xhalf-life only about 25% biological activity of the anticoagulant is anticipated in case of normal drug elimination). Time intervals after RA and the next dose of the anticoagulant are usually derived from time to peak (6-8 h minus time to peak levels). It is recommended to avoid antithrombotic drug combinations.

In the future laboratory testing and specific drug-monitoring may permit individualized timing of RA. Until then, an exclusion criterion for neuraxial and major RA blocks are therapeutic doses of NOACs. This may be excluded if all test results are within the normal range of routine coagulation tests (> 3 h after NOAC ingestion). However, if aPTT > 90 s and INR > 1.5 (Owren) or > 2 (Quick), overdosing of dabigatran is likely [21] and RA should be postponed.

General considerations

Our routine practice should always comprise written informed consent of the patient. In high-risk patients RA-blocks may be preferred over neuraxial

blocks. RA blocks with a relevant risk for bleeding should be performed by a trained anaesthetist. In case of (traumatic puncture with) overt bleeding signs prohaemostatic therapy should be applied considering the pro-thrombotic diathesis of the underlying disease which was the indication for new anti-coagulant prescription.

Postoperative awareness of thrombotic manifestations and bleeding complications must be a routine for all disciplines involved in the management of patients on new anticoagulants. In case of complications immediate diagnosis and treatment is required.

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NEW ORAL ANTICOAGULANTS. ARE WE GOING TO CHANGE OUR PRACTICE IN REGIONAL ANAESTHESIA?

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New oral anticoagulants (NOACs) have long been awaited since vitamin K antagonists, although oral drugs, have a delayed onset of action and a narrow therapeutic window. They interact with many medications and are not powerful enough, whereas LMWH are safe and effective but injectable and non-synthetic. Several apparently safe, highly effective, oral drugs are in the final stages of development. They are either anti-IIa or anti-Xa agents, with no apparent superiority over each other¹.

Dabigatran (Pradaxa®) is a direct thrombin inhibitor with the following properties: bioavailability is 6-8%, peak plasma concentrations are reached within 2 hours, postoperative peak concentrations occur later and are lower, the terminal half-life is 14-17 hours, it is given once or twice daily, it is excreted unchanged via the kidney. Dabigatran was first developed for orthopedic surgery. Two large randomized double-blind studies of short (10-14 days) and long-term prophylaxis (28 days) after respectively total knee replacement (TKR) and total hip replacement (THR) found it to be non-inferior to enoxaparin (40 mg once daily)²⁻³. Dabigatran has been approved by the European Medicines Agency (EMA) and is now used in daily clinical practice in orthopaedic patients. As compared to the North-American dosing of enoxaparin (30mg X 2) in TKR patients, Dabigatran didn't meet the non-inferiority⁴ and therefore this agent is not yet registered in North-America for VTE prophylaxis in orthopaedic patients.

• **Rivaroxaban (Xarelto®)** is an orally active oxazolidone derivative which acts as a potent direct anti-Xa agent. Its oral bioavailability is greater than 80%. It inhibits Factor Xa with a K_i of 0.4 nM. It reaches peak concentrations after 2 to 4 hours. Its terminal half-life is close to 9 hours, 11 to 13 hours in elderly patients, and it is cleared by the kidneys (2/3, but only half as an active form) and the gut (1/3). Like other oral compounds, rivaroxaban was first developed for orthopedic surgery where it has been found to be superior to enoxaparin (THR and TKR, the RECORD program)^{5,6}. For the first time in the long history of antithrombotic agents, a new compound has significantly decreased the rate of symptomatic venous thromboembolic events. However, when taking into account the surgical site, the rate of major bleeding was increased compared to enoxaparin⁷. Rivaroxaban has also been approved by the EMEA and is currently used in Europe. No increase in bleeding risk has been reported by the recent pharmacovigilance surveys for this potent agent.

• **Apixaban (Eliquis®)** is also a potent direct reversible anti-Xa inhibitor with the following properties: oral bioavailability of 51-85%, inhibition of Factor Xa with a K_i of 0.08 nM, terminal half-life of about 10-15 hours, renal elimination 25%, non-renal elimination 75% (hepatic metabolism, biliary and intestinal excretion). Phase III studies (the ADVANCE program) are now completed in orthopaedic surgery showing that oral Apixaban 2.5 mg b.i.d starting 12 to 24hrs post-operatively was as safe and more effective than enoxaparin 40mg once daily subcutaneous injection in TKR and THR patients with no differences in the bleeding rate^{8,9}. However, when compared to the North-American enoxaparin dosing (30 mg x 2) in TKR patients, Apixaban (as Dabigatran) did not meet the non-inferiority criteria¹⁰. Apixaban has obtained the European approval for VTE prophylaxis in scheduled orthopaedic surgery.

In December 2010, the European Society of Anaesthesiology published new guidelines on regional anaesthesia and antithrombotic agents¹¹. Recommendations have been made regarding the delay between the last dose of NOACs and the start of a neuraxial anaesthesia procedure, or on the minimal delay for catheter removal (table 1).

Drug-drug interactions, the intra- and inter-individual variability, the impact of age, body weight and renal function, and the occurrence of several bleeding reports in patients with renal insufficiency with dabigatran have to be taken into consideration. Furthermore, recommended time intervals considering neuraxial blockade only confer to prophylactic doses. As NOACs are about to be used in higher therapeutic doses in patients treated for atrial fibrillation¹²⁻¹⁵ or for a deep vein thrombosis¹⁶, it is expected that European anesthesiologists will face more and more patients treated with these agents.

Several different clinical cases can be individualized¹⁷:

1. NOACs should not be interrupted for skin surgery, dental and stomatologic procedures, gastric and colonic endoscopies (even if biopsy is scheduled, but no polypectomies), nor for most ophthalmologic surgery, i.e., mainly anterior chamber (cataract), although vitreoretinal surgery is sometimes performed in NOACs-treated patients
2. For low-risk patients (e.g. atrial fibrillation patients with CHADS2 score ≤ 2 ; patients treated for >3 months for a non-recurrent VTE) undergoing procedures requiring normal coagulation (normal diluted thrombin time or anti-FXa level < 0.1 U ml⁻¹), NOACs can be stopped 4-5 days before surgery. No bridging is needed.
3. For high-risk patients (e.g., atrial fibrillation patients with a CHADS2 score > 2 ; patients with recurrent VTE treated for < 3 months), bridging therapy may be considered Day -5: last NOAC dose; Day -4: no heparin; Day -3: therapeutic dose of LMWH (b.i.d) or UFH (b.i.d or t.i.d); Day -2: subcutaneous LMWH (b.i.d) or UFH (b.i.d. or t.i.d); Day -1: last injection of subcutaneous LMWH (in the morning, i.e. 24 h before the procedure) or subcutaneous UFH twice or thrice daily (i.e. last dose 12 h before the procedure), hospitalisation and measurement of diluted thrombin time or anti-FXa; Day 0: surgery.
4. Emergency procedure in a patient treated with therapeutic doses of NOAC:

No antidote is available yet. High dose of Prothrombin Complex Concentrate has shown a some biological efficacy in healthy volunteers treated with rivaroxaban¹⁸. Ex vivo, activated PCC (FEIBA®) is also effective¹⁹, but no clinical data are available with PCC or aPCC in bleeding patients. Waiting for two half-lives, whenever possible, is an alternative solution. Finally, haemodialysis can be performed in dabigatran treated patients.

For groups 1 and 2, NOACs should be restarted during the evening after the procedure, using the following doses: dabigatran, 150 or 220 mg once daily; rivaroxaban, 10 mg once daily; apixaban, 2.5 mg twice daily. Addition of LMWH is not useful. When surgical haemostasis is achieved, full therapeutic doses may be resumed.

For group 3, heparin (UFH or LMWH) should be restarted 6-72 h after the procedure. NOACs may be resumed when surgical bleeding risk is under control.

• In addition, the new oral anticoagulant agents should be used with caution after an initial period of observation^{18,20}. Biological monitoring is now available, even if the interpretation of the tests remains controversial^{21,22}. Two tests are ready for use: a diluted thrombin time (Haemoclot® for dabigatran) and a calibrated anti-Xa activity (for anti-Xa agents).

The new antithrombotic agents will probably change the clinical landscape in the years to come but currently there are very few long-term data for these products for which - it should be remembered - no antagonists are available. As far as regional anaesthesia is concerned, we have to take care!

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TABLE 1. Recommended time intervals before and after neuraxial puncture or catheter removal¹¹

	Time before puncture/catheter manipulation or removal	Time after puncture/catheter manipulation or removal	Laboratory tests
Unfractionated heparins (for prophylaxis, ≤ 15 000 IU/day)	4-6 h	1 h	Platelets during treatment for more than 5 days
Unfractionated heparins (for treatment)	IV 4-6 h	1 h	aPTT, (ACT), platelets
Low-molecular-weight heparins (for prophylaxis †)	12 h	4 h	Platelets during treatment for more than 5 days
Low-molecular-weight heparins (for treatment)	24 h	4 h	Platelets during treatment for more than 5 days
Fondaparinux (for prophylaxis, 2.5 mg/day)	36-42 h	6-12 h	(anti-Xa, standardized for specific agent)
Rivaroxaban (prophylaxis, 10 mg q.d.)	22-26 h	4-6 h	(antiXa, standardized for specific agent...)
Apixaban (prophylaxis, 2.5mg b.i.d)	26-30h	4-6 h	(antiXa, standardized for specific agent...)
Dabigatran (prophylaxis, 150-220 mg)	34-36 h	6 h	Diluted thrombin time
Coumarins	INR <= 1.4	After catheter removal	INR

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TEACHING REGIONAL ANAESTHESIA: WE STILL HAVE TO TRAIN NERVE STIMULATION!

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Background and aims: Since the booming of ultrasound regional anaesthesia techniques many anaesthetists have shown concern regarding the relative benefits of US-guided blocks in comparison with neurostimulation (NS) and surface landmarks. The use of a peripheral nerve stimulator has been the norm for performing peripheral nerve blocks for fifty years, and has been shown to be a highly effective procedure for determining adequate needle placement to produce regional anaesthesia. Although US provides noninvasive information regarding individual typical and atypical anatomy and it is used to facilitate the performance of both neuraxial and peripheral nerve blocks. It allows anaesthetists to follow the needle path, stay away from adjacent structures, observe injected solution, and make real-time adjustments that are necessary for effective perineural spread of injectate. Furthermore, the US-guided technique offers reported additional advantages, including avoidance of intraneuronal/intravascular injection, faster onset times, improved block quality, decreased pain from muscular contractions, prolonged post-operative analgesia, and decreased need for rescue analgesics. This technology is applicable to most patients requiring regional anesthesia and may be particularly useful in patients with obscure anatomic landmarks, coagulopathy, neural pathology, and severe extremity trauma. US has been shown to decrease procedural times and increase block quality in both adult and pediatric patients by providing more reliable landmarks for nerve localization and local anesthetic deposition than surface anatomy and NS alone. By facilitating real-time imaging of anatomic structures, needle position, and injectate spread, ultrasonography offers the regional anesthesiologist many advantages. Furthermore, US is particularly useful for nerve block of a pure sensory nerve (where nerve stimulation has limited applicability).

Methods: NS has several limitations as difficulty in correct needle placement because of imprecise surface landmarks, anatomic variability, and inadequate local anesthetic diffusion despite an apparently correct electrical end point. In contrast to a palpation-based neurostimulation or paresthesia technique, ultrasound imaging of the area to block can provide useful information regarding depth to the target. Ultrasonography clearly aids in the identification and avoidance of blood vessels, it appears to reduce the risk of inadvertent vascular puncture during block performance. It was described a case of hematoma formation after surface landmarks were determined and neurostimulation-guided block was attempted. After several unsuccessful needle passes using an 18-gauge a hematoma became apparent, but ultrasound allowed assessment of the severity of the hematoma and successful block salvage¹.

Sometimes patients that received NS assisted regional anaesthesia describe it as an uncomfortable technique, with most patients identifying electrical stimulation as an unpleasant moment. Plexus block under ultrasound, which becomes an increasingly popular technique, does not require electrical stimulation and it should theoretically improve the block performance comfort. There could be different reasons to explain the discomfort, apart from these electric contractions, nerve stimulation assisted blocks take longer than ultrasound guided, therefore the duration of performance block could influence in the increased pain perception. As mentioned before, when compared with neurostimulation alone, ultrasound-guided techniques have shown several clinically significant benefits such as faster block onset, longer block duration, less risk of block failure, and decreased risk of vascular puncture. Several studies have already assessed global discomfort during axillary and humeral blocks using multiple nerves NS. Almost all of these trials identified electrical stimulations as the main cause of discomfort for the patients, Dingemans et al² have prospectively compared US and NS techniques of regional anaesthesia with regard to patient's comfort during axillary block placement, and their results showed that electrical stimulation was qualitatively considered as the main unpleasant event during axillary block placement. It was demonstrated that US approaches were less painful and were more comfortable than NS.

In addition to other benefits, US requested a lower number of needle passes than NS to achieve successful nerve block. A high false negative motor response rate will increase the number of unnecessary needle manipulations or reinsertions. This may reduce the risk of plexus or nerve needle trauma. When using NS-US if you move your needle to round the nerve you could injury structures with me needle movement because of the contractions.

Furthermore, in some cases using NS a satisfactory muscle response could not be obtained within five minutes from the time the needle had entered the skin. The ultrasound end point was associated with a reduction in needle under the skin time and procedure-related pain. The US end point reduced needle time under the skin by 30 seconds³. However, combined ultrasound and neurostimulation guidance does not decrease block time. Procedure-related pain was also reduced in the catheters placed using an ultrasound end point. This may have been due to reduced needle manipulation and/or the avoidance of motor stimulation.

It has been previously shown that perineural catheter placement with US-only needle positioning is a feasible alternative to the NS technique. It is confirmed that with a commonly used needle approach for interscalene catheter placement, the absence of an evoked muscle response at 0.8 mA does not exclude close interscalene catheter placement needle-to-brachial plexus proximity. A key element of the catheter placement technique involved the elimination of the 0.2-mA minimum threshold current as a generally accepted marker of possible subepineural needle placement⁴. Even more, successful NS guided infraclavicular block is dependant on obtaining a distal stimulation, which may be difficult in 5%-21% of patients and occasional failures still occur despite adequate stimulation. Ultrasonic visualization of local anesthetic spread as a new end point for injection, published series using this end point have obtained complete blocks in 90%-95% of patients and success rates for surgery approaching 100%. It may therefore be that neurostimulation is no longer required when performing US guided infraclavicular block; the visualization of appropriate local anesthetic deposition guarantees successful block⁵. US guided infraclavicular block is more rapidly performed and gives a brachial plexus block of better quality when neurostimulation is not used as the end point for injection. Combined experience of several thousand NS-assisted interscalene blocks, both with and without US guidance, is consistent with this anatomy in that a motor response in the forearm or hand is rarely elicited. In fact, in a recent prospective study of 300 interscalene blocks placed with US needle guidance but ultimately using an NS end point, there was not a single forearm or hand response observed⁶. Comparing patients receiving an interscalene perineural catheter for shoulder surgery using either ultrasound guidance with a nonstimulating catheter or NS with a stimulating catheter, performed in both groups by trainees, the results were the following: using ultrasound technique with nonstimulating catheter it takes less time compared with NS with a stimulating catheter and can produce equivalent results⁷.

Results: Other advantage about performing US-guided blocks resulted in significant decreases in procedural times when compared to NS. In a large clinical series that studied US or NS, 25 surgical anesthesia was achieved in 99% of patients in the US-guided group and 91% of patients in the NS group. Sensory block, motor block, and extent of blockade significantly improved in the US group when compared to the NS group⁸. Teaching regional anesthesia techniques to anesthesiology residents can be demanding. In relation with learning curve of ultrasound technique the results of a training model using cadavers indicate that trainees who are novices to ultrasound guided regional anesthesia require approximately 28 supervised trials with feedback to achieve competency in ultrasound needle visualization skills⁹. It has to be added the ability of a clinician to recognize inappropriate spread of local anesthetic and then correct needle position is important too and we must teach how to do it. On the basis of our results with inexperienced trainees, Thomas et al found that using US in guiding the interscalene approach to the brachial plexus significantly shortened the duration of intervals in conduction of the block and onset of anesthesia when compared with NS moreover, these times could have significant cost savings for the institution⁸. And for an anesthesiologist with experience establishing a conventional axillary brachial plexus block using a nerve stimulator, 15 ultrasound-guided axillary blocks are required before good results can be expected with the new procedure. But in this case, the anesthesiologist has been already experienced in neurostimulation, for how long has he been learning this technique? If it has been demonstrated US has higher success rates, shorter procedure and onset times, longer block duration, less painful procedure, useful for sensitive nerves, avoid puncture vessels, give information about the depth... why are we not teaching our trainees ultrasound and sonoanatomy in the first beginning and not wasting the usefull time of their career?

Sites and colleagues¹⁰ evaluated the learning curve of inexperienced residents in a simulated US-guided interventional environment and demonstrated that residents can rapidly learn and improve their speed and accuracy in US-guided simulations. The novel finding in this study is that in a training program with residents inexperienced in both of the techniques described,

the amount of experience and dexterity required to clinically master ultrasonography is not greater than that required for the NS technique. But obviously, as every technique to performance, both placement methods have an inevitable learning curve.

Conclusions: Staff must balance the didactic instruction requirements of the resident against risks of patient discomfort, complications, and increased time requirements to improve block success in the setting of a busy surgical schedule. Whether or not the use of US can improve practitioners' ability to successfully perform peripheral nerve blocks remains controversial. Several randomized controlled trials¹¹ have been conducted to compare these two modalities. These results suggest that US improves efficacy of peripheral nerve block compared with NS for nerve localization. The data for the US groups consistently showed higher success rates, shorter procedure and onset times, and longer block duration. Other variables examined by the studies included in this review such as the volume of local anaesthetic needed to produce a block, pain reported complications during block performance, number of needle passes required to complete block, percentage of procedures successfully performed on the first attempt, percentage of patients able to tolerate a tourniquet, and patient satisfaction; all favoured US in their individual analyses.

As Marhofer¹² said, the beneficial effects on cost and patient satisfaction can only be realized with an overall success rate for regional blocks of >98%. Good education and training is necessary to achieve this both laudable and achievable aim. Many anaesthesia meetings provide basic workshops that aim to arouse the interest of potential users of this technique. The anaesthesia community is at a very early stage in the development of guidelines for structured education in ultrasound. However, a universal agreement on how to teach ultrasonography for regional blocks is still lacking. A combination of basic and advanced workshops, and ongoing supervised practice, leads to the safe and effective performance of ultrasound-guided blocks. Only high-quality training and careful supervision of trainees and novices in the art of ultrasound-guided blocks will ensure that we can put the burgeoning technology to safe and effective use for our patients.

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PHARMACOKINETICS OF LOCAL ANAESTHETICS - BASIC KNOWLEDGE FOR SAFE CLINICAL PRACTICE

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Introduction: Essential knowledge of local anaesthetics includes understanding of the chemical and physicochemical properties of the molecules, their absorption, their disposition and their elimination. All of them are influencing, to a varying extent, the production of effective and safe nerve blocks.

The latest additions to our local anaesthetic family were levobupivacaine some 12 years ago and ropivacaine a few years earlier. No new molecules with useful local anaesthetic properties are presently expected, instead focus has been directed to some old local anaesthetics like 2-chloroprocaine (60 yrs old) and articaine (40 yrs old). Their rapid and short action may be suitable for day-case surgical spinal anaesthesia, and the latter one has already established itself for use in dental blocks.

The application of reliable concentration assay methods and use of mathematical models of the process of absorption and disposition of local anaesthetics in the beginning of 1970s (1) made understanding and teaching of local anaesthesia pharmacology an interesting subfield of regional anaesthesia.

This presentation is not aimed at being a comprehensive review, but it rather highlights certain relevant issues, and perhaps forgotten principles of local anaesthetic pharmacokinetics associated with side effect and toxicity issues in clinical practice of regional anaesthesia, i.e. issues of patient safety.

Absorption and disposition

The pharmacodynamic effects of local anaesthetics (clinical nerve block) can be observed easily, although not very exactly measured. Bulk flow, local absorption and diffusion are relatively unpredictable factors which vary from individual to individual. Therefore, blood (plasma) concentrations after a standard dose show large interindividual variation.

Today, ultrasound (US) guidance in the performance of peripheral nerve blocks allows the observation of a rough "bulk flow" after injection. However, until now a possible relationship between the bulk distribution and resulting blood concentrations of local anaesthetics has not been established. As known for a long time, local anaesthetic absorption into the circulation occurs most rapidly in richly vascularized anatomical regions, very fast from the upper airways, pleura and intercostal space, and slowly from lumbar epidural space, joints, etc. The absorption rate can easily be reduced by the addition of adrenaline (2.5-5 microg/ml) into the local anaesthetic solution. Diffusion of local anaesthetics (or of any drug) is a complex and an uncontrollable process, in general, but by manipulation of the ionization (pH) or lipophilicity (e.g., liposomal preparations) the spread by diffusion can be changed.

Blood (plasma) concentrations

Systemic toxicity due to absorption of local anaesthetics from the site of application cannot be extrapolated directly from animal studies. This is one reason why a toxic symptom-triggering concentrations of local anaesthetics

in man cannot be defined. Although the pharmaceutical companies give recommendations regarding maximum doses of local anaesthetics, such doses can only be regarded as rough guidelines because they do not take into account the considerable interindividual variability between the characteristics of patients (age, size, diseases etc.) (2).

Pharmacokinetic variables usually measured and reported are maximum total and free (protein unbound) plasma concentration (C_{max}) and the time when it occurs (T_{max}). A typical and often neglected detail in publications is lack of reporting whether samples have been taken from an artery or a vein (peripheral or central). For obvious reasons, the concentrations are lower in peripheral veins than in arteries (same in samples from any artery). Even central vein local anaesthetic concentrations may vary from those of arteries, because of lung uptake of drugs.

A rapidly occurring C_{max} indicates either direct inadvertent intravascular administration, or very rapid absorption in sites with a rich vascularity. T_{max} may vary considerably, and in our own studies values of 60 - 75 min have occasionally been observed when adrenaline has been included in bupivacaine or ropivacaine solutions for peripheral blocks.

Metabolism

Ester-linked local anaesthetics (tetracaine, articaine, 2-chloroprocaine) are inactivated already in tissues, and very rapidly after entering the blood by ester hydrolysis. Therefore, they rarely cause systemic toxicity. Articaine is an interesting local anaesthetic, nowadays favoured by dentists, because its basic molecular structure contains an amide-bond, but also an methyl-ester residue on the aromatic hydrophobic ring. Hydrolysis of this ester results in articaine acid, which lacks local anaesthetic potency. Neither articaine metabolites nor 2-chloroprocaine metabolites are known to be toxic.

The metabolism and metabolites of the amide-linked local anaesthetics have attracted much more attention, primarily from a toxicological viewpoint, but also because of the therapeutic and diagnostic potential of certain metabolites.

Only a small portion of local anaesthetics is excreted unchanged in urine. The main site of metabolism is the liver, but a small degree of extrahepatic metabolism has also been demonstrated, most recently also for ropivacaine (3). Among other metabolites formed, the deethylation product monoethylglycinexylidide (MEGX) is the major metabolite of lidocaine. MEGX retains almost similar local anaesthetic potency as lidocaine and, therefore, it may play an important role in the analgesic mechanism of action of intravenous lidocaine therapy for neuropathic pain. In addition, the assay of MEGX concentration in plasma after intravenous lidocaine administration is a validated laboratory test for liver function.

The otherwise rather safe amide-linked local anaesthetic prilocaine has, from its introduction in the mid-1960s been burdened by the risk of methaemoglobinemia formation. The oxidation of haemoglobin to methaemoglobin is caused by N-hydroxylation products of o-toluidine, one of the major metabolites of prilocaine, and can be clinically harmful already after doses of 300 to 400 mg for nerve blocks in adults (4).

A common metabolite of the amide-linked local anaesthetics mepivacaine, bupivacaine and ropivacaine is pipercoloxylidide (PPX). Other metabolites are produced by various pathways (mainly enzymatic hydroxylation), but the products formed are clearly less toxic than PPX, which in relation to ropivacaine is approximately 1/12 as systemically toxic. In renal dysfunction (5) and in long-term continuous infusion of ropivacaine formation and cumulation of PPX may significantly add to the risk of systemic toxicity of ropivacaine.

The chirality, i.e., stereoselectivity of the local anaesthetic molecules is known to affect cardiac toxicity, e.g., S(-)-bupivacaine is less cardiotoxic than R(+)-bupivacaine. Generally, however, pharmacokinetic parameters, e.g., metabolism, seem to be very little affected by chirality.

Protection of toxicity by alpha-1-acid glycoprotein (AAG)

Basic molecules such as the local anaesthetics are readily bound to a variable and unpredictable degree to AAG in plasma. The concentration of the unbound (free) local anaesthetic is a major determinant of systemic toxicity. It is important to realize that the fraction of local anaesthetic bound to AAG in plasma decreases when the total plasma concentrations increases, e.g., in severe intoxication. Thus, AAG has high affinity, but low capacity to bind local anaesthetic molecules. Albumin, on the other hand, has low affinity but high capacity. The concentrations of AAG (one of the acute phase proteins in plasma) may rise in various diseases, but the rise can be unpredictable. Generally, after major surgery elevated plasma AAG levels are seen for the first 3-7 days, thus offering some protection against local anaesthetic toxicity.

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CONTROVERSIES IN PEDIATRIC REGIONAL ANESTHESIA (PRA)

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PRA is to day an established technique, daily performed worldwide confirming its safety and efficacy (1) anyway for many years pediatric anesthesiologists had to defend their right to use RA in children against the criticism of "adults anesthesiologists".

Most of these problems are now finally solved but there are still controversies to face with when a pediatric paper and/or a pediatric lecture are presented in an "adult" contest.

One of the major obstacle to PRA was the supposed risk linked to the fact we have to sedate/anesthetize kids before performing the block: two techniques double risks? (2)

This criticism finally ended thanks to the data coming out from editorials, the PRAN, APA and ADARPEF surveys and recently by the ASRA recommendations: in children is safe to perform a block under anesthesia, both central and peripheral and the risk is indeed linked to the performance of a block in a crying, excited and moving child. (3-8)

Recently one paper published in *Pediatric Anesthesia* on a series of epidural blocks performed in awake infants using ultrasound for pyloromyotomy generated immediately an editorial (9,10); even if we use the ultrasound guidance general anesthesia before a block still remains our target to work safely.

It is of course necessary to have a different systems of control of ongoing mistakes (total spinal, inadvertent intravenous injection etc) as asleep children cannot tell us if something is wrong.

The use of a test dose with epinephrine is today considered not valid and reliable in children and in most of the published cases of Local Anesthetic Systemic Toxicity (LAST) the test dose was used but without any sign of iv injection underlining the lack of reliability of this test. (5)

The T-wave amplitude and ECG changes are now considered much more reliable in case of intravenous injection and thus a slow injection with time to time aspiration is the best technique to administer safely the drugs. (11,12) Moreover today the use of ultrasound can help in detecting an inadvertent intravenous bolus.

Convulsions can occur in case of LAST so it is our opinion that, to add safety to our blocks, to maintain a spontaneous ventilation can be useful along the block performance: the use of muscle relaxants can mask convulsions and/or the stop breathing due to LAST or total spinal (13). Intubation and muscle relaxation if needed can be performed at the end of the block performance as complications happen very shortly, in few minutes after an intravenous injection.

Another controversial topic is due to the compartment syndrome: can regional anesthesia mask the signs thus increasing the risk of nerve damages?

The compartment syndrome is a complication due to the compression (ie hematoma) in a closed compartment (muscles) causing limb ischemia. Many orthopedic surgeons do not like blocks for arm or leg fracture for the fear of a masked syndrome and indeed a too deep block can cover even the

excruciating pain of ischemia which, together with pulselessness, pallor, paresthesia, is a warning sign of the compartment syndrome. There are no data confirming that regional anesthesia in children can delay the diagnosis but in any case there are some precautions that can be applied avoiding any risk (13):

- a. use a low local anesthetic concentration: it gives a good perioperative pain control but without motor block and without covering the pain due to ischemia.
- b. use ultrasound guided regional anesthesia: it allows the reduction of both the dose and the concentration of local anesthetics.
- c. monitor the postoperative period: if after few hours pain is no more controlled by usual pain killers and there is a reappearance of a dense sensory and motor block then a compartment syndrome must be suspected and an intramuscular measurement should be applied.

An early diagnosis can avoid any risk and regional techniques can be routinely used.

Last but not least is the discussion of loss-of-resistance technique with air or saline for detecting the epidural space. (1) Once again the data of damages due to air come mostly than from a strong evidence-based impact: It is important to use only one ml of air and just to feel the change of resistance without injecting it and same attitude should be applied with saline (the injection of many mls of the solution can dilute the low dose of local anesthetic in a newborn or infant).

In conclusion safety rules must be applied to the techniques we use combined with experience and good common sense as many times it is not a problem linked to the technique itself but to the wrong use of it. We do hope in the future thanks to new devices like ultrasound, new ultrasound-visible needles and catheters, new researches on drugs and neural damages and the importance of lipid emulsions as rescue drug can bring more safety and success to our blocks.

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REGIONAL ANAESTHESIA IN ACUTE TRAUMA. ONLY IN THE HOSPITAL? TREATMENT OF SEVERE CHEST TRAUMA

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Regional anaesthetic techniques are well established as part of a peri-operative multimodal pain concept. Sufficient Analgesia can be maintained for days by means of continuous techniques. Nevertheless, in particular peripheral nerve block techniques seem quite underused in the ICU patient at the moment. The trauma patient in the ICU shows a variety of injuries providing a source of severe and disabling pain. In our current understanding, severe post-traumatic pain has shown to be a major risk factor for chronification and prolonged morbidity.

Chest injuries are frequently seen in trauma victims and show a major source of morbidity and mortality in this group of patients. The most common cause are motor-vehicle accidents (1). Approximately 33% of blunt trauma patients have a thoracic injury (1). Twenty-five percent of trauma deaths are estimated secondary to chest trauma (2). The mechanisms are complex and varied (blunt versus penetrating) generating a complex pattern of injuries. Injuries of the chest wall itself as part of the musculoskeletal system (ribs, muscles, ligaments) can occur alone or in combination with injuries of the lung and adjacent structures (pleura, vessels). Surgery, chest drains and mechanical ventilation account for additional impact.

Severe pain in patients with chest injuries is the primary a symptom but also a problem per se. Pathological breathing patterns due to pain limit respiratory therapy as a main part of medical care. Weaning from mechanical ventilation is frequently limited by chest pain in the ICU patient. Formation of atelectasis and subsequent pneumonia is a common problem particularly in older patients. Holcomb et al. (3) identified an age >45 years and more than four fractured ribs as risk factors for increased morbidity. Bulger et al. (4) found that patients with fractured ribs >65 years had twice the mortality when compared to younger patients. This highlights the need for adequate pain control to provide efficient respiratory therapy and early mobilisation. The use of opioids is limited to some extent as they may cause respiratory depression and over-sedation. Subsequent hypoventilation, formation of additional atelectasis and aspiration are undesired side-effects in the patient with chest injury. Regional anaesthetic techniques block somatic pain effectively and have shown to influence outcome in this group of patients. Carrier et al. (5) performed a meta-analysis to investigate the use of thoracic PDA in patients with traumatic rib fractures. Although they found a benefit concerning duration of mechanical ventilation there was no difference in overall outcome (mortality, hospital LOS, ICU LOS). A limitation of this meta-analysis is the relative small sample size of the included studies. The use of thoracic paravertebral block (TPVB) has gained renewed interest over the last years. In terms of efficacy it is comparable to thoracic PDA with lower complication rates (i.e. hypotension)(6, 7). Moreover, the performance of a TPVB seems to be easier than a thoracic PDA (6). Clinicians often refuse the performance of TPVB due to the possible complication of pneumothorax. It has to be emphasised that the majority of patients with severe chest injury present with pneumothorax that requires drainage. This complication is best avoided when a proper technique is used to approach the thoracic paravertebral space (8). Depth of the paravertebral space can be obtained from CT-scans that should be available in a patient with chest trauma. Anticoagulation or clotting abnormalities have to be managed equally be it for thoracic PDA or TPVB. Intercostal blocks can be used to treat pain caused by isolated rib fractures as well as pain caused by chest drains, etc. The use of interpleural blocks/catheters has decreased since TPVB/PDA provide a better quality of pain relief.

In summary, regional anaesthetic techniques provide superior pain control in patients with chest injuries and show beneficial effects concerning duration of mechanical ventilation and the rate of respiratory complications. The actual number and size of studies is too small to gain more evidence

on that indication. Nevertheless, clinicians should be encouraged to use the mentioned techniques in this challenging group of patients as it is recommended for surgical patients (7).

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INTRAPERITONEAL NEBULIZATION OF LOCAL ANESTHETICS FOR POSTOPERATIVE ANALGESIA: THEORY, PRACTICE AND FUTURE TRENDS

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Background: Nebulization of local anesthetic has been recently introduced as a method for postoperative pain management in laparoscopic surgery. Video-assisted surgical techniques have reduced biological consequences of surgical trauma compared with open surgery; despite this, some patients still experience severe pain and may need analgesia with strong opioids¹. Moreover, in several studies 35% to 63% of patients reported shoulder pain after gynaecological laparoscopic surgery².

Pain associated with laparoscopic surgery is caused by two different nociceptive stimulus: one from viscera lesions (visceral pain) and one from wall stimulation (nociceptive pain), due to skin lesions for trocars positioning. Visceral pain could also be caused by changes of intra-abdominal pH, humidity linked to CO₂ pneumoperitoneum and/or possible gas retention at the end of procedure.

The inadequate relief obtained by traditional analgesia, i.e. NSAIDs and opioids, can be explained because these drugs act only on incisional pain, while they have little effect on visceral abdominal pain (typically referred by patient as shoulder tip pain), which represent the major component of postoperative pain in this category of patients³⁻⁷.

Hence, despite all the benefits that have come with the introduction of minimally invasive surgery, postoperative pain, particularly shoulder pain, remains an issue and many authors suggested to control this pain blocking visceral nociceptors with local anesthetics through intraperitoneal instillation or, more recently, nebulization of local anesthetics.

Intraperitoneal instillation of local anesthetics: Studies evaluating intraperitoneal local anesthetic instillation for pain relief after laparoscopic cholecystectomy have provided conflicting results, probably due to several factors: different instillation site (e.g. subdiaphragmatic versus subhepatic administration) or timing of administration (preoperatively versus postoperatively), different local anesthetic dose and concentration, different perioperative analgesic regimens. However, systematic reviews of randomized controlled trials evaluating the role of intraperitoneal local anesthetic instillation during laparoscopic cholecystectomy demonstrated a significant reduction in both postoperative pain and analgesic consumption⁸⁻¹⁰.

The most important reason for instillation technique's failure could be the inadequate distribution of local anesthetic throughout the peritoneal surface. To avoid this problem, new techniques aimed to allow the distribution of the drug throughout the whole peritoneal cavity have been studied¹¹.

Intraperitoneal nebulization: a new concept: Intraperitoneal nebulization has been reported to provide homogeneous spread of drugs allowing a better distribution throughout the peritoneum. The aerosol formed during nebulization is a suspension of fine liquid particles, which allows the drug dose to be dispersed through the entire peritoneal cavity, as well as to the most remote parts. Compared to intraperitoneal instillation, which is performed over a short period of time and in a limited area (i.e. gall bladder bed and surrounding area), intraperitoneal nebulization is performed over an extended period throughout all the abdominal wall surface.

This technique combines the analgesic benefits of local anaesthetic instillation and the effects of gas conditioning. The physical properties of insufflated gas including temperature and humidity may be a cause of postoperative pain. Dry and cold gas was found to increase visceral pain following laparoscopic procedures. The use of heated and humidified gas may produce positive effects, such as reduction of postoperative pain¹²⁻¹⁴. The same level of heat loss prevention was obtained with cold humidification of insufflating CO₂ than with warmed humidification of the gas¹⁵⁻¹⁶. Moreover, conditioned gas reduced superficial endothelial damage and inflammatory response in animal models; the use of heated humidified gas significantly reduces the response time of interleukin-1b and tumor necrosis factor¹⁶.

Technical features and clinical evidence of intraperitoneal nebulization

Alkhamisi et al. demonstrated that closed and pressurized laparoscopic environment enables aerosolized therapeutics to uniformly spread throughout the peritoneal cavity¹⁷. These authors used a custom-made nebulization system that included a syringe pump connected to the insufflator with a double-lumen catheter that is introduced into the abdomen through a port featuring a special introducer to prevent gas leak; obviously, the limit of this device consists in precluding this approach to be used during surgery. The same group used this method to administer bupivacaine 50 mg at the end of laparoscopic cholecystectomy and were able to show a significant reduction in pain scores, postoperative opioid requirements, incidence of vomiting, and time to ambulation compared with bupivacaine instillation into the gallbladder bed¹⁸. The same group reported that aerosolization technique was effective also in bariatric patients undergoing elective laparoscopic Roux-en-Y gastric bypass and could be used in other laparoscopic operations such as laparoscopic colorectal resection¹⁹.

Other devices, basing on mechanisms different from aerosolization, were developed to allow intraperitoneal delivery of local anesthetics. The Insuflo device consists of an insufflation tube with a small warming chamber where water or local anaesthetics are injected. The tubing also has an attached cable that is connected to a separate reusable box. Controlled electrical current warms a heating element in the chamber and the insufflated gas is subsequently warmed. Vaporization of local anesthetics with Insuflo device (Lexion Medical, St. Paul, MN) did not produce significant improvement on pain control after laparoscopic procedures because local anesthetics are vaporized and, essentially, distilled, resulting in decreased intraperitoneally bioavailability¹⁹.

Aerosolization seems a valid alternative to vaporization. In order to evaluate the efficacy of aerosolization of bupivacaine in pediatric patients, Freilich utilized a steril mucosal atomization device to administer a fine mist of bupivacaine into the peritoneal cavity during robotic-assisted laparoscopic pyeloplasty²¹. The system was then improved with a new tool that could guarantee a real uniform aerosolization of the local anesthetic (Aeroneb Pro®).

The Aeroneb Pro® (Aerogen, Galway, Ireland) is a high frequency vibrating membrane nebulizer, which is commercially available, reusable and easy to assemble, and can be placed in series with the insufflation tubing and does not need a separate tubing or injection system or driving gas. An *in vitro* study reported that the microvibration-based aerosol humidification device, the Aeroneb Pro® system, approved for inhaled drug administration in

pediatrics, is the only humidification device that could be used for local anesthetic delivery into the insufflation gas during laparoscopic procedures, because it allows to deliver significant amounts (89.1%-94.3%) of ropivacaine²²⁻²⁵.

Compared with placebo, nebulization of ropivacaine 30 mg with the Aeroneb Pro system either before or after laparoscopic cholecystectomy reduced postoperative pain as well as completely prevent shoulder pain. Patients receiving ropivacaine nebulization consumed significantly less morphine than those in the control group and mobilized quicker than those receiving placebo²⁶.

Using the same nebulization method, patients receiving Ropivacaine 30 mg before or after surgical stimulation reported significantly less postoperative pain, less morphine consumption and walked without assistance during the first 24 hours after gynaecologic surgery comparing to those receiving ropivacaine instillation²⁷.

Recently, intraperitoneal nebulization of ropivacaine before and after laparoscopic cholecystectomy using the Aeroneb Pro® system was compared with intraperitoneal instillation of ropivacaine 100 mg. Ropivacaine nebulization before and after surgery was associated with reduced shoulder pain and unassisted walking time but with an increased incidence of postoperative vomiting²⁸.

Previous studies evaluating intraperitoneal local anesthetic administration for pain relief after laparoscopic surgery have suggested that the timing of local anesthetic administration may be critical in the success of the technique. After surgical insult, a pro-inflammatory cytokine cascade in the peritoneal cavity, with direct action on the visceral afferents, is feasible contributor to visceral pain perception²⁹. Moreover, is documented that intraoperative nociceptive input contributes to the amplification and prolongation of postoperative pain, so the better choice for pain relief is to prevent the establishment of central neuronal sensitization before any noxious stimulus is triggered³⁰. It is possible that afferent block with intraperitoneal local anesthetics performed before surgery may modulate peritoneal and visceral signaling to the CNS, thereby possibly attenuating the impact of surgery and preempting chronic pain.

Actually, clinical benefits of preoperative ropivacaine nebulization, compared with postoperative administration, remain controversial, while the duration of analgesia after both pre and postoperative nebulization was significantly longer (up to 48 hours) than the clinical duration of ropivacaine³¹, suggesting both preoperative and postoperative neural inputs to participate to postoperative sensitization. What is still unclear is which is the best dosing regimen; for this reason our research group is conducting a trial to evaluate if a larger dose of local anesthetic allows better efficacy.

Major problems and open research issues: Nebulization has the potential to be a simple, effective and inexpensive intervention in the perioperative management of patient undergoing laparoscopic surgery. Nebulization may allow the anesthesiologist to decrease the amount of anesthesia during laparoscopy, thereby allowing the patient earlier recovery.

Unfortunately, nebulization reduces visibility, which makes difficult its use during surgery, and can result in additional operative time and expense. This delivery method generates a "foggy" environment that may interfere with the surgeon's vision, but it lasts only for 3-5 minutes; moreover, the use of a silicone tubing reduces the amount of local anesthetic delivered, which could be due to condensation of the local anaesthetic on the tubing wall¹¹. Advancements in nebulizing machine could solve this problems.

Finally, better acknowledgements is needed about side effects and pharmacokinetics of local anesthetics administered intraperitoneally. The possibility of a specific pattern of absorption of the drug when nebulized in the pneumoperitoneum is not supported by animal data and no symptom possibly related to local anesthetic toxicity was observed in any of the studies about nebulization. An animal study found that intraperitoneal ropivacaine nebulization has a pharmacokinetic profile similar to ropivacaine instillation^{5,32,33}. Furthermore, the free plasma concentrations observed were significantly lower than those reported to be toxic.

Anyway, all these results need to be confirmed on humans, also considering surgical insult and its effects; it is possible that tissue damage influences drug absorption (the larger the damage, the higher the absorption) relating to an increased uptake by vascular system.

Conclusions: Recent findings and data from clinical trials seem to confirm the real benefits of nebulization in postoperative pain control after laparoscopic surgery: this technique was demonstrated to be superior not only on placebo but also on instillation, and technical improvements allow a its more extensive use during clinical practice. Nevertheless, many open issues remains about this technique. Future studies should determine the optimal dose

of local anaesthetics to be nebulized and the effect of local anaesthetic nebulization in different clinical settings. Moreover it should be mandatory to determine both the pharmacokinetic profile of nebulized ropivacaine and the peritoneal concentration achieved by the drug. Our group is studying some of these issues, with the aim to find the best profile of efficacy and safety for this technique.

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ONLY SYMPATHETIC NERVE BLOCK IS NECESSARY FOR POST-OP PAIN RELIEF

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Background and aims: The treatment of acute pain through regional anesthetic techniques relies on the blockade of sensory afferents by local anesthetic agents and certain adjuvants. But what if the so called side effect of sympathetic blockade is not a side effect but in reality the major source of analgesia in the acute phase of pain transmission? What do we know about the use of sympathetic blockade in acute pain? Is our understanding blinded by our education?

Conclusions: Acute pain post trauma is mediated through not only the sensory afferents but also the sympathetic nervous system and blockade of this may increase the analgesic efficacy of regional anesthesia and decrease the incidence of chronic pain. Only sympathetic nerve block is necessary for post-op pain relief.

When we think of directed sympathetic blockade, in the setting of acute pain, there is very little described in the literature bar a few case reports^(1,2). The majority of the published data is for the management of conditions such as post herpetic neuralgia^(3,4). In the minds of most clinicians there is an automatic disconnect between acute and chronic pain. Whilst we recognize that acute pain may develop into chronic pain, the exact causalgia remains a topic of debate. What is generally accepted is that acute pain is mainly a somatic sensory derived phenomenon, while chronic pain relies on the activation of the sympathetic nervous system through a 'wind-up' phenomenon. This disconnect in the clinical setting has resulted in acute pain clinicians often referring to the development of sympathetic blockade after regional anaesthetic techniques as being a complication of the regional anesthetic technique used. Infact, rarely in the clinical practice of acute pain do we try and achieve sympathetic blockade. It is generally accepted that the practice of directed sympathetic blockade procedures generally to reside in the realm of the chronic pain physician.

But what if what we really want to achieve in acute pain is enhanced sympathetic blockade? What happens if sympathetic blockade is not a side effect, but a requirement in order to complete the analgesic efficiency of regional anesthesia? It is fact that the development of chronic pain starts with the initial insult and that the neuro-modulation process commences at this point. It is a fact that the sympathetic nervous system is involved in chronic pain. From this it should be inferred that the sympathetic nervous system is involved in the transmission of pain and it is equally logical to consider the sympathetic nervous system having a role in the transmission of pain in the acute stages of the pain process. Good control of pain in the acute phase has been demonstrated to lead to a reduction in the incidence of the development of chronic pain⁽⁵⁾. We recognize that blockade of the sympathetic nervous system in the chronic pain setting with local anesthetic agents can result in an analgesic profile that outlasts the recognized duration of action of the injected agent by days and in some cases by weeks, months or years.

There have been numerous articles advocating the use of thoracic paravertebral blockade in a variety of surgical procedures, but particularly in thoracic, breast and abdominal surgery⁽⁶⁾. This method of analgesia is currently a 'hot topic' at the many of the regional anesthesia courses including this ESRA course. It is recognized that the analgesic efficacy of paravertebral blockade may extend to days rather than hours that is expected from the pharmacodynamics of the drugs used. Part of this effect is the fact that paravertebral blockade, as with any regional anesthetic technique is not solely restricted in action to the site of injection, but rather has a wide ranging dynamics of action.

There is always extension of action of the drugs used beyond their intended target site by systemic absorption, lymphatic spread and direct spread to adjacent structures. The systemic and lymphatic spread results in centrally mediated effects of the local anesthetic agents. This process has in recent times been the subject of renewed interest, with the reappearance of articles on intravenous lignocaine infusions being described⁽⁶⁻⁸⁾. Within the paravertebral space, the localized extension of the local anesthetic agents would also involve some spread, laterally to involve the intercostal nerves and the pleura and medially towards the epidural space. This extension is usually limited and partial in extent. Any injection of local anesthetic in the thoracic

paravertebral space would invariably involve blockade of the sympathetic chain. The extended duration of action obtained may be explained by the blockade of the sympathetic nervous system and the fact that this blockade produces extended analgesia.

Our interest in the sympathetic nervous system and its affect on acute pain arose from our work on the TAP block. With this work we demonstrated an analgesic profile that out-lasted the duration of action of the drugs used. This was at variance with the pharmacodynamics of the drugs used⁽⁹⁻¹¹⁾. This was further complicated by the introduction of ultrasound, where there were discrepancies in the effectiveness of the TAP block described, depending on the approach used^(12,13). The initial concept of the TAP block was that it worked by providing a field-like block of the sensory afferents within the transversus abdominis plane. There was however a discrepancy between the analgesic and demonstrated paraesthesia levels obtained. At this time we could not provide an answer for this. Work on the presence of plexi within the transversus abdominis plane helped provide something in terms of explanation for this discrepancy⁽¹⁴⁾. However the injection of local anaesthetic within the TAP plane irrespective of the site should provide similar analgesic benefits once the needle endpoint is confirmed. However the introduction of ultrasound into the performance of the block resulted in the publication and clinical observation of different patterns of block than that of obtained with the classical landmark based approach using the lumbar triangle of Petit as the reference point.

When we investigated why different needle insertion points resulted in differing patterns of analgesia we observed very different patterns of spread for the landmark and ultrasound approaches using the lumbar triangle of Petit than those observed with the mid-axillary and subcostal approaches. Unlike the more anterior approaches the classical TAP and posterior ultrasound approaches resulted in a localized field like block but interestingly proximal spread to the thoracic paravertebral space. It was also noted that at 6-8 hours post blockade, there was no evidence of local anaesthetic solution within the paravertebral space⁽¹²⁾. This again gave us pause to think, for sure we can still have drug bound to the receptors, but the analgesic effect should be related to the amount of drug present. If there was no real clinical evidence of drug being present, in-terms of radiological evidence or clinically evident paraesthesia, the analgesic benefit should be minimal. Nonetheless, as described, the TAP block provided an analgesia window stretching into days and not hours as expected.

The presence of the sympathetic chain in the thoracic paravertebral space seemed to be the only real point of potentially providing the analgesia as described. This tied into what was clinically evident with thoracic paravertebral blockade, whereby single shot injections were providing analgesia for periods that extended beyond the pharmacodynamics associated with the drugs used. Blockade of the sympathetic nervous system may influence the development of pain in the acute setting in a number of different ways, firstly by decreasing the sensitization of nerves to released substance P and other chemotactic or chemical mediators of pain and secondly by its effect on the descending medullospinal inhibition of nociception through the agonistic effects of nor-adrenaline and on α_2 receptors⁽¹⁵⁾. The idea that sympathetic blockade could be of benefit in acute pain, while not new, has really not been explored to any major extent as is evident in the peer reviewed journals.

With this in mind, we decided to see if acute pain is modified by sympathetic blockade. The problem was to identify a means of isolating the sympathetic nervous system from the sensory afferents. In order to achieve this we performed blockade of the stellate ganglion under ultrasound imaging, with a small volume of short acting local anaesthetic agent (3mls Lignocaine 2%)⁽¹⁶⁾. By doing this we would avoid any potential prolonged sensory spread to the related sensory afferents and also, if we obtained stellate ganglion blockade, the inhibition of the sympathetic fibers should provide blockade patterns similar to that found with chronic pain blockade with local anaesthetic agents only. When we performed our case series to test our hypotheses we expected some degree of analgesic but the extend of the analgesia obtained relative to the severity of the insult was quite dramatic, when used as a part of a multi-modal analgesic regimen. The demonstration of impressive analgesic impact of blockade of the sympathetic nervous system in acute pain was unexpected. While of low power in terms of publishable data, the clinical applications, of this data, was of major importance. This data obtained was at odds with the wider clinical recognized role of the sympathetic nervous system in acute pain and required further exploration in randomized controlled trials. This has been completed at our centre and is in the process of presentation to peer reviewed publications.

What we can say, from the case series, is that we really need to explore the current understanding of the acute pain pathways, this is particularly true in the setting of the trauma patient. This is at odds with our current concept of pain and therefore our approach to pain and in particular acute pain management. The current concepts of neuro-modulation and the development of chronic pain may also require revisiting, especially if the follow up research, that has already begun in response to the case series, demonstrates a beneficial effect to early sympathetic blockade in the development of chronic pain in the post-operative patient. The sympathetic nervous system has a role not only in the management of chronic pain, but also in the management of acute pain in a wider setting than is currently accepted.

There is some question as to the benefits in the patient population in which the wind up process has not commenced and therefore its role as part of a multi-modal analgesic regimen in the everyday setting. We believe that the maximum benefit to be obtained with the blockade of the sympathetic nervous system is in the patient in whom a major insult has occurred, similar to the trauma patients described in our studies. The presence of major trauma allows for possible early activation of the sympathetic nervous system, which may be targeted by selective sympathetic blockade. In our patient population the development of clinical signs of sympathetic blockade are no longer seen as a complication of sensory afferent nerve blockade but a welcome sign of comprehensive regional anaesthetic derived analgesia.

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UPDATE ON ULTRASOUND GUIDED INFRACLAVICULAR BLOCK AND SUPRACLAVICULAR BLOCK: HOW TO CHOOSE?

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Brachial plexus blocks can be performed at different sites to tailor anesthetic and/or analgesic requirements of patients. After the introduction of ultrasound (US) supraclavicular (SCB) and infraclavicular (ICB) blocks have become more popular and much more commonly performed during daily clinical practice. Although these two techniques seem to be quite similar still there are differences that should be taken into consideration before choosing SCB or ICB.

Anatomy: SCB is performed above the clavicle, at the level of the distal trunks and origin of the divisions, where the brachial plexus is confined to its smallest surface area. Brachial plexus at this level lies just lateral and superior to the subclavian artery. Lower trunk and its divisions are in close contact to the artery. Therefore it is recommended to insert the needle in the proximity of lower trunk and its divisions to increase the chance of blocking C8-T1 dermatomes (1).

ICB is performed below the clavicle, at the cord level of brachial plexus. The axillary/subclavian artery is surrounded by three cords. The axillary vein lies adjacent to the artery and positioned caudally. These three cords - lateral, posterior and medial - are named according to their relative position to the artery. The anatomy of the plexus varies widely among individuals. The MRI study of Sauter (2) revealed that the cords were found within 2 cm from the center of the artery approximately within 2/3 of a circle. With reference to a clock face the cords are distributed between III and XI o'clock. Considering all volunteers, an average point with shortest distances to all cords was found at VIII o'clock, close to the artery, in the cranioposterior quadrant.

History: SCB was first reported by Kulenkampff in Germany in 1911. Kulenkampff has later reported a large case series without major complications in 1928 (3). Yet the close proximity of plexus to pleural dome and the medial needle orientation was associated with the risk of pneumothorax. The risk of pneumothorax resulted in avoidance of SCB in many centers unless there was a special experience of the practicing clinician in SCB. Like any other block there has been many modifications of the technique to improve the safety. Introduction of US guidance has been probably the most important improvement responsible for the renewed interest in SCB (4).

ICB was first described by Bazy (5) in 1914. Although the technique had a long history, Raj (6) modified the technique and reported a high success rate using a nerve stimulator in 1973. Since that time, many approaches, which differ in the site of needle entry and/or needle direction, have been described. Following MRI studies Klaustad (7) has suggested that ICB can be accomplished by the 'lateral sagittal route' [lateral sagittal infraclavicular block (LSIB)] with ease and low risk of complications, such as pneumothorax or vascular puncture. In this technique, it is easy to palpate the bony landmarks -clavicle and coracoid process- even in obese patients. Using LISB the single injection technique is well accepted by patients and had fewer adverse effects than an axillary block by the multiple-injection technique (8). US guidance has further improved the success and safety of the ICB.

Distribution of the block: ICB is an upper extremity block that provides complete anesthesia below the shoulder. LSIB resulted in more complete anesthesia compared to axillary block. Musculocutaneous nerve is also blocked and patients do not experience tourniquet pain (8).

SCB results in anesthesia or analgesia of the entire upper extremity distal to the shoulder including upper arm, elbows, forearm, wrist and hand. Liu et al. (9) have reported that using a relatively high volume (mean volume of 50 ml local anesthetic) SCB could provide effective anesthesia even for shoulder surgery.

Although some studies reported similar success rates for ulnar nerve block in other studies ulnar nerve block was less efficient in SCB group (10-11). On the other hand axillary nerve is better anesthetized in the SCB group, which is clinically important for shoulder surgery.

Ultrasound Guidance: Although LSIB was first performed using nerve stimulation (NS), it is a technique very suitable for US guidance. Important anatomic structures include imaging the axillary artery and the three cords of the brachial plexus posterior to the pectoralis minor muscle (Figure 1). Using a linear probe big and pulsatile axillary artery could be easily identified. Brachial plexus cords that surround the artery look hyperechoic and can be identified with high resolution US machines. Yet, sometimes a difficulty can be encountered seeing the posterior cord, which lies behind the artery and can be confused with the sonographic shadow/artifact that lies behind the vessel. In obese patients where the depth of the plexus is increased convex/micro-convex probes could be helpful. Comparative studies have revealed that US guidance further increased the block success rate up to 95% (12-13). US guidance also reduced vascular puncture incidence from 20% to almost nil (12-13).

In addition to high success rates, improved patient safety and comfort, US guidance has provided certain advantages that allow the technique to be used in many instances where it would not be clinically feasible with NS alone (14-16).

A 22G, 80mm block needle is used during block performance. The needle is directed in-plane with the US probe, and aimed towards the cranioposterior part of the axillary artery. Because previous MRI study has shown that an injection site that would be closest to all cords was around 8 o'clock position, the needle tip is positioned close to the recognizable cords around 8 o'clock position (2). The visualized *local anesthetic (LA) distribution* should be considered sufficient when it reaches all identified cords or surrounds the artery in *U shape covering 3-11 o'clock* of the clock face. If spread is estimated as insufficient the needle should be redirected to provide a U-shaped LA distribution around the axillary artery. In adult patients, we typically administer 30 ml of local anesthetic (LA) mixture (20 ml of levobupivacaine 0.5% and 10 ml of lidocaine 2%). If bilateral block is planned we administer only 20 ml of LA for each site.

For SCB the patient is positioned in the supine or in lateral decubitus position, the head is rotated to the contralateral site, high frequency linear probe is placed over the supraclavicular fossa in a coronal oblique plane. The plexus appears most commonly like a bunch of black grapes. The subclavian artery ascends form the mediastinum and moves laterally over the pleural surface on the dome of the lung. The brachial plexus lies just superior and lateral to the artery (Figure 2). The pleura moves while the first rib does not move. A 22G, 50mm block needle is used during block performance. The needle is advanced using in plane approach in either medial to lateral or lateral to medial direction. Local anesthetic spread should cover all the brachial plexus components. In order to anesthetize the lower trunk, it has been suggested that most of the local anesthetic should be administered immediately above the first rib and next to the subclavian artery (1).

Another approach has been introducing the needle into the cluster of fascicles directly dorsal/cephalad to the subclavian artery, which most likely represents an intraneural (subepineurial) injection (17).

In a large case series Chan et al. have reported 94.6% success rate in US guided SCB (18). Plante (19) studied the influence of block site for SCB and have found that injection below C6 or above C5 results in a similar success rate.

Although due to very superficial location of brachial plexus at the supraclavicular area a high frequency linear probe would be the best to visualize the relevant anatomic structures, successful use of convex probes also have been reported (20).

In adult patients up-and-down sequential method found that 32 ml of LA was found as the MEV90 (21). The study performed by Duggan (22) has reported that 42 ml of LA would be required for successful anesthesia in 95% of patients. In our clinical practice we administer 30 ml of LA for supraclavicular block.

Depending on the technique used, dose of the local anesthetic and clinician's expertise in certain block, success rate can reach almost 100% for both blocks.

Catheter technique: Infraclavicular area is the best site of brachial plexus for catheter placement. Pectoral muscles keep the catheter in place, and therefore catheter dislodgment is not a major problem. Catheters are most useful for repeated surgery, daily debridement and painful complex surgeries like elbow surgery. During catheter placement we administer 20 ml of LA as described before. The needle tip is placed around 8 o'clock, and the catheter is further threaded about 2-3 cm beyond the tip of the needle. Different regimens (LA administration on demand, and/or continuous infusion via patient controlled analgesia pumps) using dilute LA concentration can be used for pain treatment. We typically administer levobupivacaine 0.125-0.25% either 5 ml continuous infusion or 5 ml bolus doses on demand. All patients with catheters should be followed at regular intervals and necessary adjustments should be made to optimize pain therapy and also to assess possible complications like infection, migration of the catheter, failure, and persistent motor or sensory block.

When ICB and SCB continuous catheters were compared for postoperative analgesia it was found that ICB group patients had lower scores and needed less rescue oral analgesic for breakthrough pain (23).

Complications: Vascular puncture with or without inadvertent LA toxicity is the most frequent complication described, although US guidance has dramatically reduced the incidence of this occurrence. Because ICB block is a relatively deep block- a noncompressible area- coagulopathy can be considered as a relative contraindication. Using color Doppler examination, vascular structures other than the subclavian artery (transverse cervical and dorsal scapular arteries) should be carefully scanned to choose the best needle insertion site and the path to avoid vascular puncture during SCB. (24).

Probably the most feared complication is pneumothorax in both SCB and ICB. Using US guidance the risk is much lower in both approaches to brachial plexus. Yet in both approaches the pleura is in close vicinity and the risk remains. Using US guidance there has been case reports of pneumothorax both in SCB and ICB (25, 26).

Respiratory function can be compromised during SCB performance in up to 50-67%. Renes et al. (27) reported that using US guidance with 20 ml of ropivacaine 0.75%, the hemidiaphragmatic paresis incidence was zero. On the other hand Koscielniak-Nielsen (11) using 0.5 ml/kg maximum 50 ml of LA reported significantly higher incidence of paraesthesia/pain on LA injection, 13% vs 37%, Horner's syndrome 0 vs 29% in the SCB patients. Other reports also support that the incidence of transient adverse events was higher in the SCB group.

Despite using lower doses of LA SCB may be still involved in respiratory difficulties therefore bilateral SCB should not be performed. On the hand ICB seems to be much safer for bilateral blocks.

Conclusion: Due to improved safety and success rates, US guidance have increased the interest in both SCB and ICB.

SCB would provide more successful anesthesia for upper part of the arm and ICB for the distal part of upper extremity. For catheter techniques, ICB seems to be more advantageous because the catheter dislodgment is less of a problem. Minor side effects or discomfort is more commonly reported in SCB compared to ICB. Although rarely needed when bilateral block are needed ICB should be the chosen.

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FIGURE 1. AA: Axillary (subclavian) artery, AV: Axillary vein. Cords of the brachial plexus look hyperechoic. Arrows indicate lateral, posterior and medial cords. Axillary vein can be compressed to some extent.

FIGURE 1. Pleura, first rib, subclavian artery and plexus can be visualized using a high frequency linear probe. SA: Subclavian artery, Arrows: Brachial plexus

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NERVE BLOCKS UNDER ANAESTHESIA: WHAT WE NEED TO DOCUMENT?

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Documentation has become an important issue of our daily practice. Documentation serves many tasks including patient consent, professional regulations like code of medical ethics, quality management and billing. Text books and legislative recommendations describe the execution to be meticulous and comprehensive. However, when concrete issues are discussed there is generally no in depth consensus.

Consent: Documenting the process of consent clearly depends on a legal and professional basis. Countries in which patient's autonomy is fixed in the constitution have developed the necessity to disclose risks, type of intervention, indication and alternatives. Moreover, patients need to understand the content and consequences. Disclosure of risks in particular have to take into account common as well as all serious complications regardless how likely its realisation may be. Crucial is only the relevance to the individual lifestyle. For example, the supreme court of Germany pronounced a judgement that the appearance of a cranial subdural hygroma or cranial hematoma formation after a lumbar puncture needs to be disclosed [1].

Risks: A survey by Brull et al. [2,3] involving academic fellowship program directors in the USA and ASRA members revealed that local discomfort, bruising, infection, Horner's syndrome, headache, transient and permanent peripheral neuropathy, paralysis, seizures, pneumothorax, respiratory failure, cardiac arrest and death is disclosed to a variable amount. However, published audits in the quality of documentation have so far not shown satisfactory results [4,5]. Risks of regional anesthesia in anesthetized patients.

Proponents of regional anesthesia on anesthetized patients argue that safety is increased because the chance that patients will move suddenly and

cause the needle to impale vital structures is decreased. Patient acceptance also may be increased and potential benefits will reach more patients. This arguing typically is used for regional blocks in the pediatric population. Opponents of regional anesthesia on anesthetized patients argue that important early warning signs which may potentially prevent systemic toxicity and nerve injury are absent assuming that stopping an injection may prevent further intoxication and that pain perception during needle advancement may prevent nerve damage if the needle is withdrawn. Both reasonings are unproven. Based on a literature analysis Bernards et al. [6] concluded that general anesthesia does not obscure systemic intoxication and does not increase the risk of nerve damage by peripheral nerve blocks. The authors recommended that in adults neuraxial blocks should be done in awake patients whereas in children the risks should be weighed against the expected benefits. Case reports suggested that interscalene blocks should not be performed in anesthetized patients regardless of the age. Other peripheral blocks on adults should not routinely be done on anesthetized patients and for children the placement under general anaesthesia may be appropriate after consideration of the risk-benefit-ratio. Meanwhile Terasako reported his personal experience in lumbar epidural catheter placement in anesthetized patients [7]. Also there were no neurologic complications in 4298 thoracic surgical patients undergoing lumbar epidural catheter placement while under general anesthesia [8].

Documentation standards in a network for regional anesthesia

In 2008 the German Society of Anaesthesiology and Intensive Care Medicine (DGAI) and the Association of German Anaesthesiologists (BDA) founded a network for safety in regional anesthesia [9]. Using a delphi process members of the scientific subcommittee defined relevant parameters to describe regional anesthesia for both the execution procedure similar to those available in the literature [10, 11] and the postplacement maintenance items. Among the some 180 items considered necessary are patient related factors like pain state, renal function and procedure related factors. The idea included the documentation of typically rare events like catheter related infections [12] and epidural hematomas [13]. Furthermore, data continuously collected can be used for benchmark analysis in order to improve outcome parameters. Documentation of analgosedation during block procedure included general anesthesia, analgosedated patients with depth of sedation or the unsedated fully awake patient. Out of 34,135 cases 2,654 were performed in general anesthesia and 19,360 blocks were documented in fully awake unsedated patients (Table 1, Table 2). On average anesthetized patients were younger, had lower ASA scores and more peripheral than neuraxial blocks.

	Anesthetised patients	Fully awake patients
No. of blocks/ catheter placements	2,654	19,360
ASA (mean)	1.77	2.19
Age (mean)	35.9	53.2
Neuraxial blocks (%)	38.7	73.8
Peripheral blocks (%)	61.3	26.2
Performance time (mean minutes)	13	19

[Table 1]

	Anesthetised patients	Fully awake patients
Abortion rate (%)	0.04	0.04
Primary failure (%)	0.64	0.76
Multiple attempts (%)	17.3	22.0
Bloody taps (%)	1.5	1.4
Epidural hematoma (n)	0	0
Intoxication (n)	0	3
Persistent neurological deficit (n)	0	0

[Table 2]

Anesthetized patients had similar block abortion rates, primary inefficiencies and bloody tap rates. Anesthetized patients seem to have faster block performance times and less skin penetration rates. There were no epidural hematomas or neurological deficits in both groups but three intoxications documented in fully awake patients.

Conclusion

Even though that many authors discourage from doing regional blocks in anesthetized patients, registry analysis seems to reveal that it may be common

practice. Currently no neurological complications were documented in a series 2,654 blocks in the network for regional anesthesia. Performance time seems shorter without increasing the risk of serious bleeding compared to the awake patient. Documenting essential details similar to those defined by our national society can help to improve systematic block performance, billing needs and legal issues. Fortunately prominent high impact events are rare. However if these occur, documentation of the consenting process, the actual block performance details and maintenance details is crucial.

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Background: Ischemic brain damage related to the beach chair position is a matter of concern. This study is designed to evaluate whether the beach chair position before and during regional anesthesia with conscious sedation differentially induces changes in cerebral oxygenation as assessed by near-infrared spectroscopy (NIRS) in patients for elective shoulder surgery in this position. Under general anesthesia, the beach chair position has been shown to alter cerebral oxygenation in patients showing normal preoperative cerebral oxygenation values. Therefore, even orthopedic surgeons recommend to monitor and optimize regional, cerebral oxygenation. A series of case reports reporting dramatic neurologic outcome in patients after shoulder surgery in the upright position has recently been published. The complications extended from cranial nerve injury to visual loss and cerebral infarction, occurring in relatively healthy middle-aged patients at low risk for cerebrovascular incidents. Although the exact pathogenesis of these events remains unknown, it is assumed that the beach chair position for shoulder surgery, may be responsible for above mentioned complications. On the one hand, the beach chair position may be associated with malrotation of the head resulting in mechanical obstruction of the cerebral vessels. On the other hand, it may induce unfavourable hemodynamic alterations leading to cerebral tissue hypoperfusion related to the gravitational effect of upright tilting. Moreover, shoulder surgery is often performed in general anesthesia with controlled hypotension, which might further compromise cerebral blood flow. These reports mandate that more caution should be paid to the effects of patient positioning on cerebral perfusion and indicate that in such circumstances routine anesthesia monitoring might not meet safety requirements. Near-infrared spectroscopy (NIRS) provides a non invasive and continuous method to measure cerebral tissue oxygen saturation. This technique has demonstrated to provide an early warning sign of cerebral hypoperfusion during procedures with high risk for adverse neurologic outcomes. Recently, cerebral oximetry monitoring using NIRS has proved to be useful to indicate cerebral hypoperfusion during shoulder surgery in the beach chair position. Fischer et al. reported a case showing causality between regional cerebral (capillary) oxygen saturation (rScO₂), mean arterial pressure (MAP) and end-tidal CO₂ (EtCO₂). Murphy et al. evaluated the incidence of cerebral desaturation during shoulder surgery in the beach chair position compared to the lateral decubitus position. They used a standardized anesthetic regimen aiming to optimize cerebral perfusion by maintaining MAP within 20 % of baseline values and controlling end-tidal CO₂ (EtCO₂) levels between 30 and 34 mmHg. In the cases of cerebral oxygen desaturation a standardized management protocol was used to increase rScO₂ values.

Beach chair position

For this position, the patient is placed on the "beach chair" table, in the supine position. The head, neck, and torso are supported in a neutral position by special straps and attachments. The patient is placed into 10° to 15° of Trendelenburg; flexed at the hips to 45° to 60°; and the patient's knees are flexed to 30°. Pressure points are padded, and the eyes and various aspects of the head are protected. The nonoperative arm is tucked, placed on an arm board, or placed in a sling. A portion of the back of the table can be removed for access to the posterior shoulder. In addition, an optional sterile arm positioning device (SPIDER Limb Positioner; Tenet Medical Engineering, Calgary, Alberta, Canada) maybe attached to the operative arm. It is well-known that the beach chair induces significant hemodynamic changes possibly adversely influencing cerebral circulation. Compared to the supine position, assuming the upright position decreases systolic and mean arterial pressure, stroke volume and cardiac output, inducing a cerebral blood flow decrease of approximately 12%. In non anesthetized conditions, these effects are compensated by an increase in systemic vascular resistance. However, during anesthesia this autonomic response may be attenuated or even blocked. The combination of the sitting position and general anesthesia might therefore potentially be deleterious for cerebral perfusion. Therefore, reports describing cerebral ischemia during beach chair position stress the risk of hypotension. It is often suggested that systemic MAP between 50 and 150 mmHg is within the range of cerebral autoregulation and therefore guarantee adequate cerebral perfusion. This assumption has been challenged because first, the concept of cerebral autoregulation is questioned as there seems to be a huge individual variability in the autoregulation limits. Second, blood pressure measured at the brachial artery does overestimate the actual pressure at the brain level during the sitting position due to the effect of gravitation. Some authors propose an arithmetic correction of blood pressures to assess blood pressure at the level of the brain (1 mmHg for each 1.25 cm difference in height between the external meatus and the middle of the blood pressure cuff). Third, cerebral perfusion pressure (CPP) not only depends on

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CEREBRAL OXYGENATION / CEREBRAL FUNCTION MONITORING IN BEACH CHAIR POSITIONING FOR SHOULDER SURGERY

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inflow pressure, but also on outflow pressure: CPP = MAP-CVP or CPP = MAP-ICP if ICP > CVP. In the upright position, jugular veins either partially or fully collapse, and the vertebral venous plexus becomes the main pathway for venous drainage. This flow through might be impaired during head rotation and head tilt. Additionally, it is thought, that older patients have an increased risk of cerebral desaturation, however, data by Gatto and Edlow, showed no difference in the response to position change with age. Anyhow, this point must be clarified also comparing different anesthesia regimen.

Controlled hypotensive anesthesia

Hypotensive anesthesia during orthopedic procedures performed with patients in the supine or decubitus position has been shown to be a safe and effective anesthetic technique aiming to reduce operative blood losses thereby helping to maintain a clear surgical field for procedures performed in an anatomic location where tourniquet control is not a valid option. Hypotensive anesthesia has been particularly helpful in hip arthroplasty, where total operative blood losses have been reduced by nearly 50%, in addition to significant reductions in operative times, without any evidence increase in perioperative morbidity. For arthroscopic shoulder surgery, studies indicate that a safe and clear operative field can be achieved by a pressure difference of 49mm Hg between the systolic blood pressure and the pressure measured within the subacromial space. Major concerns have been raised discussing the use of hypotensive anesthesia in patients positioned in an upright beach chair position. Pohl and Cullen reported 4 cases of ischemic brain and spinal cord injury after both open and arthroscopic procedures performed with patients in the beach chair position under controlled hypotensive anesthesia. They contend that the beach-chair position provides a unique risk for cerebral hypoperfusion. It is clear that if the patient is to be maintained in a state of relative hypotension (below his or her individual resting, conscious, baseline blood pressure) to assist with intraoperative visualization, the surgeon and anesthesiologist must be aware of an adequate blood pressure at the brain. This can be achieved by appropriately stratifying an individual's risk, obtaining blood pressure measurements at the contralateral upper extremity and adjusting for the difference in height between the point of measurement (arm) and the point of interest (head).

Near-infrared spectroscopy (NIRS)

To properly interpret NIRS data, it is necessary to understand the basic physical principles by which NIRS variables are derived. The technique is based on the transmission and absorption of near infrared (NIR) light (700-950nm) as it passes through tissue. In adults, NIR light cannot pass across the whole head, so the light source and detecting devices (the optodes) are placed a few centimeters apart on the same side of the head. This is called reflectance spectroscopy and allows examination of the superficial cortex. Oxygen and deoxygenated hemoglobin have different absorption spectra in the NIR and their relative concentrations in tissue can be determined by their relative absorption of light at these wavelengths. In a non scattering medium, where light travels in a straight line between source and detector. There is a linear relationship between the attenuation of light and the absolute concentration of the absorber of interest. However, in a highly scattering medium, such as biological tissue, both absorption and scattering of light contribute to its attenuation. Furthermore, multiple scattering events increase the optical path length of the light through the tissue, thus complicating the estimation of absorber concentration. It is important to note that NIRS measures all tissue within the field of view and, therefore, measures hemoglobin oxygenation in a combination of arterial, venous and capillary blood. The derived absolute cerebral oxygen saturation measured by NIRS represent 'tissue' oxygen saturation and can be used to identify cerebral hypoxia / ischemia.

Cerebral oximetry

Cerebral oximetry using near-infrared spectroscopy (NIRS) has been used in perioperative settings for more than a decade. Using similar principles as pulse oximetry, it determines the saturation of the cerebral (capillary) tissue (rScO₂). Using multiple wavelengths of near-infrared light, the differential absorption of this light by oxygenated and deoxygenated hemoglobin determines the overall saturation of the blood (a balance of arterial and venous, in approximately a 1:3 ratio) present within brain tissue. One clinical uses for cerebral oximetry is in cardiac surgery. Yao et al. reported the relationship between the degree of cerebral desaturation and functional brain outcome (defined by minimal status examination and other indices of frontal lobe function). Murkin et al. reported a trial of 200 patients using an interventional strategy to maintain the cerebral saturation signals within 75% of their baseline value, a management strategy further elucidated by Denault et al. They focused on optimizing both oxygen supply and utilization in the

brain. Following recording of the baseline reading, they introduced an interventional algorithm if the patient's saturation dropped 20% from their baseline. This intervention focused on ruling out mechanical causes for desaturation and followed with strategies to optimize oxygen supply to the brain. For example, PaCO₂ was returned to a normal level if patients were hypocapnic. Additionally, mean arterial pressure was increased as well as FiO₂. Although not powered to examine neurological outcome the Murkin study did demonstrate a trend toward stroke reduction using an oximetry-guided interventional algorithm. More interesting however, was the evidence, that there was a reduction in major organ morbidity. In a similar study, Slater et al. also studied the use of cerebral oximetry in cardiac surgery. In their study, half of their 265 patients undergoing cardiopulmonary bypass were randomized to oximetry-guided intervention, in the case of a drop in cerebral saturation (rScO₂) below 20% of baseline. Neurocognitive testing was performed preoperatively, prior to hospital discharge, and at 3 months. The most astonishing finding was the clear delineation of a significant cerebral desaturation value. The authors noted that an absolute value of 50% regional oxygen saturation was required before any adverse effect was observed in a patient. In fact, patients without a desaturation below an absolute value of 50% did not present with significant cognitive decline. With this discovery, a cerebral desaturation score was determined for each patient. This score was calculated by the following equation: $rScO_2 = 50\% rScO_2 - \text{current } rScO_2 (\%) \times \text{time (s)}$ and determined the time in which a patient spent under this critical threshold value of 50%. The analysis of these scores revealed that an rScO₂ score greater than 3000%-seconds correlated significantly with an increased risk of cognitive impairment.

Cerebral oxygenation monitoring for shoulder surgery

In my lecture I will give an overview of the current evidence of using NIRS for shoulder surgery in beach chair position and present some preliminary data of our research. Table 1 shows the most important studies and their main results.

Author	Main take home message
Tange K Minerva Anesthesiologica 2010; 76:485-90	BC has no impact on rScO ₂ if MAP is maintained > 60mmHg (heart level) in GA.
Murphy GS A&A 2010; 111:496-505	Lateral decubitus position favours rScO ₂ compared to BC in GA.
Lee JH Arthroscopy 2011; 27:889-94	Induced hypotension (MAP > 60-65 mmHg auditory meatus level) attenuates rScO ₂ in GA.
Moerman A. EJA 2012; 29:82-7	Postural decreases rScO ₂ are related to BP and etCO ₂ in GA. (BP at heart level, no induced hypotension)
Mc Culloch Anesth Intensive Care 2010; 38:486-491	Despite autoregulation in BC, CBF decreases when relative hypotension is induced in GA.
Soeding Anesth Intensive Care 2011; 39:440-448	CBF is maintained during GA and RA when MAP is above 70mmHg à autoregulation.
YaDeau Can J Anesth 2011; 58:986-92	Hypotension after BC in RA with induced hypotension (BD heart level) is common but rScO ₂ desaturation is rare.
Jeong Anesthesiology 2012; 116: 1047-56	S/N shows a greater margin of safety against impaired rScO ₂ compared to P/R; rScO ₂ might be not reliable detecting a low SjvO ₂ .

Table 1: Overview literature dealing with rScO₂ and shoulder surgery. BC: Beach chair position; rScO₂: Regional cerebral oxygen saturation; MAP: Mean arterial pressure; BP: Blood pressure; GA: General anesthesia; RA: Regional anesthesia; SjvO₂: jug. venous bulb O₂ saturation; CBF: Cerebral blood flow; S/N: Sevo/N₂O; P/R: Propofol/Remif.

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MONITORING SEDATION DURING REGIONAL ANAESTHESIA

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Sedation is a drug-induced state, characterized as a more or less altered mental condition of the patient. Sedation can be seen as a continuum from minimal drowsiness or plain anxiolysis to non-responsiveness and impaired ventilation, close to general anaesthesia. Therefore, the focus of the anaesthesiologist should be on ability of the patient to co-operate, to maintain his airway, and to breathe adequately. When planning the pharmaceuticals and intensity of sedation, the practitioner should take into account, not only the desires of the patient, but also the intraoperative safety issues, the course of recovery, and expected delay in street fitness after the procedure. In outpatient surgery, the intensity of sedation should naturally be shallower than in circumstances, where overnight stay is an option. Needless to say, sedation is not a solution, when regional anaesthesia appears to be incomplete or fully unsuccessful. Instead, surgical pain after regional anaesthesia should be treated with either repeated regional / local anaesthesia, or full-scale general anaesthesia, with adequate control of airway and breathing.

The drugs most commonly used as intraoperative sedatives are: midazolam or other benzodiazepines, propofol, dexmedetomidine, and ketamine. The use of benzodiazepines is usually associated with strong amnesia, but the inter-individual variability is large. These drugs do not possess any analgesic effects, and combination with opioids may lead to hypoxia due to impaired ventilation. Propofol can be given as boluses, continuous infusion or using patient-controlled devices. Like benzodiazepines, propofol does not have any analgesic effects, and it can be combined with either ketamine or opioids. Propofol is a potent sedative, with a risk of rapid, unnecessarily deep sedation. Dexmedetomidine is a novel α_2 -adrenergic agonist, offering sedation, anxiolysis, hypnosis, analgesia, and sympatholysis, associated with patent airway and adequate breathing. Although pricy, it is considered as 'an ideal' sedative. Ketamine offers patent airway, analgesia and amnesia, but because of the risk of psychotropic side effects it is only seldom given alone, but in combination with propofol or benzodiazepines.

During light to 'moderate' sedation, verbal co-operation with the patient is the most reliable method to monitor the course of drug effect. However, the deepening sedation (i.e., the transition from 'moderate' to 'deep' sedation) should also be detected, or even predicted. Electroencephalogram (EEG) based indices, like BIS or Entropy, are alleged to display the depth of sedation / anaesthesia on numerical 100-0 scale. With these monitors, some obvious shortcomings appear. First of all, they are tuned to function optimally during general anaesthesia, i.e. out of the range of meaningful sedation. The EEG monitors assume GABAergic (hypnotic) drug effect; therefore they are useful with propofol and perhaps with benzodiazepines, but not ideal with dexmedetomidine, and useless with ketamine, nitrous oxide, or opioids. These indices, opposite to general belief, do not directly indicate the "depth" of anaesthesia, but the drug effect on EEG, instead. The drug effect of an opioid on EEG is similar to the effect of propofol ('slow EEG'), but the use of opioid does not guarantee unconsciousness (1). Therefore, the EEG monitors are not reliable with all drugs used to sedate a patient. Moreover, the most common source of EEG artifact during sedation, frontal muscle activity (EMG), is not easily filtered from the real EEG signal. Frontal EMG appears during arousal from anaesthesia, external stimulation, or nociception. It may change the reading of an EEG index without a change in the state of the patient. Also the EEG itself may change paradoxically during nociception, leaving the EEG indices meaningless (2).

During adequate regional anaesthesia, a peripheral blockade of nociception is assumed. Therefore, the role of sedation is merely to comfort the anxious patient during surgery, and deep sedation is not needed. Even without nociception, frontal EMG is still commonly present during shallow sedation, and EEG indices are typically very high. As a rule of thumb, high EEG index is non-informative, while very low index value (below 40) indicates unnecessarily deep sedation.

To conclude, the present EEG indices are not designed to monitor the sedative portion of an anaesthetic continuum scale. High-quality regional anaesthesia, associated with very light sedation and verbal communication, is currently the premium method to follow the state of the patient. EEG index can be used to avoid unnecessarily deep sedation, as long as GABAergic drugs are used.

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LOCAL ANESTHETICS AND INFLAMMATION

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Peripheral inflammation following surgery activates and sensitizes both peripheral and central nervous system. These phenomena involved in the maintenance of the inflammatory response lead to hypersensitivity and hyperalgesia. Hyperalgesia participates in the general experience of postoperative pain and also in the development of chronic pain. A correlation between the ability of treatments to reduce areas of hypersensitivity surrounding the wound after surgery and their ability to reduce the incidence of chronic pain has been shown. Local anesthetics (LAs) have long been used for their capacity to block nociceptive input. They can also modulate the inflammatory response following a surgical traumatism. By inhibiting the nervous conductivity at the site of the trauma, local anesthetics attenuate the sensitization of the nervous system and therefore the inflammatory phenomena. They also exert intrinsic anti-inflammatory properties by modulating the local and systemic liberation of inflammatory mediators.

1. Anti-inflammatory properties of local anesthetics

a. IV administration

LAs have been shown to have an effect on inflammation (1). In experimental situations associated with a major inflammatory syndrome (i.e. endotoxin acute respiratory syndrome), LAs have a protective effect against inflammation. During ischemia reperfusion, LAs also reduce free radicals production. In models of inflammatory or thermal pain in healthy volunteers, LAs exert their protective effects by reducing secondary hyperalgesia, especially thermal. In clinical practice, the benefit of IV administration of lidocaine during colic (2) and prostatic (3) surgery is well demonstrated: These studies reported a morphine sparing effect associated with a reduced

postoperative pain as well as ileus recovery time, hospital length of stay, and nausea/vomiting (4,5). IV lidocaine also inhibits perioperative pro inflammatory cytokines production (6). IV lidocaine infusion is effective mainly in abdominal surgery populations. Some studies in gynecologic or orthopedic surgery and a meta analysis have not found any benefit of IV lidocaine (7,8). This could be explained by the specific tropism lidocaine seems to exert on intestinal muscle.

b. Perineural or perimedullar LAs

The benefit of perineural or perimedullar blocks on postoperative analgesia has been widely demonstrated. These techniques allow prolonged high quality analgesia. By reducing the sensibilization of the nervous system induced by the surgical traumatism, they also reduce hyperalgesia and postoperative morbidity in general (9). In example, Beilin et al. (10) showed that patients receiving an epidural mixture of opiate and local anesthetics exhibit reduced suppression of lymphocyte proliferation and attenuated pro-inflammatory cytokine response in the postoperative period. This anti-inflammatory effect is even more important when the epidural analgesia and therefore the blockade of inflammatory messages precedes the surgical traumatism. A prolonged sciatic block in rats can reduce hyperalgesia, edema and inflammatory pain (11). A perineural block has a double impact on inflammation and hyperalgesia. This effect is significant only for prolonged blocks. When compared with the effects of non steroidal anti inflammatory drugs (NSAID), a bupivacaine block alone can achieve the same anti-inflammatory effect as systemic NSAID or as when the same block is combined with NSAID (12).

c. A specific inflammatory situation: cancer

The evolution of cancer cells into metastasis depends on the immune activity and the neo angiogenesis. Surgical treatment of cancer is usually necessary but it can paradoxically aggravate the patient outcome by increasing the risk of recurrence. Many perioperative factors have been shown to contribute to the dissemination of the tumor: surgery itself, stress, inflammation, pain, anesthetic drugs, blood transfusion...etc (13):

- Surgery itself releases tumor cells into the circulation and depresses cell-mediated immunity including natural killer (NK) cells (14). It also enhances release of pro angiogenesis factors and of growth factors that may promote tumor recurrence both locally and at distant sites.
- Some anesthetics depress the immune system (15).
- Pain exaggerates the pro tumor effect of surgery.
- Opioids inhibit the immune functions in humans (16). Moreover, morphine has natural pro angiogenic properties and could favor breast tumor growth in rats.

Anesthesia, pain and perioperative drugs may exaggerate the pro tumor effects of surgery. Control of pain and inflammation has then to be a priority in the care of cancer patients during surgery. Experimental studies have shown that the addition of spinal blockade to general anesthesia attenuates the promotion of metastasis by surgery (17). The type of anesthesia chosen in the cancer patient could then be crucial and influence the evolution of the disease. Pre clinical and retrospective studies have suggested that a regional anesthesia associated or not with a general anesthesia for carcinologic surgery might reduce the risk of cancer recurrence (18)(19). However, prospective randomized studies are necessary before establishing any definitive conclusion on the role of regional anesthesia in preventing cancer recurrence.

2. Mechanism of action

a. LAs anti-inflammatory properties

LAs have intrinsic anti-inflammatory properties (1). They can modulate the inflammatory response. Indeed, ropivacaine can attenuate the inflammatory response in acute lung injury. Ropivacaine intervention substantially attenuated the inflammatory response in acute lung injury and thus may carry an interesting potential for anti-inflammatory treatment.

b. IV LAs

IV lidocaine reduces secondary hyperalgesia by a central mechanism (20). At a cellular level, lidocaine attenuates free radicals production, inhibits leukocytes phagocytis activity and endotoxemia-induced cytokines production. Lidocaine also acts directly on the intestinal muscle cells by inhibiting the neuronal reflex induced by a colic distension.

c. LAs and axon reflex

By blocking the nerve transmission and therefore the spread of the inflammatory message, LAs can attenuate neurogenic inflammation and its consequences: central sensibilization and hyperalgesia (21). Bupivacaine via a sciatic block, attenuate local inflammatory edema and hyperalgesia induced by hind paw injection of carrageenan in rats.

d. LAs and axonal transport

The local anesthetics lidocaine, mepivacaine and bupivacaine have been shown to block axonal transport in *in-vitro* preparations. This inhibition occurred at low concentrations about 100 times lower than the concentrations leading to sodium channel blockade. A recent study has shown that retrograde transport of TNF- α occurs after an inflammatory insult caused by the injection of carrageenan. A nerve block with bupivacaine totally abolishes the expression of the receptor in the dorsal root ganglion and the retrograde transport of TNF- α (22).

e. Cellular targets for LAs

LAs exert their action on many cellular targets different than sodium channels. Leduc et al (23) have reported antioxidant properties of bupivacaine on lipid peroxidation associated with inflammation in rats. Hollman et al. (24) have shown that LAs in clinically relevant concentrations inhibit superoxide anion production of PAF-primed human polymorphonuclear neutrophils. This study suggested a target site for LAs within a Gq-coupled signaling pathway.

LAs act on mediators involved in the inflammation signalization process, i.e. C kinase protein, prostaglandin E2 (PGE2), Mitogen-Activated Protein Kinases (MAPK), acetylcholine receptors, or N-methyl-D-aspartate (NMDA) receptors.

f. LAs action on prostaglandin E2 (PGE2)

PGE2 is the predominant neurotransmitter released after surgical trauma and has been associated with inflammation and pain. Human and animal data have demonstrated an increase in spinal PGE2 after peripheral inflammation positively correlated with pain. Animal models of peripheral inflammation have demonstrated an upregulation of spinal COX-2 (cyclooxygenase-2) with a subsequent increase in central PGE2 levels associated with the development of allodynia and hyperalgesia. The prevention of hyperalgesia by analgesic drugs is associated with the prevention of the changes in PGE2 concentration in cerebrospinal fluid (CSF) in animals. The inhibition of hyperalgesia and local inflammation by a bupivacaine block is associated with an inhibition of the increase in COX-2 expression induced by peripheral inflammation in dorsal root ganglions and cord. The subsequent production of PGE2 in cerebrospinal fluid is also impaired. (25).

Conclusion: The benefit of LAs is not restricted to their sodium channels blockade capacity. A peripheral nerve block inhibits local neurogenic inflammation and therefore sensibilization, hyperalgesia and pain chronicity. A nerve block is an anti-inflammatory treatment.

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CHRONIC POST SURGICAL PAIN (CPSP): FROM PATHOPHYSIOLOGY TO A BETTER MANAGEMENT

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Background: Although the clinical management of post surgical pain has improved significantly in the last years, persistent and chronic postsurgical pain (CPSP) continues to be a relevant clinical and social challenge; in fact, many patients after surgery have to continue to asking for medical consultations, even several months after the intervention, due this clinical problem (1). Even if CPSP has not a formal and definitive description yet, Macrae (2) suggests a four-point-definition: Pain that develops after surgery. Pain that lasts at least 2 months after surgery. Other causes of pain have been excluded. A pre-existing cause of pain has been investigated and, if possible, excluded.

EPIDEMIOLOGY: The general prevalence of CPSP (2,3) is difficult to access, precisely for several reasons due both to surgical procedures (the pathophysiology of CPSP can vary in relation to different surgical procedures) and to clinical trials (heterogeneous studies referring to the same procedure and lack of well designed prospective studies). For example, in radical prostatectomy the prevalence of CPSP varies from 10% to 49% (4,5). The reported higher risk of developing CPSP is after

- limb amputation 50-85% (6, 7)
- thoracotomy 16-21% (8)
- breast cancer surgery 47% (9)
- major abdominal surgery 7-14% (10, 11)
- craniotomy 7-29% (12)
- knee surgery 13% (13)
- hip surgery 12% (13)
- hernia repair 63% (14)

It is noticeable that most of these procedures concern general surgery and orthopedic surgery. Hence CPSP represents a growing challenging problem for society and medicine.

PATOPHYSIOLOGY: The mechanisms underlying the development of CPSP syndrome are not yet totally fully understood. CPSP is not a "simple result" of a chronification of inflammatory response, but it is a complex phenomenon related to both inflammation and central nervous maladaptive response to the tissue lesion. (15) In fact, persistent nociceptive inputs from surgical-injured tissues could activate glutamergic neurotransmission, through NMDA receptors, producing a central sensitization (16). The clinical manifestation of this phenomenon is secondary hyperalgesia which consists in higher pain sensitivity surround of injured area in reaction to mechanical stimulation. It is clear that long-lasting noxious stimulation, inflammation and damages to nerves cause neuronal hyperexcitability that is usually short lasting and associated with reversible plastic neuronal changes. But in some cases, even if it is not so clear why, hyperalgesia becomes persists over the natural recovery period determining CPSP through a maladaptive response of peripheral and central nervous system. Perhaps, persistent and more profound changes in transmitters, receptors, ion channels and neuronal connectivity occur, leading to irreversible plastic changes and CPSP; these changes are more likely to occur in the following conditions: nerve lesions, intense and prolonged inflammatory noxious stimulation, proinflammatory context and vulnerable patients (15). Hence, secondary hyperalgesia, that is mechanical hypersensitivity in uninjured tissues surrounding the wound, is an expression of a wider post surgical central sensitization (17) and its extension correlates with the risk for CPSP after abdominal surgery (11).

To resume, it can be stated that:

1. Ongoing inflammation is a co-factor of CPSP, but it is not the only mechanism underlying it. Nevertheless it is important to understand who can develop an exaggerated persistent inflammatory response after normal surgical stimulus.
2. Central sensitization mechanisms play a key role in CPSP development. It follows that any direct or indirect nerve lesions (cut, stretch, crush) during the intervention lead not only to a more acute postoperative pain, but also to a more likely risk of CPSP (18,19).
3. As central sensitization mechanisms is related to the imbalance between endogenous inhibitory and excitatory factors that normally manage and control pain, possible targets could be improving inhibitory factors and/or reducing peripheral excitatory factors.
4. There are important differences in modulation and perception of pain between each individual and this leads to interindividual different risk of developing severe acute or chronic pain that could be better investigated (20).

RISK FACTORS: The chronification of acute postoperative pain is a complex mechanism involving risk factors related to the patient and/or to surgical procedure. The identified risk factors are:

- Type of Surgery: see Epidemiology
- Genetic proneness: the involved genes mostly studied are COMT, OPRM1, UGTB27, IL1RN, and ADRB2 gene (21)
- Female Gender: in female population CPSP occurs more frequently (200%) than in males (1)
- Young Age: aged patients seem more protected since their pain thresholds do not change significantly (1)
- Preoperative psychological factors: anxiety and negative psychological attitude, as depression, psychological weakness, stress, and late return back to work, seem to be strongly associated with CPSP (22)
- Obesity: the alteration of proinflammatory/antiinflammatory balance in obese patients favours CPSP; it is known that adipose tissue represents firstly a lipid storage, but it works as an endocrine and immunoactive organ as well (23, 24)
- Pre-existing pain: not necessarily referred to the surgical site. Moreover, conditions such as irritable bowel syndrome, migraine headache, fibromyalgia, and Raynaud disease are more likely related to the CPSP.
- Inflammatory response: especially in the surgical area (25)
- Uncontrolled postoperative pain: postoperative pain is highly related to CPSP (15). Hence it is important to detect patients who have an higher risk to complain higher postoperative pain, during the preoperative evaluation.

Hence anaesthesiologists should estimate this risk applying the Kalkman score, a validated risk scale based on patient's history and type of surgery (26, 27). In fact the items considered in this scale are sex, age, pain before surgery at the site, regular use of opioids, regular use of anxiolytic antidepressants, open surgery, type of surgery, long-lasting procedures, obesity, high level of anxiety at the preoperative visit. With a score higher than 4 (out of 15) there is an higher risk that patients could complain poor postoperative pain management and have higher risk to develop CPSP.

TREATMENT and TARGETS: On the basis of these statements, how can we effectively prevent post surgical chronic pain? It is true that most of the risk factors cited are not changeable and they are only able to indicate for sure the possibility of chronification. However, a correct perioperative management of the patient is feasible, and it becomes not only mandatory but also the only way in order to prevent CPSP. In other words, an optimal surgical technique (a surgeon's task), together with a skilful evaluation of patient and administration of drugs more related to pathophysiology of pain (an anaesthesiologist's task) can lead to the best condition to avoid chronic pain states. Hence, a good knowledge of the pathophysiological pathways underlying pain chronification is fundamental to choose the best therapeutic strategy in a conscious way.

On this basis, possible targets might be:

1. The so called "pre-emptive analgesia", quite unsatisfying for what concerns post surgical acute pain, could be an interesting way to prevent chronic pain (28, 29). In the matter of this approach, a multimodal method is recommended, with particular attention to regional anesthesia, as it could prevent the development of central sensitization avoiding that peripheral nociceptive input could reach central nervous system.
2. Tissue injury and inflammation lead to inflammatory response, causing primary hyperalgesia. Higher levels of inducible COX2 and

Prostaglandin E2 in periphery and in central nervous system play a key role in the development of both primary and secondary sensitization promoting the development of CPSP (30). As inflammatory response is important factor, some authors advocated the more extensive use of NSAIDs in postoperative setting to prevent CPSP. Actually there is no evidence to support this hypothesis and in our recent study we are showing that it is equally “protective” to use analgesics that could help to prevent central sensitization (as tramadol) rather than NSAIDs (our unpublished data - NCT 01346162).

3. Recently literature is investigating the possible peripheral role of vanilloid 1 transient potential (TRPV1) receptors. They are involved in the development of heat allodynia and spontaneous firing of stimuli in C-fibers in the area surrounding the surgical wound. In a recent study, the nociceptive stimulation decreased in mice by inhibiting these receptors using opioids: a small dose of morphine produced a reduction in the abnormal response to heat stimulation (31). Therefore, the use of opioids in a multimodal analgesia context can effectively strike also this kind of receptors. On the other hand, we have also to consider that opioids could diminish immunity function facilitating the chronification of inflammatory response with the development of the CPSP (32). Hence, it is very important to balance the postoperative pain management upon the characteristics of the single patient and not only on the basis of the same protocol for all patients; so it will necessary to focus our attention to detect and investigate interpatient variability. (33)
4. Finally, central sensitization is an important key point to the development of CPSP. It is a manifestation of modifications in the central nervous system and it is related to excitatory neurotransmitters (glutaminergic neurotransmission). N-methyl-D-aspartate (NMDA) receptors are involved in this long-term modification of neuroplasticity and this mechanism induces and maintains the central sensitization during pathologic pain. Furthermore, traumatic surgical injury to the peripheral nerve produces changes in neuronal and glia cells of the dorsal horn involved. Changes involving the microglia are of particular interest, because these cells increase the production of cytokines such as interleukin (IL)-1b, IL-6, and tumor necrosis factor α , that are normally expressed in low concentrations in the spinal cords. These neuronal/immune interactions/dysfunctions are suspected to induce a prolonged state of sensitization clinically manifested by CPSP. Acting on these neuroplasticity mechanisms is an important step in the prevention of CPSP. A drug that seems useful to stop this process is Ketamine; in fact it is a competitive inhibitor at the NMDA site of the excitatory glutaminergic transmission and reduces the incidence of postoperative residual pain. It has also an anti-inflammatory effect (15).

Conclusion: In conclusion, CPSP is very important clinical entity that it has to be considered by anesthesiologists in the evaluation of patients. The goal of the anesthesiologist is dual: to identify patient at risk to develop it and to choose the best postoperative treatment according to pathophysiology of pain. Finally, it is important to underline that in the last years there are some studies that suggest the possible role of patient preoperative evaluation with quantitative sensory testing (QST) in order not only to define patients that could develop CPSP but also to identify neurological damage of the small fibers. In fact, this tool can be also used to detect mechanisms of chronic pain, because it is clinically useful for the identification of subgroups of patients with different underlying pain mechanisms, for the prediction of therapeutic outcomes and for quantification of therapeutic interventions in treatment of pain. The use of QST to individualized therapy is an interesting concept, but needs further validation. (34)

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SURGICAL ANESTHESIA AND POSTOPERATIVE ANALGESIA FOR MAJOR FOOT AND ANKLE SURGERY

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Background: Postoperative pain after major hindfoot and ankle surgery like ankle arthrodesis, ankle alloplasty, and subtalar triple arthrodesis is usually prolonged and typically is most severe during the first 48 hours. Sciatic nerve blockade reduces postoperative pain, opioid consumption, nausea, and the length of stay and improves patient satisfaction after major foot and ankle surgery compared to systemic analgesia (1). Continuous infusion of local analgesic via a perineural sciatic catheter effectively alleviates the pain from the distribution of the sciatic nerve innervation, and ultrasound guidance significantly improves the success rate of postoperative analgesia compared to electrical nerve stimulation guidance (2). However, even with complete blockade of the sciatic nerve, intravenous opioids are oftentimes required the first postoperative days due to moderate or severe pain from the distribution of the saphenous nerve innervation of the medial leg including the medial side of the malleolus, the ankle joint capsule, and the talo-calcaneo-navicular joint (3). The analgesic effect of the opioid consumption is oftentimes insufficient and associated with a range of side effects (e.g. nausea, vomiting, dizziness, urinary retention, constipation) impeding mobilization. The saphenous nerve is the biggest branch of the femoral nerve, and a continuous femoral nerve block as a supplement to a continuous sciatic nerve block alleviates the pain after major foot and ankle surgery (4). However, blockade of the femoral nerve produces sensory and motor anesthesia not only of the saphenous nerve - but also the quadriceps femoris muscle of the thigh. That impedes postoperative mobilization and makes the femoral nerve block less attractive as a supplement to the sciatic nerve block after major foot and ankle surgery. The saphenous nerve can be blocked effectively and more selectively in the adductor canal on the medial side of the thigh at the midfemoral level (5). We routinely use single-shot ultrasound-guided saphenous nerve block in the adductor canal at the midfemoral level with 10 mL ropivacaine 0.2% to supplement a continuous popliteal sciatic perineural infusion of ropivacaine 0.2% which effectively alleviates the postoperative pain after major foot and ankle surgery. However, the patients oftentimes have moderate to severe breakthrough pain from the saphenous innervation of the medial side of leg, ankle and foot and the anterior side of the ankle joint, when the effect of the saphenous nerve block subsides - typically after 10 to 15 hours. A preliminary pilot study in our department has indicated that continuous saphenous blockade via a perineural catheter inserted in the adductor canal at the midfemoral level effectively alleviates postoperative pain the first 48 hours postoperatively with a significant reduction of opioid consumption. Our research

group is in the process of sampling data for a double blinded RCT estimating the effect of saphenous blockade with continuous perineural catheter infusion of ropivacaine versus saline infusion after single injection saphenous nerve blockade with ropivacaine in both groups. The primary outcome measure is postoperative consumption of opioids.

Surgical anesthesia for major foot and ankle surgery using peripheral nerve blocks as the sole anesthetic requires analgesia of the thigh due to the routine application of a thigh tourniquet with this kind of surgery. The thigh tourniquet produces intense ischemic muscle pain. The possible strategies for analgesia of the thigh are:

- 1) ultrasound guided blockade of the femoral nerve and the anterior and posterior branches of the obturator nerve at the level of the inguinal groove combined with an ultrasound guided proximal blockade of the sciatic nerve. The proximal ultrasound guided blockade of the sciatic nerve can either be performed with a subgluteal approach or a sacral plexus block using the Para Sacral Parallel Shift (PSPS) approach (6).
- 2) blockade of the lower lumbar plexus (L2-L4) and the upper sacral plexus (L4-S1) with the so-called Supra Sacral Parallel Shift (SSPS) technique combined with a sacral plexus block using the so-called Para Sacral Parallel Shift (PSPS) technique (6).

The SSPS technique: A curved array probe is oriented parasagittally across the upper edge of the iliac crest. Parallel shifting of the probe medially brings the transverse process of L5 and the sacral bone into view. The needle is inserted from the cranial end of the probe and advanced in-plane between the transverse process of L5 and the sacral bone until a loss-of-resistance is obtained when the needle penetrates the iliolumbar ligament. Local analgesic is injected. Our preliminary data suggests that this block is easy to perform and effectively produces analgesia of the lower lumbar plexus (L2-L4) and the upper sacral plexus (L4-S1).

The PSPS technique: The probe is aligned between the PSIS and the midpoint of the line connecting the PSIS and the Greater Trochanter. The iliac bone line is identified ultrasonographically. The probe is moved inferomedially with a *parasacral parallel shift* (PSPS). When the beam of the probe arrives at the sciatic notch, the ultrasonographic continuity of the iliac bone line is interrupted. This is exactly where the sacral plexus exits the pelvis. The probe is tilted slightly caudad and the hyperechoic sacral plexus is visualized between the sacral bone medially and the ischial bone laterally and sandwiched between the triangular piriformis muscle and the dense presacral pelvic fascia. The needle is advanced in-plane from the lateral end of the probe until the needle tip touches the sacral plexus. The identity of the sacral plexus may be confirmed by nerve stimulation with a sciatic motor response from the hamstrings in the range of 0.3-0.5 mA - especially at the beginning of the learning curve. Then 20 mL of ropivacaine 0.5% is injected with sonographic observation of perineural spread in the fascial space between the pelvic presacral fascia and the piriformis muscle as the end-point with reposition of the needle tip if necessary using solely ultrasonographic guidance.

Conclusion: Continuous perineural infusion of local analgesics around the sciatic nerve at the popliteal level and around the saphenous nerve in the adductor canal at the midfemoral level effectively alleviates the postoperative pain after major foot and ankle surgery.

Anesthesia for major foot and ankle surgery with ultrasound guided peripheral nerve blockade as the sole anesthetic requires analgesia of the thigh as well as the ankle and foot. This can be obtained with combined ultrasound guided proximal blocks of the femoral nerve, the obturator nerve, the lateral femoral cutaneous nerve and the sciatic nerve or by combining an ultrasound guided SSPS lumbar plexus block with an ultrasound guided PSPS sacral plexus block.

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ASK THE EXPERT: EPIDURAL INJECTION OF CORTICOSTEROIDS: IS PARTICULATE SIZE AND AGGREGATION IMPORTANT?

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Radiculopathy has been treated for more than half a century using aggregated particulate corticosteroids. Early approaches utilized the caudal epidural approach with large volumes, and later both lumbar interlaminar and cervical interlaminar approaches were utilized. During those years, complications were commonly due to accidental dural puncture, vasovagal reactions and other less severe complications. In rare cases direct neural trauma occurred leading to devastating neurological injuries. These accidents were often in the performance of cervical injections such as those described by Carotte and Fehling. (1) Based on the most recent ASA Closed Claims studies, (2) direct needle trauma remains the most likely reason for catastrophic neural injuries, but over the last two decades with the advent of transforaminal epidural approaches a new type of complication has emerged as a major cause of morbidity and mortality. Based on the anatomical work by the author (3) it is known that there are important variations in the blood supply to the spinal cord. Notably, the cervical spinal cord can receive its arterial supply from the vertebral artery, the ascending cervical artery, and the deep cervical artery. All of these arteries can be involved in anastomoses with each other, or supply the cord in isolation. In many cases, only one or two arteries will supply the spinal cord as, for example, in the case of a hypoplastic vertebral artery. These anatomical variants cannot be predicted accurately based on any patient characteristics, and therefore they become apparent only when procedures are performed that expose the vulnerability. It is thought that the particulate steroid embolizes downstream to occlude the cord's blood supply leading to infarction. These infarctions have not been isolated to the spinal cord, but in some cases have involved the brainstem as well. Unfortunately, this is not isolated to the cervical spinal cord, but has also been reported in the lumbar and thoracic spinal cords. While it is known that the great anterior segmental medullary artery (Artery of Adamkiewicz) is the major blood supply to the thoracolumbar spinal cord, there have been accessory arteries found in this area as well. Studies by both Tiso et al (4) and Benzon et al. (5) have demonstrated the importance of particulates in the corticosteroid of preparations such as triamcinolone and methylprednisolone. In a questionnaire sent to members of the American Pain Society, Scanlon and colleagues (6) were able to demonstrate that there were many deaths and serious neurological injuries found in association with the injection of particulate steroids. Okubadejo and colleagues (7) studied the phenomenon in swine, whereby they intentionally injected the vertebral artery with both particulate and non-particulate steroids. They found that in every case, the pigs developed brain edema and infarcts, and that this did not occur when a non-particulate steroid, i.e. dexamethasone was utilized. Thus the importance of using an agent that is not particulate is emphasized for transforaminal injections. It is important to emphasize that although cervical radiculopathy is a relatively common cause of both neck and radiating upper extremity pain, the epidemiology of this process suggests that patients will improve in the vast majority of cases of no treatment it applied. (8) It is appropriate to differentiate radicular pain from radiculopathy, as the latter presents with sensory, motor and reflex changes. These variations of radiculitis may be exclusive or concurrent in the same patient. During the initial history and physical examination, one should determine the severity and longevity of symptoms, and look for the presence or absence of myelopathy; progressive weakness or motor deficits, abnormal reflexes, e.g. Hoffmann's sign, hyperreflexia, bowel and bladder incontinence. These and other so-called "red flags" may indicate an urgent need for

surgical referral for progressive neurological dysfunction, or a need for further workup, e.g. for infectious, vascular, or tumor-related causes.

Physical Examination

Initial examination of the patient should differentiate the presence or absence of neurological signs and symptoms, normal range of motion of the neck or back, presence or absence of muscular signs, and any radiating dermatomal pain. The entire examination should look for concordance, e.g. a patient with pain in a C6 dermatomal pattern with weakness in the biceps and brachioradialis musculature, loss of the biceps reflex, and sensory loss in the thumb. There are several clinical tests that may have been utilized. These include straight leg raising tests for the sciatic nerve in the lower extremity and Spurlings test, the shoulder abduction test, and the axial manual traction test for upper extremity. A recent cross-sectional trial of 255 patients referred for electrodiagnostics at a major medical center revealed a 93% specificity, but only 30% sensitivity for the Spurling's test. The authors suggest that the test is a useful confirmatory test for patients with suspected radiculopathy. (9)

Epidural Injection Therapy

Interlaminar cervical epidural injections case series have demonstrated improved symptoms in most series in up to 2/3 of patients. (10) From a diagnostic standpoint, many surgeons and other physicians use a selective nerve root injection (SNI) as a means of supplementing the clinical and diagnostic information available, and to assist in stratifying patients into treatment groups. One study of diagnostic selective root injections demonstrated that of 101 patients receiving diagnostic injections at the root level, 90% had positive results, and of those with positive SNI, 91% had good surgical outcomes (11). Studies evaluating the distribution pattern of injectates in the cervical spine underscore the fact that very little volumes (less than one milliliter) can confound the diagnostic result of SNI (12). Very little difference in the conduct of selective root injections and so-called transforaminal epidural (TFE) injections leads to confusion in some cases. Early enthusiasm for these TFE procedures have been supplanted by hesitancy due to the increase in complications. Overall, guidelines and studies have supported favorable outcomes from well-conducted epidural therapies for the treatment of cervical radiculitis. (13,14, 15, 16, 17, 18)

Evidence for the use of pulsed radiofrequency adjacent to the dorsal root ganglion is a new and exciting technique. This has been borne out by two well conducted trials and mentioned in recent guidelines. (18, 19, 20) Duration of pain relief for several months was noted (20).

Anatomical Considerations for Epidural Injections

1. Ligamentum flavum discontinuity

Interlaminar epidurals are commonly performed at C7/T1 or T1/T2 levels but, many operators will do these procedures at higher levels. Cryomicrotome anatomical research examining the cervical and high thoracic ligamentum flavum illustrated the unreliability of relying on loss of resistance techniques to safely place epidural needles. Hogan had previously described the relative absence of a definable posterior epidural space above C7. (21) Lirk and colleagues (22) recently described a number of ligamentum flavum midline gaps from discontinuous fusion. The finding of discontinuous ligamentum flavum in more than half the cadavers at the midline above C7/T1 points out potential drawbacks to the interlaminar approach. Upper thoracic levels had continuous flava, especially at high thoracic levels below T3/4.

2. Anterior spinal cord vascular supply

Segmental medullary vessels from the vertebral artery in the cervical area (coursing through the foramina transversaria) enter the intervertebral foramina anteriorly, away from optimally transversely placed transforaminal needles. The deep and ascending cervical arteries, previously poorly understood, may enter the foramina in the posterior aspect, potentially at risk for injection with particulate steroid (3).

3. Lumbar epidural safe zone

A study of the vasculature in the lumbar foramina area demonstrated that 75% of the entering arteries did so within the so-called safe zone in the anterior superior aspect of the foramen on the lateral view. This underscores the fact that due care when injecting particulate steroids is always indicated. (23)

Choice of Steroids

Recently, Dreyfuss and colleagues compared the non-particulate steroid dexamethasone (12.5 mg dexamethasone sodium phosphate Decadron®, Sico Pharmaceuticals, Irvine CA, USA.) to 60 mg of the particulate triamcinolone acetate (Kenalog®, Bristol Myers Squibb Co., Princeton NJ, USA.). Both steroid groups had significant reductions in pain at 4 weeks. (24)

Pre-procedural Planning and Sedation

Many interventional physicians perform cervical spinal injections without a pre-procedure MRI to guide choice of technique. If a large disc protrusion is at the site of proposed needle entry, it may be prudent to move to another site or consider another technique. If a recent MRI or CT image is not available prior to planning the procedure, one should be obtained.

Image Guidance and Digital Subtraction

Fluoroscopy is appropriate for the conduct of interlaminar epidurals in the high thoracic or cervical spine. After a midline needle placement using a coaxial technique, the needle is advanced until ligamentous entry, then the operator can switch to a lateral view and very slowly advance the needle using a loss of resistance technique until it approaches the base of the spinous processes. (25)

Real-time fluoroscopy is mandatory for the safe conduct of transforaminal epidural procedures. Digital subtraction is potentially a way to detect vascular injection patterns, (25) but has not been formally studied for cervical transforaminal epidural procedures. Computed tomography would seem to be the best technique to some, but recent case reports of brainstem infarction despite optimal technique with an experienced operator imply that the ability to see the injection in real time coupled with other techniques is indicated. (26)

Evidence Synthesis and Recommendations

1. Conservative care should nearly always start with gentle PT and medications such as gabapentin, weak opioid analgesics (tramadol) and NSAIDs. Cervical traction is not likely to be of additional value to mobilization and manipulation techniques.
2. Interlaminar epidural injections should be approached with caution in the cervical region due to discontinuous ligamentum flava and the propensity for large disc protrusions to deform the posterior epidural space. ASA Closed Claims data suggests that the most common type of catastrophic complication are spinal cord accidental injuries caused by needle trauma. These cord injuries involve younger patients who are more commonly females, and less commonly cause death.
3. A pre-procedural MRI is nearly always warranted to evaluate for narrowing/ displacement of the cervical cord in the spinal canal at the target site. Injections in situations of decreased anteroposterior distance could result in direct neurological injury. A lateral fluoroscopy view is advocated once the needle is fixed in the anteroposterior plane so as to allow slow correlation of tactile (loss of resistance) and visual cues as one approaches the bases of the spinous processes. Real-time fluoroscopic contrast injection is indicated.
4. Transforaminal epidural injections should be approached with caution as to the potential presence of anatomical variants that may allow injection of corticosteroids into segmental medullary feeding vessels joining the anterior spinal arterial circulation.
5. Real-time fluoroscopy allows for suspected vascular uptake to be seen, but not uniformly. Computed tomography is not superior to real-time injection.
6. Use of non-particulate steroid for TFE (dexamethasone) is supported by one small trial, but it is noteworthy that no cases have yet been reported of infarcts with its use.
7. Digital subtraction imaging may be sensitive enough to detect vascular uptake, and is strongly encouraged
8. Test dosing with 1 ml of local anesthetic is supported by case report, in that it has not caused permanent injury. Physician preparedness for airway events or seizure is mandatory. Little is known about other agents, such as vasodilators or anticoagulants, for acute treatment of suspected steroid particulate embolus, vascular vasospasm or injury.

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Best Free Papers

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CEREBRAL OXYGENATION USING NEAR INFRARED SPECTROSCOPY FOR SHOULDER SURGERY IN BEACH CHAIR POSITION: REGIONAL ANESTHESIA WITH SEDATION COMPARED TO TO GENERAL ANESTHESIA FOR NEUROBEHAVIORAL OUTCOME

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Background: Cerebral hypoperfusion is related to beach chair position and controlled hypotension. Near-infrared spectroscopy (NIRS) is a non invasive technique for cerebral oxygen saturation (rScO₂) monitoring which appears to have prognostic value for cerebral function recovery. However, NIRS changes and outcome have not been fully evaluated comparing both regional anesthesia and general anesthesia in beach chair position.

Methods: Eighty patients scheduled for shoulder surgery were divided in 2 groups: 40 patients in the regional anesthesia (R-) group with interscalene catheter and 40 patients in the general anesthesia (G-) group with propofol / remifentanyl target controlled infusion. Anesthesiologists were blinded to the rScO₂ values. Baseline data the day before surgery included neurological and neurobehavioral tests repeated the first day after surgery. The baseline data for NIRS / bispectral index (BIS) / pCO₂, invasive blood pressure at heart and meatus level and cerebral blood flow (CBF) using doppler of the carotid and vertebral arteries were taken prior anesthesia, then after beach chair positioning and all 20 minutes after start of surgery until discharge.

Results: Patients in the R-group showed more stable values of rScO₂, blood pressure and cerebral blood flow with similar neurobehavioral test results after surgery compared to patients in the G-group. Drops in blood pressure, CBF and ScO₂ significantly correlated with impairment of neurobehavioral test results.

Conclusions: Regional anesthesia offers more stable cardiovascular conditions for shoulder surgery in beach chair position compared to general anesthesia. NIRS is a valid method to monitor cerebral perfusion and correlates with neurobehavioral tests and CBF.

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ULTRASOUND-ASSISTED VERSUS FLUOROSCOPIC-CONTROLLED EPIDURAL STEROID INJECTIONS IN PATIENTS WITH DEGENERATIVE DISEASES OF THE SPINE

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Background and aims: Epidural steroid injections are routinely performed under fluoroscopic guidance, but technically could also be completed using pre-procedure ultrasound examination. We studied feasibility, accuracy, average procedure time, pain relief and degree of disability score to compare ultrasound-assisted with fluoroscopy-controlled epidural steroid injections.

Methods: After obtaining institutional approval, 90 patients with chronic low-back and extremity pain, receiving three interlaminar epidural steroid injections at the L4-L5 level at two-week intervals, were randomly assigned between two groups. Selection criteria included that patients must be over 50 years old with multiple degenerative lumbar spine diseases, no previous

lumbar injections within six months, or any lumbar surgery. For the fluoroscopic group (FS=45), injections were performed under fluoroscopic guidance; for the ultrasound group (US=45), ultrasound scanning of the lumbar spine was performed before injection to determine future puncture site, epidural space depth and needle trajectory. Outcome measures included numbers of needle insertions and redirections, procedure time, and the visual analogue scale and Oswestry disability index at baseline, one and three months post-treatment.

Results: 88 patients completed the study. There was no statistically significant difference between the two groups in mean number of needle insertions (p= 0.197) or procedure time (p=0.083), but numbers of needle redirections were significantly lower in the US group (p=0.032). Mean pain intensity and degree of disability score before the procedure, and at one and three months post-procedure, was similar in both groups. Neither group presented serious complications.

Conclusions: This study demonstrates the feasibility of the ultrasound-assisted epidural steroid injection technique.

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DEFINITIONS OF THE NOVEL SINGLE PENETRATION DUAL INJECTION (SPEDI) BLOCK COMBINATION: PERIPHERAL BLOCKS FOR LEG SURGERY

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Background and aims: Ultrasound-guided (USG) nerve blocks of the sciatic nerve (popliteal level = PL) and the saphenous nerve (mid-femoral level = MFL) provides analgesia following leg surgery. Traditionally two separate injections are performed. Our aim was to describe a novel, faster USG block combination requiring only one skin penetration to block the sciatic and saphenous nerves; i.e. the SPEDI block.

Methods: A randomized, controlled and double-blinded trial. Following IRB approval 60 patients were randomized to the administration of an USG SPEDI block compared to two separate USG blocks of the saphenous (MFL) and sciatic (PL) nerves. Blocks were performed after induction of general anaesthesia. Outcome measures were performance time (primary outcome measure), Post-Anaesthesia Care Unit pain scores, block difficulty level, opioid consumption, serum-ropivacaine pharmacokinetics. Both block combinations were evaluated by MR imaging (MRI).

Results: The SPEDI block was significantly faster to perform (p< 0.01). Further, clinical measures, MRI and serum-ropivacaine pharmacokinetics describes the use, safety and efficacy of the novel USG SPEDI block compared to the traditional technique.

Conclusions: The USG SPEDI block combination can be performed significantly faster without moving the leg, and achieve successful perioperative pain management. The SPEDI block may find important use in the emergency setting.



[SPEDI nerve block]

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AMIDE-LINKED LOCAL ANESTHETICS EXHIBIT ANTI-METASTATIC POTENTIAL VIA INHIBITION OF SRC AND ICAM-1 SIGNALING INDEPENDENTLY OF SODIUM CHANNEL BLOCKADE

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Background: Retrospective analysis of patients undergoing cancer surgery suggests the use of regional anesthesia may reduce cancer recurrence and improve survival. Amide-linked local anesthetics have anti-inflammatory properties, although the mechanism of action in this regard is unclear. As inflammatory processes involving Src tyrosine protein kinase and intercellular adhesion molecule-1 (ICAM-1) are important in tumor growth and metastasis, we hypothesized that amide-linked local anesthetics may inhibit inflammatory Src-signaling involved in migration of adenocarcinoma cells.

Methods: NCI-H838 lung cancer cells were incubated with Tumor Necrosis Factor- α (TNF α) in absence/presence of ropivacaine, lidocaine, or chloroprocaine (1nM-100 μ M). Cell migration and total cell lysate Src-activation and ICAM-1 phosphorylation were assessed. The role of voltage-gated sodium-channels (VGSC) in the mechanism of local anesthetic effects was also evaluated.

Results: Ropivacaine treatment (100 μ M) of H838 cells for 20 minutes decreased basal Src activity by 62% ($p=0.003$), and both ropivacaine and lidocaine co-administered with TNF α statistically significantly decreased Src-activation and ICAM-1-phosphorylation, whereas chloroprocaine had no such effect. Migration of these cells at 4 hours was inhibited by 26% ($p=0.005$) in presence of 1 μ M ropivacaine and 21% by 1 μ M lidocaine ($p=0.004$). These effects of ropivacaine and lidocaine were independent of VGSC inhibition.

Conclusions: This study indicates that amide-, but not ester-linked local anesthetics may provide beneficial anti-metastatic effects. The observed inhibition of NCI-H838 cell migration by lidocaine and ropivacaine was associated with the inhibition of TNF α -induced Src-activation and ICAM-1-phosphorylation, providing the first evidence of a molecular mechanism which appears to be independent of their known role as sodium-channel blockers.

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SCIATIC NERVE BLOCK: A COMPARISON BETWEEN A PREMIXED SOLUTION OF LIDOCAINE PLUS BUPIVACAINE AND CONSECUTIVE INFILTRATION OF LIDOCAINE AND BUPIVACAINE

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Background and aims: Local anaesthetics are commonly used as a pre-mixed combination of a short and long acting agent (1). We hypothesized that sequential perineural injection of lidocaine and bupivacaine provides a longer duration of sensory block compared to the same dose and volume of local anaesthetic mixed in advance.

Methodology: Consecutive ASA I to III patients scheduled for lateral malleolus surgery were randomly allocated to pre-mixed (P) and sequential (S) groups. They received an ultrasound guided sciatic nerve block 2 cm above the bifurcation using a posterior approach. Following sensory onset, patients received standardised general anaesthesia. Postoperatively patients were assessed for sensory block, pain at rest and movement at 4, 6, 12, 16, 20 and 24 hours. Time to first rescue analgesia request was also recorded.

Results: Of the 32 patients recruited, two patients were excluded leaving $n_1=14$ in group P and $n_2=16$ in group S. At 12 hours postoperatively sensory block was greater in group S compared to group P (2.37 ± 0.8 vs 1.50 ± 1.2 , $p=0.01$). Both VAS at rest and on movement were less in group S compared to group P (0.43 ± 1.7 vs 2.92 ± 3.6 , $p=0.01$ and 0.93 ± 2.4 vs 2.78 ± 3.4 , $p=0.04$).

Six patients in group S and seven in group P required rescue analgesia with no difference in mean times to first request.

Conclusion: We conclude that sequential injection of lidocaine followed by bupivacaine provides a superior postoperative sensory block and analgesic profile as compared to premixed injection.

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DOES THE MUSCULOCUTANEOUS NERVE SUPPLY SENSIBILITY TO THE PALM?

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Background and aims: The absence of musculocutaneous nerve (MCN) block has been associated with unsuccessful anaesthesia for carpal tunnel surgery (*Ann Fr Anesth Rea* 2012; 31:34-40). In reference textbooks, the MCN does not innervate the palm. Indeed the terminal branches of the MCN are poorly described. We aimed at evaluating the prevalence of anatomical patterns that could implicate MCN in palm innervation.

Methods: The MCN was dissected in 23 arms from 17 fresh cadavers, from the axillary crease to the proximal palm. The terminal branches were dissected under microscope. The following parameters were collected: communicating branch between the MCN and the median nerve (MN) at the arm, communicating terminal branches between the MCN and the radial nerve at the forearm, palmar terminal branch of the MCN dissected distally to the distal wrist crease.

Results: A branch was observed between MCN and MN in 3 arms (13%). At the forearm, communicating terminal branches between the MCN and the radial nerve were observed in 5 additive cases (22%). A palmar terminal branch of the MCN was dissected distally to the distal wrist crease in 5 additive cases (22%), and overall in 8 of 23 cases (35%).

Conclusions: The communicating branch from the MCN to the MN contains fibers that innervate the palm via the MN (*Anat Sci Int* 2009; 84:41-46). In most reference textbooks, the radial nerve innervates the proximal and lateral palm.

Therefore, the MCN may supply innervation to the proximal palm in more than 50% of cases.

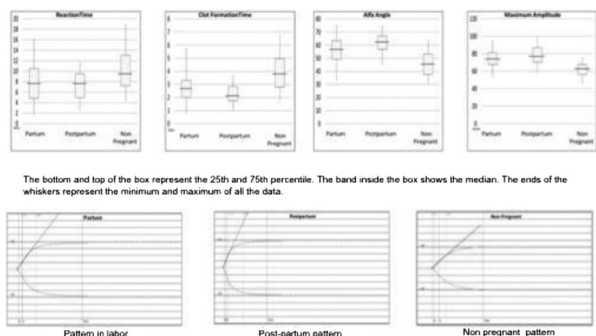
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REFERENCE VALUES FOR THE THROMBOELASTOMETER (MONOTEM-A) DURING LABOR AND AFTER DELIVERY

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Background and aims: Thromboelastography has been used in pregnant woman, however the normal values in labor and after delivery have not been established yet. To determine the reference ranges for the thromboelastometer in healthy pregnant women during labor and after delivery. A sample of women of childbearing age was also included as a control.

Methods: After institutional approval, informed consent to collect blood samples for analysis was obtained from 95 healthy laboring women and 40 non pregnant women volunteers. A 360 μ L sample from 1 mL of whole native blood was tested using thromboelastometry (monoTEM-A, FrammarHemoloxix) and analyzed within 4 min, at 37 °C. The following parameters were recorded: R = time to initial fibrin formation; K = time to initial clot formation; Alfa Angle = acceleration of clot formation and MA = strength of the blood clot. MonoTEM-A® device was calibrated and tested daily.

Results:

Conclusions: MonoTEM-A thromboelastometry confirms the hypercoagulability seen in pregnancy and the puerperium. Formal reference ranges for monoTEM-A that may be potentially useful in laboring women, 24 h after delivery and in women of childbearing age are presented. We observed a state of hypercoagulability in laboring women, which increases after delivery, when compared with controls.

105**SPINAL CHLOROPROCAINE VERSUS LIDOCAINE FOR DAY CASE KNEE ARTHROSCOPY: DISCHARGE TIMES AND FLUID POLICY**

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Background: In the ongoing quest for the ideal spinal local anesthetic for day case procedures many products have been weighed but not found wanting because of TNS or prolonged duration. Fluid restriction is generally accepted to prevent urinary retention in spinal anesthesia. This randomized, double blind prospective study compares the differences in block and micturition characteristics between lidocaine and chloroprocaine and the influence of fluid policy.

Methods: After approval of the ethic committee 80 patients scheduled for day case arthroscopy received spinal anesthesia (L3-L4) in the lateral decubitus position with the operated leg uppermost. They were randomized to receive either lidocaine 60 mg or chloroprocaine 40 mg and this with preload (+) of 500 mL plasmalyte or fluid restriction (-). Block characteristics, micturition and discharge times were noted and bladder volumes were monitored by ultrasound. Micturition problems were registered by a special scoring system.

Results: Demographic data and onset times for surgical anesthesia were comparable between groups. Chloroprocaine provided a shorter duration of sensory and motor block and faster discharge from the PACU. Time to first spontaneous voiding was significantly shorter in both chloroprocaine groups. Discharge time was significantly faster in the chloroprocaine (+) group (165 min) than the chloroprocaine (-) group (180 min) or the lidocaine groups (218min, 221 min). There was non-significant trend towards more major micturition problems with lidocaine.

Conclusions: Our study suggests that chloroprocaine is a good alternative for spinal anesthesia for day case procedures compared to lidocaine and a preload of 500 ml plasmalyte does not seem to cause more bladder retention.

Free Communications**106****COMBINED SPINAL EPIDURAL WITH EPIDURAL VOLUME EXTENSION VERSUS SPINAL ANESTHESIA FOR CAESAREAN SECTION: MULTIVARIATE ANALYSIS OF FACTORS AFFECTING UMBILICAL ARTERIAL PH**

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Background and aims: The present study was designed to examine the influence of epidural volume effect on the spread and duration of low dose hyperbaric levobupivacaine. The aim of this study was to evaluate the influence of epidural restriction on the incidence of hypotension, ephedrine consumption, cord-pH during the Caesarean section.

Methods: 60 full term parturient women (ASA I or II) with uncomplicated pregnancies were prospectively randomized into two groups: 37 women's into single shot spinal anaesthesia group (SSSA) and 39 women's into combined spinal-epidural anaesthesia group (CSE-EVR). The initial dose for CSE-EVR was exactly half of the SSSA dose (0,5mg per 10cm height of hyperbaric levobupivacaine and 20microg fentanyl). After spinal injection, an epidural catheter was located in the CSE-EVR and injected a volume of 20ml saline solution. We evaluated the height of the block by the pinprick method and the motor block by Bromage scale. Hemodynamic monitoring (NIBP, HR) was assessed every 2 minutes until the childbirth, then every 5 minutes during operative time. Anaesthetic efficacy was evaluated for breakthrough pain by visual analogue pain score (VAPS), Apgar score at birth, umbilical artery-pH, and epinephrine consumption.

Results: The incidence of hypotension and ephedrine supplementation was significantly lower in the CSE-EVR group (19 patients vs.35) than in the SSSA group ($p < 0.05$). Multiple linear regression analysis of cord-pH with ephedrine as depend factor:

$$\text{cord-pH} = 7,329 - 0,003 \text{Ephedrine} (R^2 = 0,089)$$

In the regression analysis we incorporate all the other variables like the group belong, ephedrine consumption, and intraoperative mean pressure we achieve:

$$\text{cord-pH} = 7,08 + 0,001 \text{Ephedrine} + 0,003 \text{RRmean} - 0,072 \text{Group} (R^2 = 0,391)$$

Conclusions: We conclude that in order to minimise the risk of fetal acidosis the CSE-EVR techniques should be used. The ephedrine use, the intensity and duration of hypothenion can be reduced with low dose CSE-EVR anaesthesia.

107**COMPARISON BETWEEN LEVOBUPIVACAINE 0.25%, AND 0.5% IN TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK FOR CESAREAN SECTION: A PROSPECTIVE DOUBLE BLIND RANDOMIZED CONTROLLED TRIAL**

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Background and aims: TAP block becomes a commonly used technique to provide analgesia after cesarean section (CS), however, the optimal dosage of local anesthetic (LA) and the extent of its analgesic effect is not yet well established. the aim of this study was to identify whether the use of levobupivacaine 0.5% could reduce the opioid requirements in comparison to levobupivacaine 0.25% or saline after CS.

Methods: Patients undergoing elective CS under spinal anesthesia were randomized to receive the TAP block using 20 ml of either levobupivacaine 0.25% (L25 group, n = 30), levobupivacaine 0.5% (L50 group, n = 30), or saline (S group, n = 30) in each side. A standard postoperative analgesic regimen of paracetamol 1 g every 6 h, and intravenous fentanyl PCA was followed. TAP blocks were given to all patients at the end of the surgical procedure, under ultrasound guidance. The primary outcome was the 24 hrs opioid (fentanyl) consumption. Other outcomes included time to the 1st fentanyl bolus intake, pain scores and maternal satisfaction.

Results: S group showed a significantly increased 24 hrs fentanyl consumption when compared to the other two groups [(1600µg ± 466) vs (1102µg ± 250) in L25 group, and 1138µg ± 358) in L50 group, $P < 0.0001$], significantly shorter time to the 1st fentanyl bolus [(2.46h ± 0.5) vs (3.5h ± 1) in L25 group, and 3.4h ± 1) in L50 group, $P < 0.0001$], and lower maternal satisfaction [(7.4 ± 0.7) vs (8.2 ± 0.6) in L25 group, and 8.55 ± 0.7) in L50 group, $P < 0.0001$]. However, no significant differences have been found between L25 and L50 groups

Conclusions: TAP block, using levobupivacaine, significantly reduces opioid consumption after CS with high maternal satisfaction, however no benefits have been encountered from increasing levobupivacaine concentration from 0.25% to 0.5%.

108**TO BLOCK OR NOT TO BLOCK? UK ANAESTHETISTS' PERCEPTIONS OF ULTRASOUND GUIDED REGIONAL ANAESTHESIA (USGRA) IN A LARGE DISTRICT GENERAL HOSPITAL (DGH)**

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Background and aims: In the UK, the introduction of Ultrasound(US) has contributed to renewed interest in the sub-speciality of Regional Anaesthesia(RA).

Increasingly institutions perform routine upper-limb(UL) operations with USGRA and abdominal blocks are commonplace.¹⁻²

RA-Enthusiasts associate USGRA with better patient-outcomes and an improved safety-profile.³⁻⁴ However, there is limited supporting evidence and variation in risk/benefit between operators.⁵ In these circumstances, we conducted a survey to determine how practicing anaesthetists perceive the routine-use of USGRA in ASA 1/2 patients in a large DGH.

Methods: We proposed the following premise in various UL procedures: "If you were an ASA1/2 patient with no contraindications to GA, would you choose to have the following technique instead of or in addition to GA."

Abdominal procedures: "...instead of infiltration of local-anaesthetic as part of your post-operative analgesia."

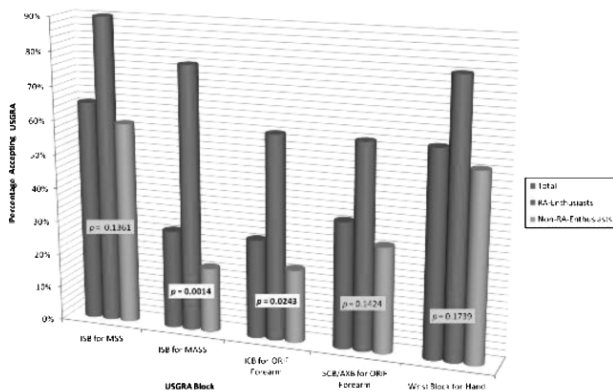
Data Analysis:Fishers Exact Test.

Results:

[ANAESTHETISTS' ACCEPTANCE OF USGRA]

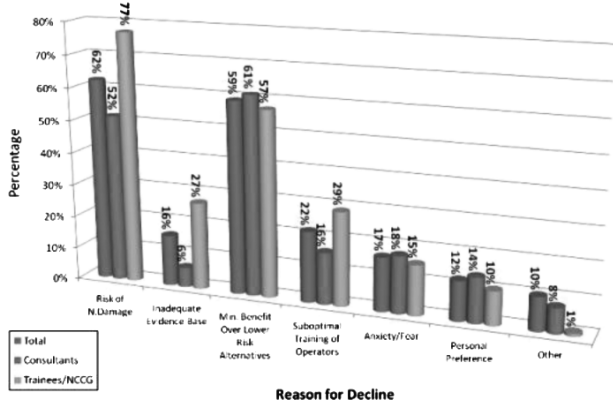
	Interscalene Block (ISB) for Major Shoulder Surgery (MSS)	ISB for Minimal Access Shoulder Surgery (MASS)	Infraclavicular Block (ICB) for ORIF Forearm	Supraclavicular (SCB)/Axillary (ANB) Block for ORIF Forearm	Wrist Block for Hand Op	Iliioinguinal (IIB)/Ilioypogastric (IIB) Block for Open Femoral/Inguinal Hernia	IIB/IIB/Transversus Abdominis Plane (TAP) Block for Open Appendix	Bilateral TAP Blocks for Laparotomy	Bilateral TAP Blocks for Pfannenstiel Incision
Consultants n=24	15 (63%)	7 (29%)	6 (25%)	5 (21%)	12 (50%)	21 (88%)	19 (79%)	19 (79%)	13 (54%)
Overall Response n=52	13 (68%)	4 (21%)	4 (26%)	19 (37%)	31 (60%)	14 (74%)	36 (69%)	36 (69%)	37 (71%)

USGRA: A Difference in Acceptability? Blockers vs Non-Blockers



[Acceptance of UL-USGRA: Blockers vs Non-Blockers]

Upper Limb Surgery: Reasons For Declining USGRA



[Upper Limb Surgery: Reasons For Declining USGRA]

Conclusions: Amongst UK anaesthetists, abdominal blocks are highly acceptable. In contrast we identified scepticism, low-levels of confidence and an over-inflated perception of risk associated with UL-USGRA. This raises the question: should we be offering procedures that we might not accept for ourselves?

RA is one of the fastest growing sub-specialities but outside MSS, the majority of anaesthetists would not risk an UL-block. Benefits include cost-savings, improved post-operative pain, reduced recovery-time and opioid-requirements.³⁻⁷ The incidence of permanent nerve damage following USGRA is similar to that following GA e.g. 0.3-1.5% from surgery in the lithotomy position.⁸⁻⁹

This study suggests that in the UK work is still required before USGRA can overcome 'perception-based-practice' and become more widely-accepted.

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THE EFFECT OF ANESTHESIA TECHNIQUE ON MATERNAL AND CORD BLOOD ISCHEMIA-MODIFIED ALBUMIN (IMA) LEVELS DURING CESAREAN SECTION: A RANDOMIZED PROSPECTIVE CASE-CONTROL STUDY

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Background and aims: Ischemia-modified albumin (IMA) is an early marker for various ischemic events such as cardiac ischemia. The aim of this prospective study was to determine the changes in IMA levels during cesarean section under general anesthesia (GA) or combined spinal epidural anesthesia (CSEA).

Methods: The study protocol was approved by the Medical Ethical Review Committee (No; 45 June.20.2011) and all subjects provided written informed consent before entry into the study. A case control study of fifty-one term healthy pregnant patients was conducted. The patients were allocated into GA (n=28) or CSEA (n=23) groups. IMA was measured from maternal blood at the beginning and at the 35th min of cesarean section, and from cord blood after clamping. Albumin levels from the same samples were noted and compared with the IMA levels.

Results: No significant differences were found in maternal age, body mass index, gestational age, parity, gravidity, operation time, birth-weight and fetal gender between the groups (p>0.05). The IMA levels in maternal blood at the beginning of the study were similar (p>0.05). IMA levels significantly increased during the cesarean section in the GA group compared to the CSEA group (p< 0.05).

Conclusions: This is the first study comparing maternal and cord IMA levels under general anesthesia (GA) and combined spinal epidural anesthesia (CSEA). Maternal blood IMA levels and IMA/Alb ratio increased significantly during cesarean section under GA compared to regional anesthesia (RA). We believe that any research on IMA levels should take into account the effects of anesthetic method.

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AUDIT OF TRANSVERSE ABDOMINIS PLANE (TAP) AND RECTUS SHEATH (RS) BLOCKS AS PART OF MULTI-MODAL ANALGESIA DURING POST-PARTUM PERIOD FOLLOWING CAESAREAN SECTION

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Background and aims: RCOA recommends 90% of patients undergoing Caesarean section should have a pain score < 3 out of 10. In 2008, McDonnell *et al* showed patients with TAP block had significantly reduced intravenous morphine requirement and lower pain scores. An initial audit at a tertiary hospital in 2009 revealed patients with TAP block had a median 24-hour morphine consumption of 8.5mg compared to 20mg in those receiving conventional analgesia but similar pain scores in both groups.

In 2011, combined rectus sheath and TAP blocks were introduced at this Trust. We audited the postoperative pain scores and morphine consumption to evaluate the incidence of pain and patient satisfaction.

Methods: Following approval, prospective re-audit undertaken over 4 months. Informed consent obtained verbally. Both rectus sheath and TAP blocks were performed postoperatively under ultrasound guidance using 0.25% levobupivacaine (5ml and 15ml on each side respectively). In addition all patients received conventional analgesia including intrathecal diamorphine, regular paracetamol and opioids.

Results: 28 patients included Mean morphine consumption at 24 hours was 14.7mg with 39% requiring less than 10mg in 24 hours.

Overall, 82% of patients were very satisfied and 18% satisfied with their analgesia.

Conclusions: Although all patients were satisfied with their pain management, the standard of 90% patients reporting a pain score of 3/10 was not achieved. Morphine consumption was lower compared to 2008. Rectus sheath and TAP blocks should be incorporated into the multi-modal analgesia management of patients undergoing Caesarean section with further studies on evaluating their efficacy.

111 PREDICTION OF HIGH LEVEL SPINAL BLOCK IN CAESARIAN SECTION

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Background and aims: High level spinal block in Caesarian section may result in severe hypotension. Aim of this study was to learn impact of intra-abdominal pressure(IP), patient's height and body mass index (BMI) in pregnant women on sensory block level during spinal anesthesia.

Methods: 120 pregnant women with gestational age 38-40 week have been investigated. IP, patient's height and BMI were registered before Cesarean section. For spinal anesthesia was used Marcain Heavy 0.5%. Maximal sensory block level and anesthetic dosage were estimated.

Results: Maximal sensory block level (Th2-3) was observed in pregnant having IP above 22 cm H₂O, height - under 160 cm and BMI above 30. Mean Marcain dosage was 1, 6±0, 2 ml. Minimal sensory block level (Th8-9) was observed in pregnant having IP below 19 cm H₂O, height - above 170 cm and BMI below 30. Mean Marcain dosage was 2, 5±0, 3 ml. On basis of assessment of obtained results was elaborated "high level spinal block risk scale".

Conclusions: This scale may be used for risk prediction of high level spinal block. Low risk - 3 - 6 scores. Moderate risk - 7 -9. High risk - 10 - 12. Very high risk - above 13 scores.

1. Height (cm)	Scores
>171	1
170-166	2
165-161	3
160-156	4
155-150	5
<150	6
2. Body mass index (BMI)	
20-24.9	1
25-29.9	2
30-34.9	3
35-39.9	4
>40	5
3. Intraabdominal pressure (cm H ₂ O)	
<16	1
17-19	2
20-21	3
22-23	4
>24	5

[High level spinal block risk scale]

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EXPERTS VS TRAINEES: DO PATIENTS REALLY FEEL THE DIFFERENCE?

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Background and aims: The EFSUMB criteria (efsumb.org) describes three levels of competence, level-3 being the highest. But is this clinical relevant?

We aimed to compare experts (level-3) to trainees (level-1-practitioners) during the administration of preoperative ultrasound-guided nerve blocks.

Methods: We used a qualitative assessment trial of clinical practise. A consecutive cohort of orthopaedic day-case-surgery patients who had a preoperative basic ultrasound-guided nerve block administered were included in this study over a 12 month period. We divided the practitioners into three groups. Novices without formal training. Level-1-trainees had completed an ultrasound-guided nerve-block-school. Level-3 experts conducting ultrasound-guided nerve-blocks and doing research and quality improvements. All novices were excluded.

Results: 872 patient procedures were included. There were two experts and 26 trainees. The two patient populations were comparable. Block duration was significantly shorter and procedure time significantly longer in the trainee group. Experts used significantly less sedatives during the procedure even though the patient tended to have better block procedure experience.

Conclusions: Significant benefits are evident when ultrasound-guided nerve blocks are administered by experts compared to less experienced practitioners.

Parameters	All patients	Anxious patients	Relaxed patients
Outcomes	Level-3 vs level-1	Level-3 vs level-1	Level-3 vs level-1
Short / long procedure	2.01 vs 0.29 (p<0.01)	2.21 vs 0.49 (p<0.01)	2.11 vs 1.28 (p<0.01)
Non-sedated / sedated	0.81 vs 0.21 (p<0.01)	0.85 vs 0.27 (p<0.01)	0.91 vs 0.22 (p<0.01)
Procedure acceptance high / low	2.52 vs 1.95 (NS)	1.45 vs 2.54 (NS)	2.56 vs 2.01 (NS)
Post-operative well-being high / low	0.90 vs 0.61 (p=0.02)	0.68 vs 0.32 (NS)	1.03 vs 0.63 (p=0.02)

For all comparisons, level-3-experts vs level-1 practitioners.

Short procedures (less than 3 minutes) to longer procedure times. Procedure acceptance pleasant / neutral to tolerable / unpleasant. God perceived health first post-operative day to patients with poor health.

[Level-3 experts vs level-1-practitioners]

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TAP BLOCK FOR ILIAC CREST BONE GRAFT (ICBG) PAIN IN PATIENTS UNDERGOING AUTOLOGOUS BONE HARVEST FROM ANTERIOR ILIAC CREST (AIC) FOR CLEFT PALATE REPAIR

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Background and aims: Iliac Crest Bone Graft (ICBG) donor site pain is often more than primary operative site. TAP block efficacy for ICBG pain in patients scheduled for AIC graft for cleft palate repair was evaluated.

Methods: Prospective, randomized trial composed of two Group A: TAP block; Group B: local infiltration with saline with 1:2,00,000 adrenaline at ICBG harvest site. With ethics board approval, parental consent, 60 cleft palate patients were enrolled. TAP block performed with "double pop-up" technique. Mid-point of iliac crest and subcostal margin was point of entry. 0.75 ml/kg mixture of equal volumes of 2 % lignocaine with 1:2,00,000 adrenaline and 0.5 % bupivacaine was injected. Successful block defined clinically by less than 15 % increase in heart rate or blood pressure in response to skin incision at ICBG site.

Results: Significant response to incision at ICBG site (HR/ BP > 15% of baseline) seen in 4 (13.33%) v/s 26 (86.67%) patients (p< 0.05). Intra-operative, total fentanyl consumed were significantly more in group B. 4 (13.33%) v/s 26 (86.67%) patients reported pain on palpation of the iliac crest in PACU. Time to first ambulation was 4.03 ± 2.1 v/s 5.11 ± 1.26 hours. Time for first rescue analgesic 3.22 ± 1.02 v/s 2.11 v/s ± 1.45 hours (p< 0.05).

Conclusions: TAP block for ICBG pain improves postoperative mobility, decreases opioid requirement, facilitates rehabilitation and accelerates recovery.

References:

The effect of transversus abdominis plane block for pediatric patients receiving bone graft to alveolar cleft. Masui. 2010 Sep;59(9):1185-9.

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PUMP'S FEEDBACKS AND E-SETTINGS FOR POSTOPERATIVE CONTINUOUS PERIPHERAL NERVE BLOCKS (CPNB) IN 59 ORTHOPAEDIC SURGERY PATIENTS: THE NEW PARADIGM OF TELEMEDICINE FOR POSTOPERATIVE PAIN MANAGEMENT

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Background and aims: Post operative continuous peripheral nerve blocks needs adjustments to reach the concept of functional analgesia without side effects. We hypothesized that telemedicine transmission of pump feedback-sand pumps settings by remote control will improve it.

Methods: Retrospective analysis of 59 ASA patients I & II with CPNB using a telemedicine PCA pump (Rythmic iCEA Pump™, Micrel, Athens, Greece) with Ropivacaine 0.2%. The patient answered to questionnaire 3 times a day or more on demand, the data were immediately transmitted from the pump to server via a GPRS module.

If one indicator was out of the predefined thresholds, the anesthesiologist' phone on call was immediately receiving a short text. He can also connect to the website, checked the data and modified the settings of the pump by remote control.

Results: 30 sciatic, 24 femoral and 5 interscalene catheters were followed. 5 accidentally removed. 16 patients complained about numbness promoting 2±1 changes in pump settings; 9 about motor blockade with 1±1 change; 5 about difficulties for physiotherapy with 1±1 change. Early physiotherapy, walk in the surgical ward and allowed activities were totally uneventful in 54 patients. The patient satisfaction was 8.5±1.5. No adverse event needed a postoperative analgesia technique change.

Conclusions: Pump's feedbacks and e-settings for postoperative analgesia using CPNB permitted a real adaptation to patients thoughts, complains and pain VAS values after orthopedic surgery without nurse and physician physical intervention. The new paradigm of telemedicine for postoperative pain management is on the way.

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DOES A CONTINUOUS SAPHENOUS NERVE BLOCK IMPROVE THE PAIN TREATMENT AFTER MAJOR ANKLE SURGERY?

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Background and aims: Continuous sciatic nerve block (CScNB) is used for pain management following major ankle surgery. Pain from the saphenous nerve sensory area often remains. We aimed to investigate whether pain was reduced by adding a continuous saphenous nerve block (CSaNB) to CScNB after major ankle surgery.

Methods: Following independent ethics committee approval, a double-blinded RCT was carried out among 50 patients scheduled for major ankle surgery. Preoperatively, sciatic (popliteal level) and saphenous (midfemoral level) nerves were blocked with Ropivacaine (20 mL 0.75% and 10 mL 0.375%, respectively) and sciatic and saphenous catheters were inserted. All procedures were ultrasound-guided. Postoperatively, all patients received CScNB (0.2% Ropivacaine 10 mL/h). Patients were randomized using computer-generated random numbers and sealed envelopes to continuous saphenous catheter infusion 5 mL/h for 48 hours of either Ropivacaine 0.2% or isotonic saline. Primary outcome measure was morphine consumption the first 48 postoperative hours. Secondary outcome measures were success rate of the saphenous nerve block, clinical analgesia of the foot and ankle the first 48 hours and cost-effectiveness (incremental cost-effectiveness-ratio).

Results: Results await conclusion of the trial by June 2012. A pilot study indicated expected mean consumption of 10 mg (SD 10 mg) morphine in the intervention group and 30 mg (20 mg) in controls.

Conclusions: We expect reduced morphine consumption when adding CSaNB to CScNB after major ankle surgery.

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OUTPATIENT CONTINUOUS REGIONAL ANALGESIA AFTER AMBULATORY ORTHOPAEDIC SURGERY: A COST-EFFECTIVENESS ANALYSIS

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Background: Aim of this study is to assess cost-effectiveness of outpatient continuous regional analgesia.

Materials and Methods: We designed a case-control prospective study comparing two cohorts, undergoing orthopaedic foot surgery, with a continuous popliteal block either in hospital or at home. Blocks were performed with mepivacaine 1.5%, followed by a continuous infusion of 5 mL/h ropivacaine 0.2%, via a disposable elastomeric pump (Easypump, BBraun, Germany). Specific contraindication were patients' refusal, lack of an accompanying persons, difficult accessibility to hospital. Patients were assessed daily by a standardised questionnaire either at the bedside or by phone. A top-down technique was used to estimate costs of human resources, while micro-costing for material costs. Results are given as medians and interquartile ranges (IQR).

Results: 168 patients were included (20 males, 148 females, age 58.3±13.7, ASA 1-2). 36 patients gave their consent to be managed outpatiently, 132 patients stayed 2 nights. Treatment was equally effective, with a median pain level of 2 (24h: IQR 1.5vs1, p=0.137; 48h: IQR 2vs2, p=0.563; 72h: IQR 2vs2, p=0.248). Adverse events did not differ significantly: catheter displacement (5.5%vs4.5%, p=0.812), persistent motor block (2.8%vs4.5%, p=0.605), insertion point inflammation (5.5%vs4.5%, p=0.812), accidental falls (2.8%vs0.70%, p=0.235). No differences were observed in additional visits request (8.0%vs6.8%, p=0.811), unscheduled readmissions rate (8.0%vs3.8%, p=0.383) or need for informal cares (25.0%vs34.8%, p=0.239). Readmissions related costs were 720.10 USD per outpatient patient and 410.50 USD in controls. Additional ambulatory visits costs were 8.10 USD per outpatient patient and 6.9 USD in controls. Total costs were 2195.22 USD vs 13502.94 USD (a net difference of 10986.58 USD per patient).

Conclusion: Outpatient continuous regional analgesia can be highly cost-effective, allowing a consistent reduction in postoperative management costs.

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AN EXAMINATION OF THE EFFECTS ON FIBROBLASTS OF PERIARTICULAR INJECTION SOLUTION USED AS ANALGESIA IN ARTHROPLASTY A CELL CULTURE LABORATORY AND ELECTRON MICROSCOPY STUDY

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Background and aims: Periarticular injection is an important component of multimodal analgesia in total hip and knee arthroplasty, prepared using a 60 mL volume of 0.5% Bupivacaine 200-400 mg, Morphine 4-10 mg, Epinephrine 300 µg, Methylprednisolone 40 mg, and Cefuroxime axetil 750 mg. This invitro study aimed to examine the effects on fibroblasts.

Methods: This study used 3T3 rat fibroblast cells. Under incubation, cells were produced by routine passage twice a week. In the study group, 100 µL of the prepared solution was added to 100% live 3T3 cells and nothing to the control group. Live cell ratio was determined by Trypan Blue staining at 24, 48 and 72 hours. Morphology was evaluated by Transmission Electron Microscopy(TEM).

Results: The number of cells in the study group remained stable and the control group showed an increase of 47% between 24 and 48 hours and a further 7% at 72 hours. The study group ratio of live cells determined by Trypan Blue staining was 96% at 24 hours, 98.2% at 48 hours and 96.7% at 72 hours, and control group, 95.1% 98.7% and 97.9% respectively. The TEM examination showed no morphological differences between the two groups.

Conclusions: A decreased number of fibroblasts in the solution group demonstrated the efficacy of the applied periarticular injection solution and no effect on the morphological structure of the cells in the TEM examination leads to the conclusion that this solution can be safely used as a component of multimodal analgesia.

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INTRADISCAL RADIOFREQUENCY WITH THE DISKIT II SYSTEM: AN HISTOLOGICAL EVALUATION IN SHEEP

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Background and aims: Chronic discogenic low back pain can be treated with a dual radiofrequency (RF) lesion technique (Diskit II, Neurotherm®). It is unclear whether this treatment produces histological changes.

Methods: Three lumbar discs were dissected from the spine of a freshly slaughtered sheep, stored at 4 °C for 24 hours and rewarmed in saline at 37 °C. In all discs an isolated needle with 2 cm active tip was placed at the left and right lateral side. A radiofrequent current was generated between the two electrodes. For each disc another treatment algorithm was used (table 1). The discs were fixated in formaldehyde and stained with hematoxylin.

TABLE 1. Algorithm

Disk 1 : Control disc.

Disk 2 : 2 min. 50 °C, followed by 2 min. 55 °C, 2 min. 60 °C and 4 min. 65 °C.

Disk 3 : 2 min. 65 °C, followed by 2 min. 70 °C, 2 min. 75 °C and 4 min. 80 °C.

Results: In disc 2 and 3 a widespread destruction of the matrix and cells of the nucleus pulposus (NP) are present (Fig. 1). In the annulus fibrosus (AF) localized damage was found in both treated discs (Fig 2).

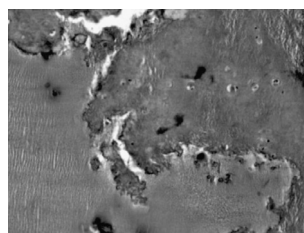


Fig. 1: NP

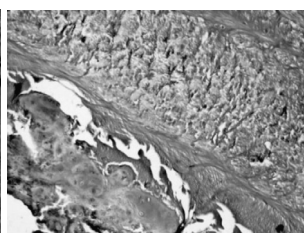


Fig. 2: NP

There were no differences in histological findings between the discs treated with 65 °C and 80 °C. It could not be determined where the changes in the AF were exactly located.

Conclusions: Dual RF lesioning of the intervertebral disc with the Diskit II method (Neurotherm®) produces diffuse destruction of the nucleus pulposus and focal zones of damage of the annulus fibrosus.

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REDUCTION IN CORTICAL GAMMA OSCILLATIONS AND PARVALBUMIN EXPRESSION OF MEDIAL PREFRONTAL CORTEX IS ASSOCIATED WITH EMERGENCE HYPEREXCITATION FOLLOWING ISOFLURANE ANESTHESIA

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Background and aims: Emergence hyperexcitation, a short-lived trouble during the recovery from anesthesia, has often been observed in clinical practice. However, the underlying mechanisms remain unclear. Phenotype loss of fast-spiking parvalbumin-positive (FS-PV⁺) interneurons and reduction in cortical gamma oscillations are associated with decreased inhibitory signal transmission followed by increased cortical hyperexcitability. Therefore, this study was designed to determine whether FS-PV⁺ interneurons are involved in emergence hyperexcitation following anesthesia.

Methods: This study was performed in 72 rats, which were allocated to three anesthesia regimes: one hour isoflurane anesthesia, one hour propofol anesthesia, and one hour mock anesthesia. Motor activity and parvalbumin expression of FS-PV⁺ interneurons in the medial prefrontal cortex were examined.

Results: Isoflurane-treated rats emerged earlier and agitated comparing to rats recovered from propofol anesthesia. Cortical parvalbumin expression in rats reduced during isoflurane and propofol anesthesia. However, the reduced

cortical parvalbumin expression reversed quickly following propofol but not following isoflurane anesthesia.

Conclusions: This study demonstrated that the reduction in cortical parvalbumin expression of medial prefrontal cortex contribute to the increased motor activity following isoflurane rather than propofol anesthesia in rats. These data suggest the dysfunction of fast-spiking parvalbumin interneurons is involved in emergency agitation.

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BENEFICIAL EFFECTS FROM COMBINED TREATMENT OF PULSED RADIOFREQUENCY AND EPIDURAL STEROID INJECTION

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Background and aims: Interlaminar epidural steroid injections (IESI) and Pulsed Radiofrequency (PRF) each alone have middle-term relief on low back and leg pain. PRF is growing in popularity between pain treatments as a minimally or not neurodestructive technique with the use of pulsed time cycle that delivers short bursts of energy to nervous tissue. No evaluations exist for the two combined treatments to solve chronic pain. The purpose of this study was to establish the age and period effects of combining together selective IESI and PRF of the dorsal root ganglia (DRG) for lumbar radiculopathies treatment.

Methods: Sixty-four consecutive adult patients with lumbar radiculopathies were evaluated. The primary outcome collected measures were a numeric rating scale (NRS) for pain and the Oswestry disability index (ODI), the secondary outcome measures were pain relief score, reduction of analgesic consumption and patient's satisfaction. Clinical assessments of these measures were performed at 1, 3 and 6 months, 1 year after the procedures. Attention was made for age, patient with precedent lumbar surgery and type of surgery.

Results: NRS and ODI scores were significantly decreased when compared with the baseline values and with significant changes in all secondary measures at all points of follow-up. Poor results were revealed with fusion surgery and older age, evidence of a minor efficacy was found after 6 months of the follow-up.

Conclusions: PRF with IESI is more efficacious in reducing pain scores, analgesic consumption, improving functional outcome of patients with lumbar radiculopathies in early period of life and before surgery.

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NOVEL RADIOFREQUENCY TECHNIQUE TO TREAT LUMBAR VERTEBRAL METASTATIC CANCER PAIN

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Background and aims: Metastatic bone cancer pain is responsible for 65% of cancer pain (300, 000 cases per year in USA). Most of them are due to vertebral body metastases. Radiation therapy; chemotherapy and surgical excision are the current treatment options. Each comes with possible serious side effects or associated morbidities. Cooled radiofrequency ablation (RFA) aims to produce a large intervertebral lesion which ablates the bone tumor interface to destroy free nerve endings resulting into considerable pain relief and debulking of the local tumor mass.

Methods: We are describing the technique and outcome of the first two cases performed at the Cleveland Clinic Pain Management Center. Two female patients (58, 62 years old) with metastatic breast cancer to the L3 vertebral body; presented with severe low back pain that failed opioid therapy. MRI revealed large tumor mass occupying the center of L3 vertebral body. L3 vertebral cooled radiofrequency was performed for both patients under fluoroscopic guidance for 15 minutes at 70° C degrees using the Osteocool® kit (Baylis Medical, Toronto, Canada).

Results: Both patients experienced 75% reduction in the pain VAS score associated with decreased disability and improved functionality as evidenced by 80% improvement in PDI (Pain Disability Index). Results were maintained at 2 and 3 months intervals.

Conclusion: Cooled RFA seems to be an effective treatment modality and may potentially have a role in alleviating pain and improving functionality secondary to lumbar vertebral metastases. Prospective and randomized controlled studies are warranted to establish such benefit.

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A COMPARISON OF INTRANEURAL AND EXTRANEURAL SHEAR MODULUS IN THE THIEL EMBALMED HUMAN CADAVER

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Background: Direct nerve damage occurs during Ultrasound Guided Regional Anaesthesia (UGRA). Shear wave elastography is a quantitative ultrasound technology increasingly used to differentiate between “hard” breast cancer masses and “soft” normal tissue[1]. Aim of the study was comparison of shear modulus in intraneural and extraneural tissue in Thiel embalmed human cadavers. Secondary objectives included measurement of shear modulus and its reproducibility.

Methods: Thiel cadaver advisory committee clearance obtained. B-mode imaging was overlaid with a colour map of shear wave modulus (SuperSonic, Aix, France) and two paired circular regions of interest were selected over the appropriate nerves and adjacent muscle. Two anaesthetists measured shear modulus for intraneural and extraneural pairs at same three sites - interscalene, median and sciatic. Two cadavers were selected for imaging and 20 paired measures taken of each block site by both anaesthetists for the first cadaver and 25 paired measurements in the second. Linear mixed models with maximum likelihood estimation (MLE) were used to assess effects. Significance was defined at $P < 0.05$.

Results: 167 measurements were eligible for analysis. Intraclass correlation coefficient was 0.73 amongst raters. Mean (CI 95%) intraneural Young's modulus was 26.8(24.6-29.2)kPa compared to extraneural tissue 6.2(5.7-6.8)kPa, $P < 0.01$. Interscalene 25.6(23.3-28.3)kPa and median nerves 24.3(21.8-27.0)kPa had a greater Young's modulus compared to sciatic nerves 3.5 (3.0-4.0), $p < 0.01$

Conclusions: Differences exist in shear modulus for intra and extra neural measures and for different block sites.

1. Evans A et al. Quantitative shear wave ultrasound elastography: initial experience in solid breast masses. *Breast Cancer Res* 2010;12:R104.

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A COMPARATIVE STUDY OF THE EFFECTS OF SIBUTRAMINE VERSUS PREGABALIN ON EXPERIMENTALLY-INDUCED PERIPHERAL NEUROPATHY IN RATS

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Background and aims: Peripheral neuropathy (PN) is accompanied by painful tingling or burning sensations that can become disabling .PN can result from diabetes mellitus and cancer chemotherapy. The study aimed at evaluating the efficacy of sibutramine -a serotonin (5-HT) and norepinephrine (EP) reuptake inhibitor- and pregabalin, an anti-epileptic agent, in peripheral neuropathy.

Method: Animal care and experiments received approval from animal ethics committee at National Institute of Ophthalmological Research. Seventy adult male albino rat were divided as ten as negative control);diabetes was induced in thirty rats & the remaining thirty were given vincristine 50 µg/kg i.p. daily for ten days. Each of the latter two groups was equally divided into three subgroups(n=10 in each): One subgroup was given saline (diabetic and vincristine control), one was given daily oral pregabalin 100 mg/Kg, and the third received daily oral sibutramine 5 mg/Kg .Treatment was continued for 3weeks.

Results: Diabetes induction and vincristine therapy were associated with occurrence of PN .Weight loss was significantly greater with sibutramine. Both drugs were associated with improvement of thermal allodynia and hyperalgesia, and significant effects on nerve conduction findings. Histological examination showed that, sibutramine treatment improved myelination in diabetic and vincristine neuropathies. Pregabalin treatment was associated with some improvement of myelination yet the area % of myelinated area was not significantly different from diabetic or the vincristine controls.

Conclusion: Both drugs are potentially useful for management of diabetic and vincristine -induced PN.

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MICRORNA 219 PRODUCES ANALGESIA FOR INFLAMMATORY PAIN VIA INHIBITING EXPRESSION OF CALMODULIN-DEPENDENT PROTEIN KINASE II

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Background and aims: MicroRNA (miRNAs) are small evolutionarily conserved non-coding RNAs of 18-25 nucleotides in length that act as expression regulators of genes involved in fundamental cell processes. miRNAs have attracted much attention as regulators of neuronal development and synaptic plasticity. miRNA 219 was reported to be correlated with expression of NMDA receptor and calcium/calmodulin-dependent protein kinase II (CaMKII). Down-regulation of miRNA 219 was noted in our microarray miRNA profiling in inflammatory pain. Thus, in this study, we examined the antinociceptive effect of miRNA 219 on inflammatory pain and the associated expression of CaMKII affected by miRNA 219.

Methods: The rats received intrathecal injection of 1, 5, or 10 µg vector encoding miRNA 219. Mechanical allodynia and thermal hyperalgesia induced by complete Freund's adjuvant (CFA) were tested 3 days later. Time course effect of 5 µg miRNA 219 were also performed on 3, 7, 14 and 21 days after intrathecal injection of 5 µg vector encoding miRNA 219. Spinal cord were dissected for quantitative analysis of miRNA-219 and CaMKII after behavior test.

Results: Intrathecal injection of 5 and 10 µg of vector expressing miRNA 219 significantly decreased CFA-induced mechanical allodynia and thermal hyperalgesia. The antinociceptive effect of miRNA 219 persisted for 21 days after injection of 5 µg miRNA 219 that was correlated with increased expression of miRNA 219 and decreased expression of CaMKII.

Conclusions: miRNA 219 provides long term antinociceptive effect for inflammatory pain via inhibiting expression of CaMKII.

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COMPARISON OF PLASMA CONCENTRATIONS OF LEVOBUPIVACAINE WITH AND WITHOUT EPINEPHRINE FOR TRANSVERSUS ABDOMINIS PLANE BLOCK UNDER ULTRASOUND

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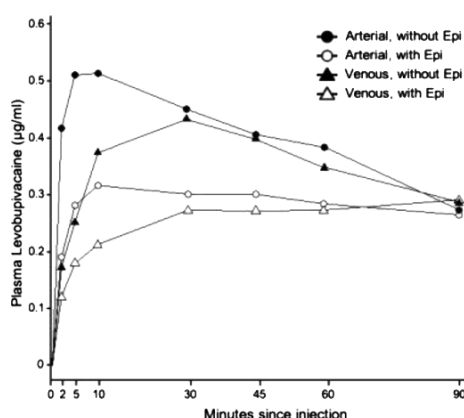
Background and aims: Pharmacokinetic profile of levobupivacaine (L) in TAP blocks has not been previously reported. We aimed to determine the effect of the addition of vasoconstrictor in the plasma concentrations achieved and the extent of the block.

Methods: After institutional Ethics Committee approval, 11 healthy male volunteers were enrolled in this double-blinded, two-period, cross-over study. The subjects were randomized to receive a unilateral TAP block with 20 mL of 0.25% L with or without 5 µg/mL epinephrine, with a 2 weeks washout period. Sensory dermatomal anesthesia was recorded. Simultaneous arterial and venous blood samples were obtained.

Results: The median upper and lower spread of sensory blockade was T9 (IQR,T7-T10) and L1 (IQR,T12-L1) with epinephrine, and T9 (IQR,T8-T10) and T12 (IQR,T11-L1) without epinephrine ($P > 0.05$).

The mean maximum arterial L concentration (Cmax) with epinephrine was 0.36 µg/mL (95%bCI, 0.30 - 0.42) and 0.63 µg/mL (95%bCI, 0.49 - 0.85) without epinephrine ($P=0.014$). The mean venous L Cmax was 0.32 µg/mL (95%bCI, 0.28 - 0.39) and 0.49 µg/mL (95%bCI, 0.37 - 0.68), with and without epinephrine, respectively ($P=0.006$).

Conclusions: Adding epinephrine to levobupivacaine solution reduces its peak plasma concentration after unilateral TAP blocks, with no remarkable effects in terms of block characteristics or duration.



[Picnew]

126 SUPERVISING ULTRASOUND-GUIDED BLOCKS (USGNB): A TABLET-BASED ON-LINE SYSTEM

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Background and aims: For ensuring a high standard of USGNB, we have developed an interactive systematic teaching and skill-monitoring concept. It is based on theory, rehearsal, and supervised clinical training.

Supervising experts corrects procedure- and knowledge-related flaws of the trainee, during procedure. Until recently data was reported as an after-time registration.

The latter establishes a risk of enhancing bias, based on a wish of success of the trainee and is also time demanding.

For obtaining precise in-time and bedside measures of trainee performances without increasing time consume, a novel tablet or notebook-based IT system was developed.

Methods: A SQL database with a front-end web application for PC, tablets and smartphones has been created. Supervisor uses tablets bedside for in-time registration of trainee performance, along with concomitant attachments of ultrasound-picture and effect-registration.

Results: In 2 months around 300 blocks has been recorded. Feedback from supervisors report a substantial decrease in time used at registration. Data has been more complete compared to earlier.

Conclusions: Online tablet registration is a rapid and precise evaluation of clinical performance, when training ultrasound-guided blocks.

The generalisability of the registration concepts, suggests its future applicability also for other clinical procedures.



[Bedside registration using tablets]

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COMBINED ULTRASOUND AND NEUROSTIMULATION GUIDANCE: THE SENSIVITY AND VALENCE OF MOTOR RESPONSES DURING ULTRASOUND-GUIDED BLOCKS OF THE PLEXUS BRACHIALIS

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Background and aims: We determined the sensitivity and valence of motor responses during ultrasound-guided nerve blocks. The aim of this study was to evaluate the conformity of visualization needle and LA distribution via US with the proper motor response.

Methods: 80 patients were included in this prospective study. Needle placement and fluidity distribution was visualized via ultrasound. The output current (0.1ms, 2Hz) was increased from its minimum up to 2mA until motor response occurred. Primary end point was the perineural LA distribution and proper motor response. We set a maximum of two needle insertions to achieve a motor response. A motor response below 0.5mA and a perineural LA distribution were assessed as a successful combination. Between 0.5-2mA performance was assessed as uncertain and a distribution without motor response was assessed as failed combination.

Results: Successful block quality was achieved in 79 patients (99%). A motor response was shown in only 32 patients (40%) to a amperage of ≤ 0.5 mA, 22 (28%) up to 2.0mA and 25 patients (32%) had no motor response to ≤ 2.0 mA. In 47 patients (62%) a second needle insertion was necessary, caused by an absence of motor response up to 2.0mA.

Conclusions: Ultrasound guidance and monitoring the spread of LA is associated with a high success rate for PNB with or without motor response. Maybe the valence of neurostimulation is overrated during ultrasound-guidance. The goal to enforce a motor response may prolongate procedure time and raise needle movements without improved results.

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MINIMUM EFFECTIVE VOLUME OF ROPIVACAINE 7.5 MG/ML FOR THE ULTRASOUND-GUIDED LATERAL AND SAGITTAL INFRACLAVICULAR BRACHIAL PLEXUS BLOCK

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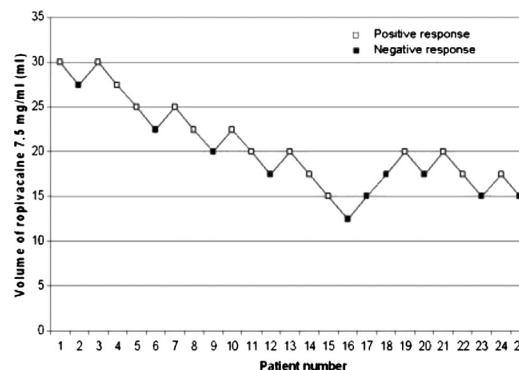
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Background and aims: Our aim was to determine the minimum effective volume (MEV) of ropivacaine 7.5 mg/ml using the ultrasound-guided lateral and sagittal infraclavicular brachial plexus block (LSIB).

Methods: We recruited patients scheduled for hand surgery. The block was performed by multiple deposits filling up a defined sector around the axillary artery (3-11 sector, 12 o'clock anterior). An independent observer, blinded to the volume assignment, tested the sensory and motor status every fifth minute for 30 minutes after completed injection. The first patient received 30 ml. Anesthesia or analgesia of all five nerves distal to the elbow was defined as a successful block. Depending on success or failure, the subsequent volume given to the next patient was adjusted down or up by 2.5 ml. MEV in 50% of the patients and sample size (25 patients) was determined using the Dixon and Massey up-and-down method. MEV₉₅ will be calculated using probit transformation and logic regression.

Results: Figure 1 shows the full dataset. MEV₅₀ and MEV₉₅ will be presented at the congress.

Conclusions: This study defines MEV₅₀ and MEV₉₅ for a precisely defined infraclavicular block.



[Up-and-down sequence of LSIB, ropivacaine 7.5mg/ml]

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COMPARISON BETWEEN COILED CATHETERS AND STIMULATING CATHETERS FOR CONTINUOUS FEMORAL NERVE BLOCK

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Background and objectives: The benefit of ultrasound-guidance to precisely place needles adjacent to nerves is undisputed. Ultrasound, however, is less helpful in accurately placing perineural catheters. Indeed the final resting position of the catheter tip is unpredictable and can be inadequate in 10%-50% of cases. Recently a catheter has been developed which coils up on insertion, resulting in the final resting position of the catheter tip being beside the needle tip (SonoLongCurl; Pajunk) - this allows the catheter to remain close to the confirmed initial needle tip position. The aim of this study was to determine the effectiveness of the new catheter in comparison to a standard stimulating catheter for continuous femoral nerve block after total knee arthroplasty.

Methods: 63 patients were enrolled in a double-blind, randomized, controlled study. Patients were randomized to receive either the coiled catheter or a stimulating catheter for continuous femoral block. The block was evaluated at different time-points by a blinded assessor. Outcome measures including pain on movement, PCA consumption, and sensation in the femoral nerve distribution were evaluated.

Results: Three patients were excluded from analysis. Of the remaining patients 29 received a stimulating- and 32 a coiled catheter. The coiled catheter was easier to place (subjective difficulty; $P=0.024$) with fewer catheter passes ($P=0.006$). There was no difference in primary block success or secondary block failure rate.

Conclusions: Placement of the coiled catheter in comparison to a stimulating catheter is easier. The primary and secondary block success rates, furthermore, of both techniques are comparable.

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CONTINUOUS SAPHENOUS NERVE BLOCK AS SUPPLEMENT TO SINGLE-DOSE LOCAL INFILTRATION ANALGESIA FOR POSTOPERATIVE PAIN MANAGEMENT AFTER TOTAL KNEE ARTHROPLASTY

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Background and aims: The golden standard for pain treatment after TKA is femoral nerve block. However, it can cause a troublesome motor blockade. Local Infiltration Analgesia (LIA) is an alternative that does not interfere with early mobilisation, but its duration is limited. An intra-articular catheter has not proven efficient to prolong the analgesic effect. The saphenous nerve block is another alternative that does not affect muscle strength. We investigated the analgesic effect of adding a continuous saphenous nerve block to a single-dose LIA after TKA surgery.

Methods: The study was approved by the Ethics-Committee of the Capital Region, Denmark. Forty patients were included in this double-blind randomized controlled trial. All patients received spinal anesthesia and single-dose LIA during the operation. The ultrasound-guided saphenous nerve catheter was placed in the adductor canal at mid-thigh level immediately postoperatively. Patients were randomized to receive boluses of 15 mL of either Ropivacaine 7.5 mg/mL or Saline twice daily for two postoperative days.

Results: On the day of surgery: worst pain-scores were lower in the Ropivacaine group VAS 3 (0-7) v.s. 6 (0-10) median (range) in the Saline group ($p = 0.02$) and pain scores at rest were 2 (0-7) v.s. 4 (0-8) ($p = 0.003$). In addition patients in the ropivacaine group performed better during physiotherapy ($p = 0.004$) and had less sleep disturbances ($p = 0.01$) during the first postoperative night.

Conclusions: Combining continuous saphenous nerve-block with single-dose LIA offered better pain treatment than LIA alone for patients undergoing total knee arthroplasty.

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SAFETY AND PHARMACOKINETICS (PK) OF NOVEL FIRST-IN-CLASS ANALGESIC: TRPA1 ANTAGONIST CB-189,625 IN HEALTHY ADULT MALES

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Background and aims: CB-189,625 blocks transient receptor potential ankyrin repeat 1 (TRPA1) channels attenuating surgically induced and inflammatory mediated pain in animal models. This novel approach to treat acute perioperative pain is being developed by Cubist Pharmaceuticals and Hydra Biosciences, Inc. This study assessed safety, tolerability and PK of CB-189,625 in humans.

Methods: Following Ethics approval, blinded subjects were randomly assigned to CB-189,625 ($n=6$) or placebo ($n=3$). CB-189,625 was dosed at 200, 400, 800, 1200 and 1600 mg as an oral solution. Placebo was the same concentrations of vehicle. Blood samples were collected over 48 hrs for PK. Safety labs, ECG, and physical exams were also done.

Results: CB-189,625 was well tolerated with no apparent safety signals. Adverse events were primarily gastrointestinal attributed to the vehicle. Plasma concentrations of CB-189,625 increased rapidly with C_{max} at 0.5 hours post-dose. CB-189,625 exposure (AUC) increased in an apparent dose-proportional manner. The median elimination half-life for CB-189,625 ranged between 4.2 to 6.0 hr, supporting possible twice-a-day dosing (Table 1).

Conclusions: CB-189,625 was safe and well-tolerated in healthy adult males with favorable PK permitting a suitable dosing regimen in future clinical studies.

TABLE 1

Parameter	200 mg	400 mg	800 mg	1200 mg	1600 mg
C_{max} (mcg/mL)	2.2 (1.6-2.9)	2.9 (1.7-4.2)	4.3 (3.2-7.0)	7.1 (4.4-10.4)	8.5 (4.4-13.6)
T_{max} (hr)	0.5 (0.5-0.5)	0.5 (0.5-0.5)	0.5 (0.5-1.0)	0.5 (0.5-0.5)	1.0 (0.5-1.5)
Half-life (hr)	5.9 (4.0-8.9)	4.9 (3.3-8.3)	4.9 (4.1-5.7)	4.2 (3.3-5.8)	6.0 (4.3-9.1)
AUC(0-t) _{ug*hr/mL}	11.4 (5.9-18.7)	12.6 (7.1-22.4)	21.6 (10.1-43.4)	35.4 (15.0-40.6)	64.9 (25.6-111)
CL/F (L/hr)	17.8 (10.7-33.9)	32.0 (17.8-56.4)	37.5 (18.4-78.9)	33.9 (29.6-79.8)	24.7 (14.4-62.5)

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THE EFFECT OF DEXAMETHASONE ON THE DURATION AND QUALITY OF SINGLE SHOT INTERSCALENE BLOCK WITH ROPIVACAINE FOR SHOULDER SURGERY: A PROSPECTIVE RANDOMIZED CONTROLLED TRIAL

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Background: Interscalene brachial plexus blockade (ISB) provides excellent analgesia but is often time-limited. Dexamethasone added to local anesthetics prolongs the duration of an ISB¹. However, systemic glucocorticoids also improve postoperative analgesia². We hypothesized that IV and perineural dexamethasone equally prolong the duration of an ISB.

Methods: We performed a prospective, double blind, RCT. Patients presenting for arthroscopic shoulder surgery were randomized in three groups all receiving an ISB with ropivacaine 0.5% (R); ropivacaine 0.5% and dexamethasone 10 mg (RD) and ropivacaine 0.5% with IV dexamethasone 10 mg(RDiv). Primary outcome was the time between the ISB and first analgesic request. Descriptive statistics are used for baseline characteristics. Continuous variables are presented as means with interquartile range (IQR). Kaplan-Meier survival curves (figure 1) were compared with the log-rank test.

Results: 150 patients were included after obtaining ethical approval and informed consent. Demographic variables were indifferent between study-groups. The mean time to first analgesic request was 825 min (IQR 635-910), 1433 min (IQR 1015-1710), 1475 min (IQR 1095-2035) for group R,RD and RDiv respectively ($p<0.0001$ for comparison between group R versus groups RD+RDiv).

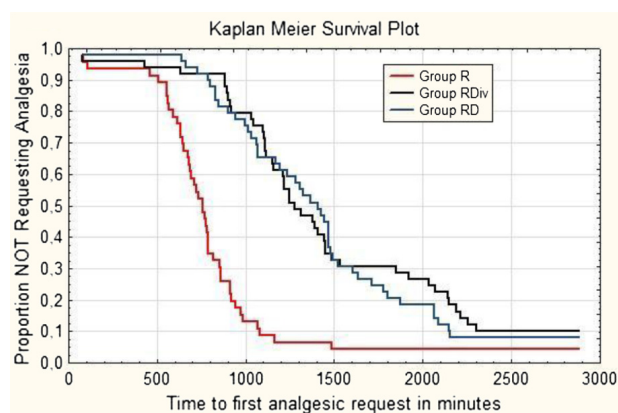


FIGURE 1. Kaplan Meier Survival Plot.

Conclusion: Intravenous dexamethasone equally prolongs the duration of an ISB with ropivacaine compared to perineural dexamethasone.

1. Cummings KC Effect of dexamethasone on the duration of interscalene nerve blocks with ropivacaine or bupivacaine. *British journal of anaesthesia*. 2011;1-8
2. Oliveira GS Perioperative single dose systemic dexamethasone for post-operative pain: a meta-analysis of randomized controlled trials. *Anesthesiology*. 2011;115(3):575-88

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RADIOLOGICAL EVALUATION OF THORACIC PARAVERTEBRAL CATHETERS: A PROSPECTIVE OBSERVATIONAL CLINICAL TRIAL IN ADULTS AFTER THORACOSCOPIC SURGERY

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Background and aims: Continuous paravertebral block is often described as producing a variable degree of block with a limited extent over a few segments only. This variability could be explained by a discrepancy between the needle tip location and the final resting position of the catheter tip once introduced through the needle. This possibility has recently been studied in an imaging study in fixed human cadavers. The aim of this prospective clinical trial was to evaluate the location of paravertebral catheters placed using the classical landmark puncture technique and to correlate the distribution of contrast dye injected through the catheters with the extent of somatic block.

Methods: Paravertebral catheters were placed in 30 patients after video-assisted thoracic surgery. A fluoroscopic examination in two planes using contrast dye was followed by injection of local anaesthetics and subsequent clinical testing of the extent of the anaesthetized area.

Results: In 30% of the cases, contrast dye spread was not seen within the paravertebral space as intended. Misplaced catheters were in the epidural space (3 cases), in the erector spinae musculature (5 cases) and in the pleural space (1 case). Seven patients had a clinically insufficient block resulting in a 23% failure rate. There was a discrepancy between the radiological findings and the observed distribution of loss of sensation.

Conclusions: We can conclude that the paravertebral space is not suitable for catheters in current use and we suggest using single injection techniques unless the catheters are placed under direct vision by a surgeon.

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INTRODUCTION OF INTRATHECAL HYPERBARIC PRILOCAINE TO DAY SURGERY UNITS ACROSS WEST OF SCOTLAND

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Background and aims: Based on its pharmacokinetics of quick regression, the hyperbaric formulation of Prilocaine may be an alternative to General anaesthetic (GA) in day case surgeries. Our aim was to assess its suitability.

Methods: We audited 26 adult patients who received 30-50 mg of hyperbaric Prilocaine with 10 mcg of fentanyl for lower abdominal and lower limb procedures. Spinal was administered in sitting position. Patients lay on their side or sat up for 3 minutes for lateralisation. We focussed particularly on the time to independent ambulation. Patients requests of sedation and conversion to GA were recorded. All the patients completed a satisfaction survey before discharge and were followed up at 48-72 hours.

Results: The median time to ambulation was 124 (74-220) minutes and to discharge 180 (150-240) minutes. All patients self voided before discharge. In one patient Spinal was clearly inadequate and GA was administered and hence excluded. There were 3 more conversions to GA, one in where surgery start was delayed and procedure overrun for 2 hours and the other two had delayed onset of block but no additional analgesia was required intraoperatively. 5 patients received sedation with TCI Propofol and 5 with Midazolam. On follow up 2 patients had low back pain. 24 patients were highly satisfied with the experience.

Conclusions: 15% conversion rate to GA suggests that further modifications are required to technique. Recovery was rapid and caused no delays to discharge. Patient satisfaction was high and adverse effects minimal. Hence, hyperbaric Prilocaine may be suitable for selected day surgery patients.

Posters

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EPIDURAL ABSCESS AFTER PATIENT-CONTROLLED EPIDURAL ANALGESIA FOR AN ASTHMATIC PATIENT WITH INHALED CORTICOSTEROID TREATMENT

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A 65-year-old man, with a history of asthma controlling with long-term use of inhaled corticosteroids, received right total knee replacement under spinal anesthesia. After surgery, he used patient-controlled epidural analgesia with 0.0625% marcaine for 3 days. The epidural catheter was inserted into L2/3 and placed up 6 cm. The patient discharged uneventfully on the 6th postoperative day.

Seven days later, he suffered from acute urinary incontinence retention and bilateral lower limbs weakness with 2 of 5 of muscle strength. A sagittal T₂-weight magnetic resonance imaging (MRI) scan obtained at emergency room showed an epidural abscess mainly at T10 to L2 with spinal cord compression and posterior paraspinous myositis with abscess formation major at L2 to L4. He underwent emergent laminectomy of thoracic level 10 to lumbar level 2 with debridement and received empiric antibiotic treatment. The pus culture was methicillin-resistant *Staphylococcus aureus* (MRSA) and antibiotic treatment was shifted to daptomycin with fosfomycin. His muscle strength of lower limbs was recovered to 4 of 5 without any infective sign and he was discharged one month later.

Conclusions: Epidural abscess is a rare but potentially life-threatening neurological emergency. Fifteen to twenty-two percent of spinal epidural abscesses are due to invasive procedures or instrumentation. Spinal surgery, epidural anesthesia, steroid and pain-relieving injections, and placement of pain pumps are all associated with spinal epidural abscess. Although inhaled corticosteroids are seldom related to immunocompromise, a high suspicion is necessary to avoid delayed diagnosis and adverse neurologic outcomes in a patient with multiple risk factors.

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BILATERAL ULTRASOUND TAP BLOCK IN A CHILD AFFECTED BY PRADER-WILLI SYNDROME

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Background: Prader-Willi syndrome is a rare congenital disorder characterized by hypotonia, hypogonadism, developmental delay and hypopentia and is associated with obesity caused by hyperphagia making very difficult to perform regional anesthesia through traditional landmarks. We describe a bilateral ultrasound TAP block on a child affected by this disease underwent to bilateral hernia repair.

Case report: A 4 year old male, suffering from Prader-Willi syndrome, 36 kg of weight was presented for surgical treatment for bilateral hernia repair.

General anesthesia was induced with fentanyl 2 mcg/kg and propofol 3.5 mg/kg and mechanical ventilation performed through a proSeal laryngeal mask airway without muscle relaxants. General anesthesia was maintained with 120 mcg/kg/min propofol and 0.10 mcg/kg/min remifentanyl in Air/O₂ mixture (FiO₂ = 0.4) by IPPV. A 21 G 80 mm needle was used for bilateral ultrasound transversus abdominis plane (TAP) block. A linear array 10 MHz was placed in a transverse plane to the lateral abdominal wall in the mid-axillary line between the lower costal margin and iliac crest and levobupivacaine 0.25% at a dosage of 0.3 ml mg/kg administered in each side in the plane between the internal oblique and transversus abdominis muscles.

Conclusions: The ultrasound TAP block provided excellent intraoperative and postoperative analgesia without complications. The use of ultrasound allowed us to overcome the difficulties of child obesity. A longer needle was necessary because of thickness of the adipose tissue. No case of this syndrome underwent to a bilateral ultrasound TAP block has been published in literature.

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LUMBAR SYMPATHETIC BLOCK - USE OF ULTRASOUND

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Lumbar sympathectomy is used to treat Chronic Regional Pain Syndrome (CRPS) or ischaemia of lower limbs. We describe the use of Ultrasound to facilitate needle placement to the anterolateral surface of L3 on two patients before confirmation using standard fluoroscopy.

Patients were prone with a cushion under the abdomen. The sacral surface and transverse processes were identified using a curvilinear probe and S Nerve (Sonosite, Bothell, WA, USA). The probe was pivoted over the transverse process of L3 to a horizontal position and moved laterally. The beam was aimed medially to visualise the rounded surface of the vertebral body and the needle guided onto the anterolateral surface of the vertebral body (Fig 1).

In both patients the target structure was visible. The endpoint was not clearly identified using ultrasound, but did facilitate single needle pass without redirection, thereby causing less discomfort to the patients.

We believe this is the first description of the use of ultrasound guidance for lumbar sympathetic block. Ultrasound may be useful for identifying the anterolateral aspect of the vertebral body reducing the number of needle passes, but fluoroscopy is still required for confirmation of needle placement.



FIG. 1. Needle approach to L3 vertebral body

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UTILITY OF ULTRASOUND-GUIDED TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK IN A EMERGENCY DEPARTMENT (ED)

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Background and aims: The postoperative analgesic efficacy of the TAP block has been demonstrated in various surgical procedures. The aim of this study was to test the feasibility and efficacy of TAP in a ED.

Methods: We collected ultrasound-guided TAP blocks performed in the ED over a period of 3 months. Were noted: the clinical indication, the morphine consumption one hour before and one hour after the TAP block and the clinical efficacy based on the Numerical Rating Scale (NRS).

Results:

TABLE 1.

	Morphine Consumption (mg) before TAP block	Morphine (mg) Consumption with TAP block	NRS before TAP block	NRS with TAP block
Acute pancreatitis	8	2	7	2
Strangulated umbilical hernia	20	10	9	3
Strangulated inguinal hernia	12	5	7	3
Pelvic trauma	15	5	7	3
Pelvic trauma	13	7	9	4

Five TAP blocks was performed. The TAP blocks were used for pain management or as a supplement to the multimodal analgesia and the failure of the intravenous morphine or in case of bad clinical tolerance of the morphine. For the 5 cases the TAP block allowed reduction of 57% of morphine consumption and decrease the pain of 41,6%. The analgesic effect persists during 24 hours. No complication was observed. For the inguinal strangulated hernia, the TAP block allowed the hernia reduction.

Conclusions: The TAP block is a technique simple to realize, safe, providing prolonged analgesia. It can be useful in a ED reducing morphine consumption and allowing a better treatment for abdominal pain.

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ULTRASOUND-GUIDED INTERSCALENE BLOCK IN A PATIENT WITH A DEEP BRAIN STIMULATOR

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Background and aims: Deep brain stimulators are used to treat a variety of movement disorders such as Parkinson's disease and benign essential tremor.

They consist of a subcutaneous control box below the clavicle and two leads which pass through the neck to the basal ganglia in the brain. At the level of the clavicle the leads pass close to the brachial plexus and may therefore be damaged during interscalene and peri-clavicular blocks.

Methods: A 72 year old presented for revision shoulder hemi-arthroplasty. She had been successfully treated for benign essential tremor with a deep brain stimulator.

Combined interscalene and superficial cervical plexus blocks were performed under ultrasound guidance. An out of plane approach was used for the interscalene block. Both leads were identified and avoided and 12ml of 0.5% Bupivacaine was infiltrated around the upper trunk of the plexus.

Results: The deep brain stimulator was unaffected and the block provided excellent post-operative analgesia.

Conclusions: In patients with deep brain stimulators, the use of a peripheral nerve stimulator may damage the leads and induce dangerous electro-magnetic currents. An ultrasound guided technique is therefore mandatory. As can be seen in the image the leads can easily be identified and avoided.



FIG. 1. DBS leads lateral to brachial plexus

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HEMODYNAMIC EFFECTS OF SUBDURAL 2% PRILOCAINE

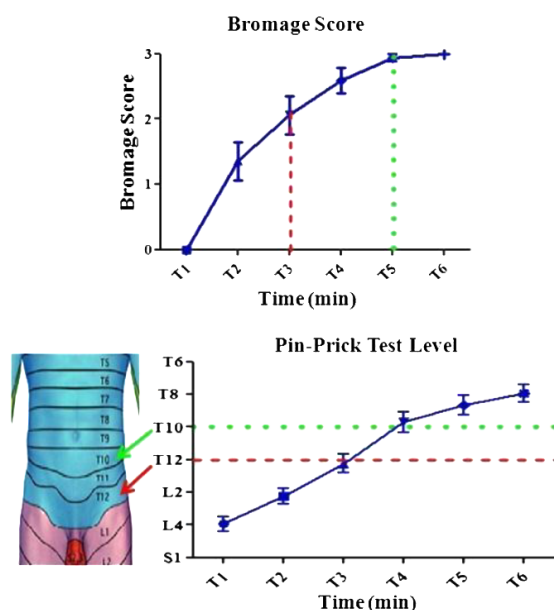
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Background and aims: Hyperbaric 2% Prilocaine is a medium acting local anesthetic for spinal use. The aim of our study was to investigate hemodynamic effects of this local anesthetic recording invasive measurements of hemodynamic variables: arterial pressure, cardiac index, stroke volume variation, cardiac frequency. Meanwhile we evaluated its efficacy on sensory and motor block and speed onset.

Methods: Ethical committee approval obtained (January 21, 2012, Ethical Committee of ASL Milano 2). All patients received an arterial catheter placement in radial artery and were connected to Vigileo/FloTrack® system: basal parameters were recorded 5 minutes before anesthesia. After combined spinal-epidural anesthesia and subdural administration of the drug, hemodynamic parameters were recorded every 2 minutes, as well as level of sensory and motor block, for the first 12 minutes (total of 7 points of measurements).

Results: No clinically significant hemodynamic events were recorded. At 10 minutes Bromage 3 score was obtained in all patients, in 8 minutes skin analgesia level of T10 was reached by all patients.

Conclusions: Prilocaine has demonstrated an optimal hemodynamic stability with no clinically significant hemodynamic effects recorded and good anesthetic efficacy, with fast and efficient sensory and motor block.



[Progression of Bromage Score and PinPrick Level]

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PRILOCAINE VERSUS BUPIVACAINE IN UROLOGICAL AMBULATORY SURGERY

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Background and aims: Prilocaine is a short acting anesthetic. Little is known about the intrathecally administration of prilocaine in urological setting. This study aims to compare the efficacy and safety of anaesthesia offered by subaracnoid administration of prilocaine with that of bupivacaine in day surgery.

Methods: Fifty patients scheduled for endoscopic surgery, ASA I - III, were randomized to receive an intrathecal injection of 2ml of iperbaric solution of bupivacaine 10 mg (group B) (n = 25) or of iperbaric prilocaine 60 mg (3ml) (group P) (n=25). Analgesia was effective when sensitive block achieved T10 dermatome at pinprick test. Onset time and duration of motor block was monitored using Bromage Scale, analgesic drugs supplementation and blood pressure values were recorded too.

Results: Mean length of surgery was 30 min. At 1h, motor block in Group P had fully resolved in 75% of patients, compared with 5 % in Group B (p < 0,05). The onset time of sensory block was shorter in group P (mean value 2 min) than in group B (mean value 5 min) (p < 0,05). Sensory block duration was superior in group B (mean value 100 min) than in group P (mean value 55 min) (p < 0,05). A significant decrease in blood pressure was more common in bupivacaine group. No additional analgesic drugs were requested.

Conclusions: Both anaesthetics provided an effective and safe anaesthesia. In accordance with our results Prilocaine could be a better choice for spinal anaesthesia in urological ambulatory surgery.

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CAFFEINE ANAMNESIS AND ORAL KITCHEN SALT IN PATIENTS WITH HEADACHE AFTER NEURAXIAL BLOCKADES

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Background and aims: It is known that there are people who are prone to the development of initial episodes of headaches caused by CSF hypotension. They usually say you feel better after taking caffeine-containing beverages: coffee, tea. Caffeine history of these patients with periodic headache lasts for years, decades. We hypothesized that patients with high risk of headache after neuraxial blockades can be identified in advance by studying their "history of caffeine". In addition, some of these individuals to ease head pain, accompanied by a feeling of "emptiness in my head," are very popular salty food, salty drinks, or just plain kitchen salt - sodium chloride. These observations are explained by the known effect of sodium on the production of cerebrospinal fluid, the balance of extracellular and intracellular fluid in the brain. Therefore, we hypothesized that people prone to caffeine-sensitive headache, with the development of it after an epidural or spinal anesthesia, can help an ordinary sodium chloride, passed orally.

Methods: Careful questioning, always bearing food preferences and detailed clinical observation of 1000 patients who underwent neuraxial blockade.

Results: Headache after the closures occurred in 1 - 2% of these patients. In the beginning (about half of all cases), we cut short in such pain only epidural blood patch. Then, taking into account the "salt" and "caffeine" history, we have to use the normal oral intake of kitchen salt - approximately 0.5 - 1 teaspoon in 200 ml of water. Acceptance of sodium chloride, usually within an hour headache subsided completely, which subsequently did not arise again.

Conclusions: Caffeine and salt accounting history can not only predict but also to effectively treat the headache associated with neuraxial blockade. Caffeine addiction - not a negative habit, but a sign of addiction to liquor hypotension and associated headaches.

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CONSENT FOR PAEDIATRIC EPIDURALS - A SURVEY OF PRACTICE AMONG ANAESTHETIC TRAINEES AT A PAEDIATRIC TERTIARY REFERRAL CENTRE

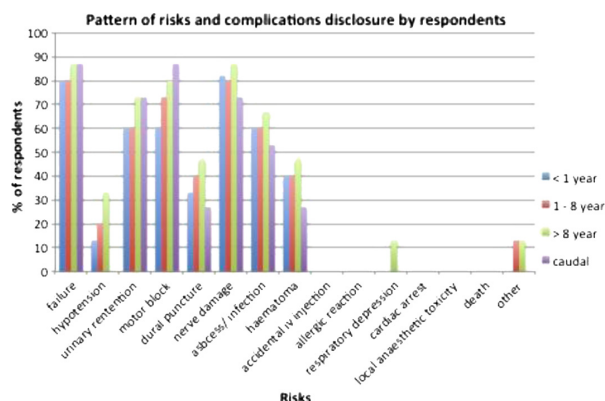
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Background and aims: Informed consent is of prime importance in the performance of epidurals in children. An average of 2100 paediatric epidurals

are performed per year in Great Britain [1] while a recent audit at our institution reported an average of 148 sited per year [2]. There are currently no guidelines for disclosing risks or their associated incidence rate in the paediatric population but patient information leaflets are available at our institution. The aim of this survey was to evaluate current practice in how anaesthetists obtain consent for these procedures.

Methods: Background information and a survey was emailed to all anaesthetic trainees at our institution in February 2012.

Results: Response rate 58% (15/26).



[Pattern of risk disclosure by respondents]

>50% disclosed at least 5 risks (fig 1). 33% (5/12) routinely disclosed the incidence of risks.

Conclusions: This survey highlights the current practice in obtaining consent for paediatric epidurals at our institution. It suggests that there is some inconsistency in the knowledge of risks and information given to patients by trainees.

References:

1. Llewellyn N, Moriarty A The national paediatric epidural audit Paediatr Anaesth 2007; 520-533.
2. Great Ormond Street Hospital - Acute Pain Database 2012.

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CEREBRAL OXYGENATION IN MAJOR ABDOMINAL OPERATIONS UNDER COMBINED GENERAL AND EPIDURAL ANAESTHESIA

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Background and aims: The aim of this study was to investigate the effects of combined thoracic-general and lumbar -general anaesthesia on cerebral oxygenation during major abdominal operations.

Methods: 25 patients undergoing major abdominal operations were divided into 2 groups. In Group I thoracic epidural was performed at Th6 to Th10, and in Group II lumbar epidural at L2 to L3. Analgesia was provided with ropivacaine 0.5% at operation and age depended dose. General anaesthesia was maintained with sevoflurane and sic-atracurium. Haemodynamic parameters were followed up continuously invasively. Depth of anaesthesia was kept between 40 and 55, assessed by the Cerebral State Index-CSI. Cerebral oxygenation was monitored by the Near Infrared Spectroscopy (NIRS) using rSO₂ index. An SjVO₂ catheter was inserted in the right jugular bulb and samples of jugular blood were taken for blood gas, glucose and lactate measurements at 1st, 2nd and 3rd hour during operation, at PACU and 24 hours later.

Results: There were no statistically significant differences between groups at any time and between time periods in haemodynamics, rSO₂ and SjVO₂ measurements (p>0.05, ANOVA test).

Conclusions: During major abdominal operations under combined general and thoracic or lumbar epidural anaesthesia, cerebral oxygenation was not affected at any studied period.

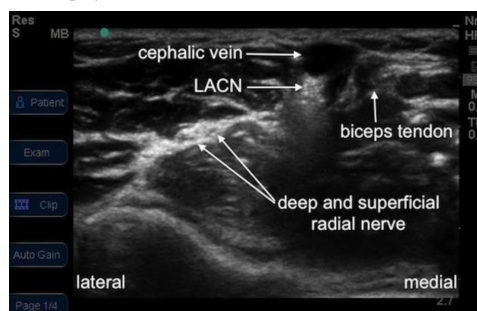
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ULTRASOUND-GUIDED BLOCKADE OF THE LATERAL ANTEBRACHIAL CUTANEOUS NERVE

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Background and aims: This volunteer study was designed to describe consistent anatomic relationships of the lateral antebrachial cutaneous nerve (LACN) at the level of the elbow to facilitate ultrasound-guided nerve blockade.

Methods: Ethics committee approval was granted. Fifteen healthy volunteers were recruited and block side randomised. Just distal to the elbow crease the LACN was identified on ultrasound and its visibility scored. Distances and relative positions between LACN and adjacent structures were measured. 1% Lidocaine (3 ml) was injected using a needle-in-plane approach under continuous ultrasound visualisation. The resulting sensory deficit to ethyl chloride spray was assessed.



[Figure 1]

Results: The LACN was identified on ultrasound in all cases. In 87% it was located ≤2mm from the biceps tendon, always lateral to it. In 73% the LACN was situated ≤2mm from the cephalic vein. The nerve was most commonly (in 87%) positioned infero-medially to the cephalic vein on ultrasound imaging. The LACN was blocked in all volunteers, demonstrated by a typical pattern of sensory loss.

Conclusions: The biceps tendon and the cephalic vein are suitable landmarks for ultrasonographic identification of the LACN. Selective blockade of the LACN facilitates anaesthesia and analgesia with reduced motor blockade for hand and wrist surgery.

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CAN ULTRASOUND DETECT DIABETIC PERIPHERAL NEUROPATHY? A CROSS-SECTIONAL STUDY

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Background: Ultrasound (US) machines provide high-resolution images of nerves and may identify peripheral nerve disease such as diabetic sensorimotor polyneuropathy (DSP). US maybe a useful bedside tool, less invasive than nerve conduction studies (NCS), for diagnosis and staging of DSP. We examined the association between posterior tibial nerve (PTN) size and presence and severity of DSP.

Methods: After ethic-board approval, we studied 98 consecutive diabetic patients having NCS and classified them as cases with DSP or controls. Severity was determined using the Toronto Clinical Neuropathy Score (TCNS). A masked sonographer measured the PTN cross sectional area (CSA) at 1, 3, and 5 cm proximal to the medial malleolus (PMM), and the results were compared to DSP status.

Results: 55 patients had DSP and their mean PTN-CSA was larger compared to controls at distances of 1 (23.03 vs. 17.72 mm²; p = 0.004), 3 (22.59 vs.

17.69 mm²; $p < 0.0001$) and 5 (22.05 vs. 17.25 mm²; $p = 0.0005$) cm PMM. The measurement at each level was the same within each patient. The CSA was directly related to the severity of DSP determined by the TCNS. A threshold value of 19.01 mm² provides acceptable diagnostic characteristics to identify DSP with a sensitivity of 0.69 and specificity of 0.77.

Conclusions: This large study of diabetic patients confirms that the PTN-CSA is larger in patients with DSP than in controls. Consequently, US is a promising point-of-care screening tool to determine the presence of DSP.

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IS A DISTAL APPROACH TO SCIATIC NERVE BLOCK AS EFFECTIVE AS PROXIMAL APPROACHES FOR TOTAL KNEE ARTHROPLASTY? A SERVICE EVALUATION

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Background and aims: Total knee arthroplasty (TKA) is associated with severe pain leading to delayed mobility and discharge. We compared distal with proximal approaches to sciatic nerve block for TKA to establish any difference in analgesic requirement, time to mobilisation and inpatient duration. **Methods:** A retrospective data collection was undertaken of 60 patients following TKA. In addition to the sciatic nerve block, all patients had single shot femoral nerve blocks and received simple analgesics.

Technique, including volumes and concentrations of Levobupivacaine for each block were recorded. Daily post-operative opiate consumption, time to mobilisation and discharge were recorded.

Results: 80% of the sciatic group had a spinal compared to 90% in the popliteal group. Morphine consumption was similar in the 2 groups on day 1 (distal 16.0 vs prox 16.4) and day 2 (13.8 vs 16.3). 11 patients receiving distal blocks had no morphine vs 6 patients with proximal blocks.

Average time to mobility (distal 1.6 days vs prox 1.67 days) and discharge (4.33 days vs 4.03 days) were also similar. After removing patients from each group who had prolonged admissions for chest infections and poor glucose control, the average discharge time was distal 3.4 vs proximal 3.9 days.

Conclusions: The distal approach to the sciatic nerve has been shown to be at least as effective as a proximal approach for TKA within our trust. There has been no significant difference between the 2 groups regarding opiate consumption and in average time to mobilise and discharge between the two groups.

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CHANGES IN RESISTIVE INDEX (RI) IN MIDDLE CEREBRAL ARTERIES AFTER UNILATERAL STELLATE GANGLION BLOCK (SGB)

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Background and aims: Stellate ganglion block (SGB) has been used in the treatment of cerebral derangements thought to be associated with a headache, for the purpose of relieving spasm and presumably increasing the cerebral blood flow, normalizing endothelial resistance. A number of clinical observations, ascribing dramatic results of stellate block to the release of cerebral angiospasm.

Methods: Unilateral (SGB) was performed on 30 volunteers' patients, female, 30-40 years (with cluster headache) with 5 ml 0.250 ropivacaine + 4mg dexamethasone using a paratracheal ultrasound guided technique at the C6 level and confirmed by the presence of Horner's syndrome. The resistive index (RI) was measured (by ultrasound transcranial CV Doppler* of middle cerebral artery) at baseline (SGB) and 1min and 10 minutes after (SGB) on both sides (the other side was taken as a control, patients with a abnormal RI on both sides was discharged). Normal values of RI was taken according the age.

Results: Our observation that unilateral, compromised side, after stellate ganglion block, in our patients produce measurable change in the (RI), is in contrast with the presumption that this procedure leads to dilatation of the cerebral vessels and normalize (RI) at middle cerebral artery.

Conclusions: The difference between the block and the non-block sides was significant before procedure, and after 10 minutes become the same with an insignificant difference. Possible will be as an indicator for decision of the block side (with a higher (RI) in patients with a cluster headache. Ultrasound technique will be helpful for provide safe block and effect control.

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DERMABOND® TOPICAL SKIN ADHESIVE IS USEFUL FOR PREVENTING CONTINUOUS FEMORAL NERVE CATHETER DISLODGE

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Background and aims: Continuous femoral nerve block (CFNB) is often used for analgesia after total knee arthroplasty (TKA). One common problem with CFNB is pericatheter leakage of anesthetic solution at the insertion site, which may increase the risk of dislodgement of the catheter. 2-Octyl cyanoacrylate glue (Dermabond® Topical Skin Adhesive; Ethicon Somerville, NJ) is a liquid topical skin adhesive that we believe can be used to prevent pericatheter leakage. Thus, we undertook this study to determine whether Dermabond reduces leakage and, in turn, the incidence of catheter dislodgement.

Methods: This is a retrospective cohort study of 141 patients who underwent TKA or uni knee arthroplasty (UKA) with CFNB during November 2009 to January 2012. We compared the incidence of pericatheter leakage and catheter dislodgement (before planned removal) in 76 patients who received Dermabond® (D group) and 65 patients who did not (C group). We used Fisher's exact test for statistical analysis. For all analyses, $P < 0.05$ determined significance.

Results: In the C group, pericatheter leakage occurred in 13 (20%) patients, of which 7 (10.7%) resulted in catheter dislodgement. In the D group, leakage occurred in 6 (7.9%), of which 1 (1.3%) was dislodged because of leakage. The incidence of leakage and subsequent catheter dislodgement was significantly lower in the D group ($P = 0.048$ and 0.024 , respectively).

Conclusions: Dermabond® may be useful for preventing pericatheter leakage and may also reduce the incidence of continuous femoral nerve catheter dislodgement.

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THE IMPAIRMENT OF VOCABULARY AND ARITHMETIC ABILITY IN COMPLEX REGIONAL PAIN SYNDROME PATIENTS

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Background and aims: CRPS type 1 does not have demonstrable nerve lesions, whereas CRPS type 2 has evidence of obvious nerve damage. CRPS can affect emotional distress and cognitive function. The aim of this study was to find the different cognitive functions between the control and CRPS type 1 patients groups.

Methods: CRPS patients group consisted of 26 subjects and the control group consisted of 26 healthy subjects and they participated in the neuro-cognitive tests which included four-subtests of the Korean version of the Wechsler Adult Intelligent Scale-Revised (K-WAIS) and the Trail Making Test (TMT)-A and TMT-B.

Results: CRPS patients showed the lower score in the Vocabulary subtest compared with control group ($p = .005$). CRPS patients showed low scores in the Arithmetic subtest ($p = .026$) compared with control group ($p = .005$). There were no significant differences in Picture Arrangement, Block Design subtests and total IQ. The performance on the TMT-A and TMT-B did not show significant differences between two groups.

Conclusions: We suggest that CRPS affects the decline of Vocabulary and Arithmetic intelligence, implying cognitive dysfunctions of brain in CRPS patients.

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CERVICAL TRANSFORAMINAL EPIDURAL STEROID INJECTION: DIAGNOSTIC AND THERAPEUTIC VALUE

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Background and aims: Cervical TFESI may help decrease the pain and restore function in patients with cervical radiculopathy. However, there have been multiple case reports identifying the complications of this procedure. This retrospective analysis reviews the patients who have received cervical TFESIs and evaluates if there was an associated with a decrease in the need

for spine surgery. The pain relief, duration of benefit, changes in opioid requirements, and complication type and rate were also analyzed.

Methods: Patients referred to the CC-PMC by Spine Surgery for cervical TFESI were identified using the procedure CPT code over a 5 year period. The EMR was reviewed for demographic information, pain scores, cervical TFESI details and did the patient proceed for surgery.

Results: 23 individual patients were identified having received this procedure. Patients received between 1-4 TFESI. 52.3% of these patients did not require surgical intervention (as they had adequate pain relief) and the cervical TFESI helped identify the appropriate level for surgery in the remaining 47.7%. There were no adverse events associated with this procedure.

Conclusions: Cervical TFESI may be associated with a reduction in the need for surgery. Of the 23 consecutive patients identified, 52.3% of the patients did not require spine surgical intervention. This procedure was valuable in identifying the symptomatic level in patients with multilevel spondylosis. No adverse events were noted. Although this study is limited by its retrospective nature, this study suggests a correlation between the cervical TFESI and the decrease in the need for surgery.

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EFFECTIVENESS OF THORACIC FACET JOINT RADIOFREQUENCY DENERVATION IN TREATMENT OF CHRONIC BACK PAIN - A RETROSPECTIVE AUDIT OF CLINICAL OUTCOMES

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Background and aims: Thoracic facet joints have been suggested to be the source of middle and upper back pain for a long time. One of the methods to treat facet joint pain is radiofrequency denervation of median branch of the primary dorsal rami of the spinal nerves.

Methods: The treatment was performed at district general hospital between 2007 and 2011. Patients were selected on the basis of history of chronic upper and middle back pain lasting for over a year not amenable to conservative treatment and confirmatory diagnostic injections with local anaesthetic and steroid to the median branch nerves.

Results: 28 patients, 18 females and 10 males, mean age 55 were included. 19 patients (66%) reported improvement at first follow up which occurred between 27 and 243 days after the procedure. Average duration of pain relief was 7.8 months. VAS score has improved from mean of 7.8 (range 4-10) to—mean of 3.3 (range 0-8). Functional improvement was reported by 10 patients. 6 patients reported complete pain relief.

Conclusions: Radiofrequency denervation of median branch blocks in treatment of chronic upper and middle back pain is a useful management option.

Reference: Atluri S, Datta S, Falco FJE, Lee M. Systematic review of diagnostic utility and therapeutic effectiveness of thoracic facet joint interventions. *Pain Physician* 2008; 11:611-629.

Ethics: This is to confirm that Dr Y Stefak undertook an Audit of "Radiofrequency ablation in management of Back Pain" Ref: 674 This audit did not require ethic approval. Barry Roberts Clinical Governance Administrator.

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PAIN MANAGEMENT SERVICES IN LINCOLNSHIRE, THE UNITED KINGDOM

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Background and aims: The aim of our survey was to gather the opinion of General Practitioners (GP) based in Lincolnshire on Pain Management Services provided by United Lincoln Hospital NHS Trust (ULH) and to explore the possible methods for further improvement.

Methods: We sent an online survey questionnaire to the General Practitioners for their opinion about the following:

- Satisfaction with the ULH NHS Trusts current Chronic Pain Services.
- Areas of the Chronic Pain Services needing further development.
- What could be done to reduce the waiting time for appointments?
- Best way to deliver more education to GPs on chronic pain relief

Results: Satisfaction with current pain services in ULH

- Very satisfied (3%)
- Satisfied (18%)
- Neither satisfied nor dissatisfied (38%)
- Not satisfied (38%)
- Very dissatisfied (3%)

Main areas of Chronic Pain Services for development in ULH as suggested by the GP's are:

- Availability of Pain Management Programs (22%)
- Number of patients seen by pain specialists (29%)
- Availability of interventional pain procedures (24%)
- Psychological support for patients (15%)

Potential suggestions and recommendations for reduction of waiting times:

- Creation of Protocol for referring new patients (19%)
- Guideline for managing follow up patients (26%)
- Introduction of Telephone/e-mail helpline for GP (21%)
- Introduction of Pain Management study day for GPs in ULH (19%)

Conclusions: The survey indicates the need for expansion of pain management services in ULH and higher level of cooperation between General Practitioners and Pain Specialists.

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PAIN, BOWEL FUNCTION AND QUALITY OF LIFE IMPROVEMENT, IN CHRONIC PAIN PATIENTS STARTING THEIR FOLLOW UP IN PAIN UNITS. QOOL STUDY

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Background and aims: Opioids are first treatment of choice of moderate-severe pain, but produce a high incidence of bowel disorders and are associated to severe impact in quality of life (QoL). Qool study investigates evolution of QoL in patients with non cancer pain and its relationship to pain and bowel function (BF).

Methods: Observational, prospective, 3 months follow up study to assess evolution of QoL in patients with moderate-intense pain, treated in Spanish Pain Units (PU). The study was approved by Ethic Committees.

Results: 3029 patients from 143 PU. 67% women, 62±14years (mean±SD). Osteoarthritis/Arthritis was the most common disorder (56%), followed by neuropathy (45%) and other musculoskeletal pain (41%).

Significant improvements (< 0.01) were confirmed in pain intensity (Brief Pain Inventory-BPI): 6.6vs4.2 and QoL (preference values EuroQoL-5D: 0death-1better health status): 0.35vs1.58 after 3 months.

Patients treated with oxycodone/naloxone confirm significant improvement in QOL, pain intensity and BF (p < 0.01) than patients treated with other strong opioids. BF was normalized at study end (BFI=18±19) with a clinically relevant improvement (17 ± 24 points) and a reduction > 60% in most prevalent basal gastrointestinal symptoms (constipation, flatulence, pain and problems defecation and swelling). Oxycodone/naloxone patients without prior opioid treatment ("naive") showed a significant improvement compared to other opioid naïve patients in the control of pain and BF.

Conclusions: Patients treated at PU experienced significant improvement in QoL.

Patients treated with oxycodone/naloxone experienced significant improvement in their QoL, superior pain relief and normalization of BF vs other strong opioids.

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QUALITY EVALUATION OF THE ANESTHESIA RECORDS - EPIDURAL ANALGESIA DURING LABOUR

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Background and aims: Deficiencies in documentation have been demonstrated in several studies of the accuracy and completeness of handwritten anesthesia records. The goal of our study was to assess the quality of the anesthesia records used in our institution to document epidural analgesia during labour.

Methods: After receiving ethics committee approval all anesthesia records created during the first 6 months of the year 2010 at our institution were retrospectively reviewed and the completion rates of 14 clinical and technical documentation elements were evaluated.

Results: 547 handwritten records were reviewed. 99% of those records had the identification of the patient, and 100% had the identification of the anaesthesia team. The vital signs were registered in 73% of the records before and in 16% of the records after the initiation of the epidural analgesia. The position of the patient during the placement of the epidural catheter was registered in 74% of the records. The was reference to the interspace used in 37%, the depth of loss of resistance in 34% and the length of catheter inserted in 24%. The presence or absence of complications or difficulties was registered in 29% of the records. The local anaesthetics and adjuncts used and the efficacy achieved appeared in 98% and 3% of the records respectively.

Conclusions: Our results suggest that the quality of our anesthetic records should be improved in several ways. Special attention should be given to the documentation of the effects and the technical characteristics of epidural analgesia during labour.

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RADIO IMAGE STUDY OF THE BRACHIAL PLEXUS NEUROVASCULAR SHEATH (NVS)

K. Geier *Anesthesiology and Pain Clinic, Hospital Municipal de Pronto Socorro and Hospital São Lucas da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil.*

Background and aims: Studies and observations of the anatomical course of the brachial plexus in cadavers and in surgical dissections have been showing the brachial plexus surrounded by a NVS (1). Inside of the NVS, there are several papyraceous septa forming sub compartments surrounding the plexus components (2). However, the inside septa is subject of controversy (3). This radiological study proposes to clarify this doubt.

Methods: With the supraclavicular blocks a catheter was aimed to the midclavicular point onto the first rib. On the other hand, the infraclavicular block approach was made at the midpoint between the coracoid process and the second rib. The infraclavicular catheter was aimed cranial to the clavicular midpoint. In both approaches, the end-point puncture was the loss of resistance (LOR) to air by penetrating the NVS. The axillary brachial block was performed according to Cookings's transarterial technique followed by catheterization the NVS. All blocks were effective and documented by radio images prior removing the catheters. Various volumes of 300 Iopamiron mixed with 1.5% lidocaine, 1:200,000 epinephrine were used.

Results: Several authors had already reported a LOR to air or "pop" after the needle penetrated the interscalene gap and axillar NVS. After performed several effective blocks with short catheters at these sites, contrast medium was injected. The radio image study showed various distributions of the anesthetic solution inside the NVS (figures 1,2,3).

Conclusions: The radio image studies, suggest that the brachial plexus is surrounded by a tubular fascia with inside septa.

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COMPARISON OF THE ECHOGENICITY OF TEXTURED REGIONAL ANESTHESIA NEEDLES: AN IN VITRO STUDY

S. Kai, J. Takatani, K. Okuda, T. Noguchi *Anesthesiology and Intensive Care Medicine, Oita University, Oita, Japan.*

Background and aims: Textured needles are designed for reflection of ultrasound beam on their shafts. This study examined the echogenicity of the needles at a variety of angles in vitro.

Methods: Five 22-gauge needles (Control: BBraun Plexifix, BBraun Stimuplex D plus, Unisis Engrave, Hakko Sonolect, and Pajunk SonoPlex) were

placed in pork phantom at a depth of 2 cm, at angles of 0, 30, 45, and 60 degrees relative to the phantom surface. The in- and out-of-plane ultrasound images of the needle shafts were recorded. Pixel intensity was defined as the gray-scale value between 0 (black) and 255 (white). The objective visibility was estimated as the difference in mean pixel intensity between the needle and background. $P < 0.05$ was considered significant.

Results: Among in-plane images, all needles tended to decrease their visibility as insertion angle increased. Pajunk was the only needle that showed the higher visibility than control at all angles ($P < 0.01$ for each). Among out-of-plane images, no textured needles showed the higher visibility than control, and BBraun and Unisis showed the lower visibility at 30 degrees than control ($P < 0.01$ for both).

Conclusions: Pajunk is advantageous over a wide range of insertion angles in in-plane approach. No textured needles have an advantage in echogenicity over control in out-of-plane approach.

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THE PREVENTIVE EFFECT OF RESINIFERATOXIN ON THE DEVELOPMENT OF NEUROPATHIC PAIN IN NERVE LIGATION INJURY MODEL

W. Koh, J. Shin, J. Song, S. Kim, J. Suh, J. Leem *Asan Medical Center, Seoul, Republic of Korea.*

Background and aims: It has been suggested that hyperactivity of damaged unmyelinated nociceptive C-fibers is one of the underlying mechanism of neuropathic pain. Previous report demonstrated that resiniferatoxin (RTX), a capsaicin analog that binds to the transient receptor potential vanilloid 1 (TRPV1), produces long-lasting desensitization of unmyelinated nociceptive C-fiber afferents. In the present study, we tested the hypothesis that pretreatment of perineural RTX desensitize C-fibers afferent input, as a result, it may attenuate the development of mechanical allodynia in a rat nerve ligation injury model of neuropathic pain.

Methods: After approval of animal study ethic committee, RTX (0.0001%, 0.001%, and 0.01%) or vehicle was administered in perineural sheath of L5 spinal nerve, and mechanical allodynia was induced by tight ligation of the left lumbar 5th and 6th spinal nerves in male Sprague-Dawley rats 3 hours later. Mechanical allodynia in the left hind paw was evaluated using von Frey filaments to measure withdrawal thresholds using an up-down method.

Results: A long-lasting antiallodynic effect was noted in the pretreatment of RTX 0.001%, 0.01% injection groups ($P < 0.05$). However, there was no significant difference between RTX 0.0001% with control group.

Conclusions: The current results suggest that pretreatment of perineural injection of RTX degenerated unmyelinated C-fiber afferents, leading to attenuation of the development of mechanical allodynia in animals with nerve ligation injury model of neuropathic pain.

References:

- Neubert JK, Mannes AJ, Karai LJ, Jenkins AC, Zawatski L, Abu-Asab M, Iadarola MJ. Perineural resiniferatoxin selectively inhibits inflammatory hyperalgesia. *Mol pain* 2008; 4:3.

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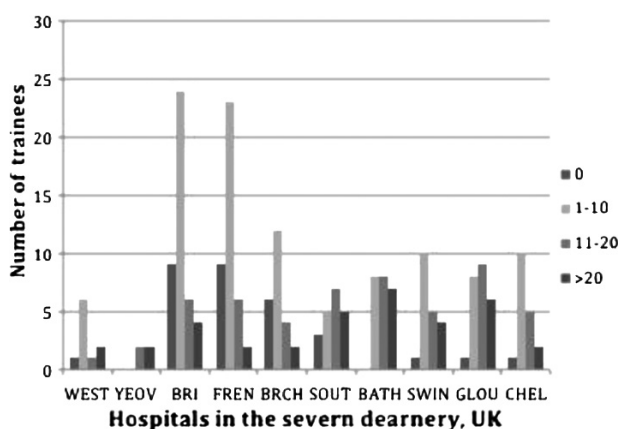
TARGETED TRAINING IN ULTRASOUND GUIDED REGIONAL ANAESTHESIA (UGRA)

T. Martin¹, H. Murdoch², C. Thompson² ¹Royal United Hospital Bath, Bath, ²North Bristol NHS Trust, Bristol, UK.

Background: Ultrasound guided regional anaesthesia (UGRA), part of a multimodal approach to peri-operative analgesia, is on the core curriculum for UK anaesthetic training. Acquiring these skills involves training that is difficult to incorporate into a busy clinical environment. We developed targeted introductory training to facilitate clinical learning and experience.

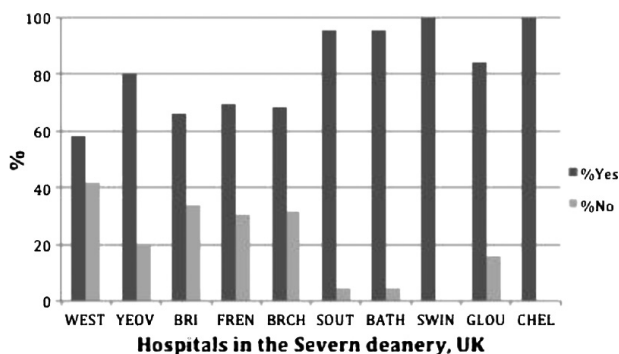
Methods: Trainees of the Severn Deanery (UK) were surveyed about their experience of UGRA. 9 trainees then underwent introductory training in sonoanatomy. They completed a skills self-assessment before & after training, then two months after the course.

Results: 69 out of 128 trainees responded to the survey (54%). 255 training 'episodes' from all hospital attachments were generated allowing identification of when and where UGRA training occurred.



[Graph showing variations in numbers of UGRA blocks]

77% of intermediate trainees undertook fewer than 10 peripheral nerve blocks during years 3 and 4. 70-80% reported no experience of upper limb blockade. Over 50% of higher trainees report limited upper limb blockade experience (< 10 cases). Knowledge of anatomy and nerve stimulation progressed from basic to higher trainees. Knowledge of sonoanatomy showed no such progression. Lack of teaching, poor availability of ultrasound machines and low case numbers were factors identified as limiting trainee experience of UGRA. Self-assessment forms compared before and after the sonoanatomy course showed all candidates improved. Only those working in a hospital with an active UGRA service maintained skills at two months.



[Graph showing variation in percentage of trainees]

Conclusions: Targeting training around hospital placements with an active UGRA service augments skill retention. Training is ideally undertaken during higher training in our region.

160 DOCUMENTATION OF CHRONIC PAIN PROCEDURES IN A UNIVERSITY TEACHING HOSPITAL - A RETROSPECTIVE AUDIT

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Background and aims: Currently there are no guidelines on documentation to be recorded for pain management procedures. The aim of the audit was to assess the quality of documentation in our institution.

Methods: A total of 44 sets of procedural charts were analyzed over a 1 month period.

Results: The results are summarized in the table.

TABLE 1.

Parameter	Mentioned, in number of cases	%
Asepsis, Level	41/44	93
Patient position	21/44	47
Needle for skin	4/44	9
Needle for procedure, size	39/44	88
Needle for procedure, type	7/44	15
Visualisation	28/44	63
Aspiration/Complications	9/44	20
Electrical stimulation	3/5	60
Lesion temperature	1/5	20

[Documentation entered for the pain procedures]

The overall level of documentation of the procedure was good, except for aspiration, complications, visualization and electrical data during procedure. **Conclusions:** The audit showed a great variability in documentation. We recommend standard documentation for the recording of chronic pain procedures and the introduction of local guidelines on the minimal documentation.

References:

1. D Soltanifar Documentation of regional anaesthesia in a university teaching hospital. ASRA 35th meeting 2011.
- Ethics. Your clinical audit "Documentation of Pain Procedures in Chronic Pain Intervention Clinic" registered number 2943. Ethical approval is not required.

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MULTIBEAM ENHANCEMENT TECHNIQUE WITH A CONVEX PROBE IMPROVES ULTRASOUND NEEDLE VISIBILITY

J. Takatani, S. Kai, K. Okuda, T. Noguchi *Anesthesiology and Intensive Care Medicine, Oita University, Oita, Japan.*

Background and aims: It is hard to visualize a needle placed at a deep angle with ultrasound. A software Multibeam enhancement (MBE) adds oblique ultrasound beams to make a bright needle image. We examined its advantages with a convex probe.

Methods: A 22-gauge needle was positioned 4 and 6 cm below and at 0, 30, 45, and 60° relative to the pork phantom surface. In-plane shaft images were recorded in 4 settings (MBE: Off, Shallow, Medium, and Steep), and evaluated in gray scale values between 0-255 (black-white). The objective visibility [pixel intensity units (PIU)] was estimated as the difference in mean pixel intensity between shaft and background. Data were described as mean $\pm$ SD, 95% confidence intervals.

Results: At 0°, no MBE settings improved objective visibility. At 30°, both Shallow- and Medium-mode with 4 cm deep needle, and Medium-mode with 6 cm deep needle, significantly increased the visibility compared with Off-mode (4 cm deep: Off 74 $\pm$ 18 PIU vs. Shallow 122 $\pm$ 18 PIU, $p < 0.01$, vs. Medium 108 $\pm$ 18 PIU, $p < 0.01$. 6 cm deep: Off 46 $\pm$ 27 PIU vs. Medium 84 $\pm$ 22 PIU, $p < 0.05$). At 45° and 4 cm deep, Medium-mode showed significantly higher visibility than Off-mode (Off 23 $\pm$ 19 PIU vs. Medium 79 $\pm$ 43 PIU, $p < 0.05$). At the other positions, reliable data were unavailable.

Conclusions: To some degree MBE with the convex probe brightens a needle. This technique may allow us safer ultrasound procedure.

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PREVENTION OF INCORRECT SIDE PERIPHERAL NERVE BLOCKADE- A SURVEY OF ANAESTHETIC PRACTICE

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Background and aim: Wrong sided peripheral nerve blockade is unacceptable. The 'Stop Before Your Block campaign'¹ was launched in 2011, aiming to reduce their incidence by taking additional preventative measures prior to performing a nerve block. Following a critical incident within our trust where an incorrect side nerve block was administered, we wanted to survey the steps taken to prevent wrong site blocks amongst the anaesthetists.

Method: A questionnaire was distributed within the anaesthetic department of a large district general hospital between February and May 2012.

Results: 44 questionnaires were distributed of which 25 (57 %) consultants, 4 (9 %) speciality doctors, 13 (30 %) trainees responded (2 incomplete). Of

these responses, 35 (80 %) performed peripheral nerve blockade or fascial plane blocks as part of their anaesthetic practise.

Of the key recommendations of the campaign, we identified only 20 (57%) anaesthetists routinely perform a 'stop moment' prior to performing a block. In addition to the WHO check-in by the operating department practitioner, only 14 (40 %) anaesthetists routinely check the surgical consent form independently. Of these anaesthetists, only 7 out of 14 check the consent form immediately before needle insertion prior to a block.

Conclusions: Steps taken to prevent wrong sided peripheral nerve blockade were inadequate and further education, promoting the 'Stop Before You Block' campaign was targeted at the clinical governance meeting. We plan to repeat the survey to assess changes in practice.

References: 1. Safe Anaesthesia Liaison Group. Stop Before You Block. 2011. <http://www.rcoa.ac.uk/index.asp?PageID=1763>

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LATERAL CUTANEOUS NERVE OF THE THIGH BLOCKADE AND ITS EFFICACY IN HIP INCISIONS

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Background and aims: Lateral cutaneous nerve of the thigh (LCN) block is often used in hip arthroplasty to supplement Femoral Nerve Block (FNB) to ensure better anaesthesia/analgesia over the incision site.

This study aims to assess the clinical utility of ultrasound guided LCN block by comparing the cutaneous distribution of paraesthesia following blockade with the predicted incision site for Hip arthroplasty in healthy volunteers.

Methods: Following local ethics approval, 20 volunteers with LCNs easily identifiable on ultrasound were recruited to participate. A consultant orthopaedic surgeon first drew 3 predicted incision lines for hip arthroplasty (the 3 most commonly used approaches) on the same subject, using a UV reflective marker pen invisible under normal light. The participants then underwent standardised ultrasound guided LCN blockade by an expert in regional anaesthesia.

After 30 minutes, the field of paraesthesia was mapped graphically (by pin prick sensation), using a standard surgical marking pen. The incision sites were then mapped on using a UV lamp. The percentage of the incision site covered by the LCN block was then assessed and measured.

Results: The results demonstrated that of the 60 marked incisions, 52% were entirely outside the area of paraesthesia with the remainder experiencing significantly less than 50% wound coverage. In only one subject (5%) was greater than 50% wound coverage achieved.

Conclusions: These results indicate that ultrasound LCN blockade can be reliably performed in expert hands. Blockade of the LCN however appears to offer very limited wound coverage in the standard approaches to hip surgery.

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AXILLARY BLOCK UNDER ULTRASOUND GUIDANCE: 2 VS 3 INJECTIONS TECHNIQUE

D. Huynh¹, S. Bloc¹, T. Garnier¹, B. Komly¹, P. Leclerc¹, L. Mercadal¹, B. Morel¹, G. Dhonneur², C. Ecoffey³ ¹Private Hospital Claude Galien, Quincy-sous-Sénart, ²University Hospital, Créteil, ³University Hospital, Rennes, France.

Background and aims: Under nerve stimulation (NS) a 2-injection technique for axillary block (AX) offers a lower success rate in the territory in the musculocutaneous nerve (MC) (1). Ultrasound guidance (US), which enables us to locate the nerves, the site of injection, and the distribution of local anesthetic, could offer a higher success rate. The aim of this study was to compare 2- and 3-injection techniques under US.

Methods: 50 patients were included in the study. In the 2-inj, 15 ml of 1.5% lidocaine was injected between the axillary artery and the latissimus dorsi tendon and 15 ml between the artery and median nerve. In the 3-inj, 13 ml were identically injected and 4 ml closer to MC. AX was tested for 30 minutes (musculocutaneous, radial, median, ulnar, medial cutaneous of forearm) with sensory (0,1,2) and motor (0,1,2) scores. 18 was defined as the score of a complete block. The distance between median and MC was calculated (M-MC).

Results: A complete block (score =18) occurred in 88% (3-inj) and 44% (2-inj). The success rate of MC block was higher in 3 inj (100% vs 80%). In 2-inj, when M-MC was less than 14 mm, the success rate of MC block was 100%.

Conclusions: 3-inj offers a greater success rate over the 5 nerves of the brachial plexus. Nevertheless, anesthetizing the MC should not be system-

atic. Its distance from the median nerve could indicate the necessity of a third injection.

(1) Sia S. Reg Anesth Pain Med. 2001.

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PREDICTING MAXIMUM SERUM VALUES OF LOCAL ANAESTHETICS. A REVIEW OF STUDIES ON NON-NEURAXIALLY ADMINISTERED ROPIVACAINE

K. Jensen, J. Børglum *Anaesthesia and Intensive Care, University Hospital of Copenhagen: Bispebjerg, Copenhagen, Denmark.*

Background and aims: The literature contains some controversy whether certain peripheral nerve blocks carry a higher risk of systemic toxicity resulting from inadvertently fast or extensive absorption. We wanted to evaluate the variability of simple ropivacaine pharmacokinetics administered for different peripheral nerve blocks by a meta-analytic approach.

Methods: We conducted an extensive cross-referenced Medline search on all human studies relating either serum values of ropivacaine or toxic systemic reactions resulting from its use. Available pharmacokinetic data were extracted from each study, and the patterns of variation of time-to-maximum serum value (Tmax) and apparent volume of distribution (Vd) were assessed.

Results: 67 studies comprising 87 cohorts were included in the analysis (Table 1). Apart from infiltrative techniques which may delay absorption of ropivacaine, no particular peripheral nerve block appears to be associated with rapid systemic spread per se. The variability of both Tmax and Vd are considerable within and between studies, and a similarly equivocal relationship between Tmax and Vd make predictions of maximum serum values untenable in some individuals.

Route of administration	Studies (n)	Tmax (mins)	Vd (L) at Tmax	Vd/Tmax ratio
Upper extremity nerve blocks	24	33 (9-140)	123 (67-167)	3.5 (1.5-6.6)
Truncal nerve blocks	18	32 (10-67)	136 (31-375)	4.0 (1.2-8.3)
Lower extremity nerve blocks	15	43 (15-80)	133 (57-300)	3.4 (1.4-5.1)
Infiltration nerve blocks	10	52 (15-105)	156 (49-313)	5.5 (1.5-10.7)

[Tmax and Vd for each route of administration.]

Conclusions: We conclude that potentially toxic serum values may appear within the currently recommended maximum dosage of ropivacaine for peripheral nerve blocks.

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AN OPEN, PROSPECTIVE COMPARATIVE STUDY OF SEVEN APPROACHES OF SCIATIC NERVE BLOCK FOR UNILATERAL LOWER LIMB SURGERIES IN 140 PAEDIATRIC PATIENTS

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Background and aims: Aim of study was to compare efficacy of seven approaches of sciatic nerve block in paediatric patients.

Methods: With ethical committee approval, 140 blocks performed in eligible children scheduled for lower limb surgery via Parasacral (PS), Labat (LB), Subgluteal (SG), Raj (RJ), Posterior Popleteal (PP), Lateral Greater Trochanter (GT) and Lateral Popleteal (LP) approaches in children (20 / group). Sciatic nerve stimulated using PNS and accepted at 0.4 mA and 2 Hz. 0.5 ml/kg of equal volumes of 0.5 % Bupivacaine and 2 % Lignocaine with epinephrine injected. Increase in heart rate >15% of baseline was a failed block. Variables assessed: Performance Time, Number of Attempts, Needle Depth, Failure rate, duration of block, Parental satisfaction, rescue analgesia, complications.

Results: Number of attempts was higher in PS (2.3 ± 1.9) and GT (2.1 ± 1.6) groups. Performance time was also higher in PS (6 ± 3.19 minutes) and GT (5.8 ± 2.9 minutes) groups. Sciatic nerve was most superficial in PP (1.61 ± 0.4 cm) and SG (2.1 ± 0.9 cm) groups. Failure was noted in 1 case each in PS and LB groups. Urinary retention in 2 cases in PS group.

Conclusions: Considering the advantages offered by distal and superficial approaches, Posterior Popleteal and Subgluteal approaches prove to be superior with regard to performance time and ease of location of sciatic nerve.

References:

- Sciatic Nerve Blocks in Children: Comparison of the Posterior, Anterior, and Lateral Approaches in 180 Pediatric Patients.
Bernard Dalens, et al. *Anesthesia Analgesia* 1990;70:1 31-7

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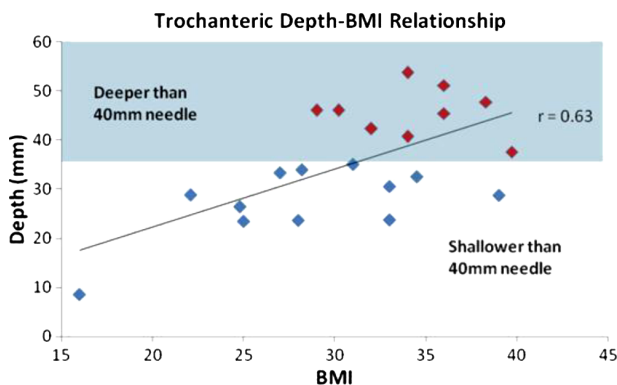
TROCHANTERIC BURSA INJECTION: HOW LONG IS YOUR NEEDLE?

M.H. Davies¹, A. Jennings¹, J. Lee¹, K. O'Dwyer² ¹Department of Anaesthetics, ²Department of Trauma and Orthopaedics, Worcestershire Royal Hospital, Worcester, UK.

Background and aims: Injection of the trochanteric bursa is a common intervention for regional hip pain secondary to acute or chronic inflammation. A landmark technique with a 21G, 40mm hypodermic needle (tip to bevel distance 36mm) is common practice¹. We sought to establish if this needle has adequate length to reach the bursa in a representative population.

Methods: Following informed consent, consecutive patients undergoing pre-assessment for primary hip arthroplasty underwent ultrasound sonography to assess the depth of their greater trochanter. Sex, age, weight and BMI were also recorded.

Results: Twenty-one patients (9M:12F) of mean age 69 [51-81] had their trochanteric depths assessed. The mean BMI was 31 [16-40]. The mean trochanteric depth recorded was 35mm [0.86-5.38]. 43% of bursa were found at a depth not accessible to injection with a 40mm needle, this increased to 62% in patients with a BMI of >30. Pearson's correlation coefficient between BMI and trochanteric depth was 0.63.



[Trochanteric Depth-BMI Relationship]

Conclusions: The use of 40mm needles for trochanteric bursa injection is inadequate to reach the target in nearly half of patients. Injection outside of the bursa is unlikely to be therapeutic. We suggest a longer needle should be used. Ultrasound can be used to assess trochanteric depth when required.

References:

- Wittich CM, Ficalora RD, Mason TG, Beckman TJ. Musculoskeletal injection. *Mayo Clin Proc.* 2009 Sep;84(9):831-6.

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IMPROVE THE MANAGEMENT OF SEVERE NON CANCER CHRONIC PAIN: SPAIN DATA OF EUROPEAN CHANGE PAIN SURVEY

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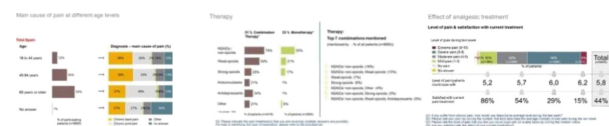
Objective: to explore how patients perceive their non-cancer chronic pain and deal with it; aiming to improve pain management.

Research design and Methods: CHANGE PAIN, an European initiative endorsed by the European Federation of IASP® Chapters (EFIC), provides

guidance on how to improve the management of severe chronic pain. In Spain, 8695 patients filled this survey. The cross-sectional data were provided during routine visits to 893 physicians from different specialties. Pain intensity was assessed with two scales: 11-point numerical rating scale (NRS) and 5-point verbal rating scale (VRS).

Results: Most patients were in their late adulthood (45-64 years; 34%) or elderly (65 years or older; 53%), and women (57%). Pain duration was frequently one year or longer (65%). Combined pharmacological treatment (51%) was more common than monotherapy (33%). The most prescribed agents were nonsteroidal anti-inflammatory drugs alone (18%) or combined with weak opioids (15%), followed by weak (7%) or strong (6%) opioids in monotherapy. The majority of patients had moderate (47%) or severe (30%) VRS rated pain, whilst NRS rating showed more severity: 28% and 49% for 4-5 and 6-8 score ranges. Many patients had pain above their tolerable level (38%) and were not satisfied with therapy (55%). Their main goals were pain relief and reduction of side effects.

Conclusions: Current chronic noncancer pain management can be improved. The uncoupling of VRS and NRS pain ratings reveal the high individuality of pain experience, and the wide variation in treatment choices indicates that an optimal management strategy has not been found yet. Advances might be attained by boosting communication to tailor treatments to individual patients' perceptions.



[Pic1]

[Pic2]

[Pic3]

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LONG TERM FOLLOW UP OF COMBINED COELIAC PLEXUS AND SPINAL CORD STIMULATOR IMPLANT FOR PAIN DUE TO CHRONIC PANCREATITIS: A NOVEL APPROACH

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Background and aims: The treatment of visceral pain, including chronic pancreatitis, remains a challenge. The largest number of patients treated with SCS to date has been published by Kapural et al. The direct celiac/splanchnic plexus was recently reported by our team as an attractive alternative. We report a long term follow up of a patient with chronic pancreatitis, successfully treated with combined spinal cord and celiac plexus stimulator.

Methods: A 62-year old lady presented with intractable abdominal pain from chronic, non-alcoholic, pancreatitis. Her condition was resistant to all conventional pharmacological and interventional pain treatment. A successful trial with celiac plexus stimulation using mono-leads, and subsequently a standard quad, was followed by a permanent implantation of two quads targeted at the celiac plexus, along with a SCS lead combined with an EON Mini neurostimulator, in December 2010.

Results: The patient continues to enjoy significant pain relief more than 16 months following the full implant of the neurostimulator. Initially, she used the stimulation for 5hrs/day, now reduced to 4hrs at a time, 3 to 4 times every week with low frequency stimulation 2 - 10Hz. She reports significant reduction in opiate use and an improvement in her quality of life.

Conclusions: Following the successful management of Chronic Pancreatitis with SCS and, recently, with direct celiac/splanchnic plexus stimulation, a combination of the two techniques is a natural progression. To our knowledge this is the first case of successful long term treatment of pain due to chronic pancreatitis using a combined Peripheral and SCS approach.

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ULTRASOUND GUIDED PERINEURAL FOREARM CATHETERS FOR SUCCESSFUL TREATMENT OF ESTABLISHED CRPS - A CASE REPORT

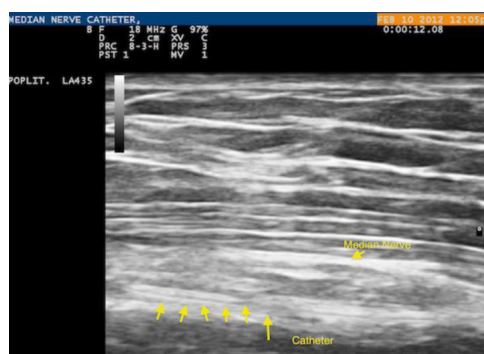
J.C. John, N. Williams, C. Birch *Anaesthetics, Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, UK.*

Background: Use of Perineural catheters to treat CRPS is not commonly described in adults. We present a case report.

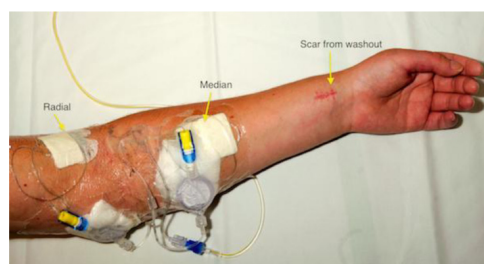
Methods: A 26yr old woman with a spinal cord stimulator for ongoing CRPS in the right arm presented with new onset CRPS symptoms in the opposite hand following a trigger finger release under LA. The symptoms over the hand developed after she required drainage of tendon sheath infection 2 weeks after the initial surgery. Diagnostic blocks of the median nerve in the forearm and radial at the elbow resulted in immediate and complete analgesia. Catheters were placed near both nerves under ultrasound guidance.



[In line view of the radial nerve just above elbow]



[Inline view of median nerve]



[Forearm]

An infusion of Ropivacaine 0.2% was started via a Y connector through an ambulatory electronic infusion pump set to deliver a basal rate of 5ml/hr and a bolus of 5ml every 60 minutes.

Infusion was stopped a week later. There was complete resolution of pain and the physical appearance of the hand had changed to normal.

Results: She remains pain free 8 months down the line.

Conclusions: Perineural catheters in the mid forearm are particularly suited for achieving numbness over the hand without compromising muscle function of the wrist since the flexors of the wrist are supplied proximally. Patient was able to achieve active aggressive physiotherapy while maintaining good muscle function in the intrinsic muscles of the hand and wrist.

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EFFECT OF CAUDAL DEXMEDETOMIDINE WITH 0.15% ROPIVACAINE ON SEVOFLURANE REQUIREMENT, EMERGENCE AGITATION, AND POSTOPERATIVE ANALGESIA IN CHILDREN UNDERGOING AMBULATORY SURGERY

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Background and aims: We performed this study to evaluate the effects of caudal DEX added to high volume/low-concentration of ropivacaine in children.

Methods: After obtaining IRB approval, eighty children (age 1-6 years, ASA I) were enrolled in this study.

After induction, caudal block was performed. The children received 1.5ml/kg ropivacaine 0.15% with dexmedetomidine 1 µg/kg (DEX group, n=40) or same dose of ropivacaine with normal saline (Control group, n=40). **Results:** In DEX group, ET-Sevo and emergence agitation were significantly lower. Postoperative pain scores showed no differences.

		Control group (n=40)	DEX group (n=40)
HR (bpm)	baseline	128 (22)	129 (20)
	after surgical incision	126 (16)	121 (18)
	during the operation	117 (13)	107 (16)*
EtSevo (%)	after surgical incision	3.1 (2.0-5.0)	2.7 (2.0-4.2) *
	during the operation	2.9 (2.0-4.2)	2.3 (2.0-3.8) *

[Intraoperative data]

		Control group (n=40)	DEX group (n=40)
Sedation score	0	2 (0-2)	2 (0-2)
	30m	0 (0-2)	0 (0-2)*
	2h	0 (0-0)	0 (0-2)
Agitation	0	18/40 (45%)	3/40 (7.5%)†
	30m	7/40 (17.5%)	4/40 (10%)
	2h	1/40 (2.5%)	1/40 (2.5%)

[Postoperative data]

Conclusions: We concluded that caudal DEX when added to high volume/low-concentration of ropivacaine significantly reduced the sevoflurane requirement and emergence agitation in children.

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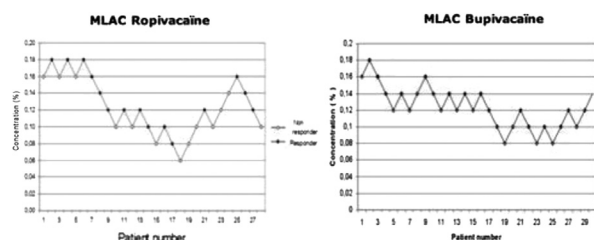
MINIMUM LOCAL ANESTHETIC CONCENTRATION OF BUPIVACAINE AND ROPIVACAINE FOR CAUDAL ANESTHESIA IN CHILDREN

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 Bruxelles, Belgium.

Background and aims: This study aimed at determining the minimum local anesthetic concentration (MLAC) for bupivacaine and ropivacaine used for caudal epidural analgesia in children undergoing lower abdominal surgery.

Methods: Following institutional EC approval and parental informed consent, 60 ASA I-II children aged 1-8 years were included in this prospective randomized study. General anesthesia was maintained with sevoflurane (0.5 MAC end-tidal). Each child received 1 ml/kg of bupivacaine or ropivacaine solution through a caudal catheter. The concentration of each anesthetic was started at 0.16%, and subsequent concentrations were determined by the analgesic response of the previous patient to skin incision using the Dixon's up-and-down sequential allocation. Testing interval was set at 0.02%.

Results: Three children were excluded, due to technical or surgical problems. Using the Dixon and Mood approach (1), the MLAC for bupivacaine and ropivacaine were 0.122% (95% CI 0.113%-0.132%) and 0.123% (95% CI 0.110%-0.135%) respectively. Similar results were obtained with the Choi and Wetherill approach (2).



[Up and down bupivacaine and ropivacaine]

Conclusions: The MLAC (or ED50) of bupivacaine and ropivacaine was 0.11% to 0.14% in children undergoing sevoflurane anesthesia.

References:

1. Dixon WJ. J Am Stat Assoc 1965 ; 60:967-782.
2. Choi SC. Biometrics 1990 ; 46:485-92.

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HIGH-VOLUME CAUDAL BLOCKADE (1.5 ML KG⁻¹) IN INFANTS CAUSES TRANSIENT REDUCTION OF CEREBRAL PERFUSION

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Background and aims: By use of ultrasound scanning we have recently been able to describe a bi-directional bulk flow of CSF (coined “the CSF rebound mechanism”) that take place during high-volume caudal blockade in infants and that is partly responsible for secondary longitudinal spread of the block. (BJA 2012). The aim of the present study is to delineate the magnitude and duration of the reduction of cerebral blood flow (CBF) associated with high-volume caudal blockade in infants.

Methods: Following Ethics committee approval and parental consent, 10 infants scheduled for subumbilical surgery will be studied. Following induction of general anaesthesia the children will receive a high-volume caudal block (1.5 ml kg⁻¹ of ropivacaine 0.2 %). Blood flow in the middle cerebral artery (MCA) will be monitored by transcranial Doppler before, during and for the first 10 minutes following the completion of the block.

Results: The caudal injection was associated with a reduction of diastolic blood flow in the MCA. The first change of CBF could be detected when approximately half of the planned volume (0.75 ml kg⁻¹) had been injected. CBF appeared to have returned to baseline after approximately 2.5 minutes after the completion of the block. Further data will be reported at the meeting.

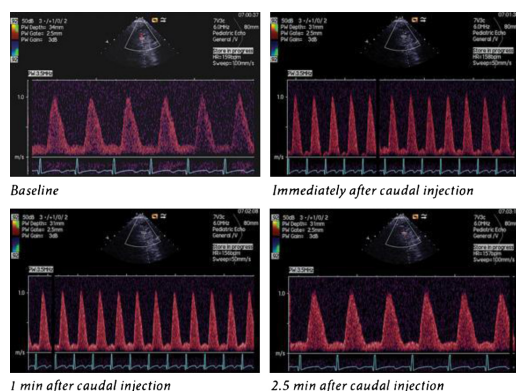


FIGURE 1. Doppler recordings of CBF from the MCA i

Conclusions: The use of a high-volume caudal block in infants is associated with a time-limited and moderate reduction in CBF. Our findings provide further support for the “CSF rebound mechanism” associated with high-volume caudal blockade in children.

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A RETROSPECTIVE AUDIT OF MAGNESIUM LEVELS DURING MAGNESIUM INFUSION USE FOR THE TREATMENT/PROPHYLAXIS OF ECLAMPSIA

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Background and aims: Since the MAGPIE trial was published in The Lancet in 2002, Magnesium sulphate has widely been demonstrated as safe and effective for the treatment and prevention of seizures. Further research is still required to provide a minimum effective dose. In our stand alone maternity hospital which is a tertiary referral centre with almost 10,000 deliveries per year, more than 80% of admissions to the High Dependency Unit are related to preeclampsia. The vast majority of these patients receive Magnesium therapy for 24 hours using a standard 4g bolus followed by 1g/hour infusion over 24 hours. As part of our hospital protocol 4-hourly serum magnesium levels are measured.

Methods: All HDU admissions over a 12 month period for magnesium sulphate therapy and their serum levels of magnesium taken while on the infusion were obtained. The occurrence of seizures noted in the case notes was also recorded.

Results: Of the 59 identified cases, only 75% had therapeutic serum magnesium levels according to our hospital reference range of 1.8 - 3.5mmol/L. None of the 59 patients had any documented seizures.

Conclusions: Magnesium is listed by the Institute for Safe Medication Practices amongst only 12 High Alert medications. Despite this, monitoring of serum magnesium levels is not recommended and a minimum effective dose has yet to be defined. Our 100% rate of seizure prevention despite only 75% of levels being therapeutic, suggests that the therapeutic range of serum magnesium adopted by our unit may be higher than is necessary.

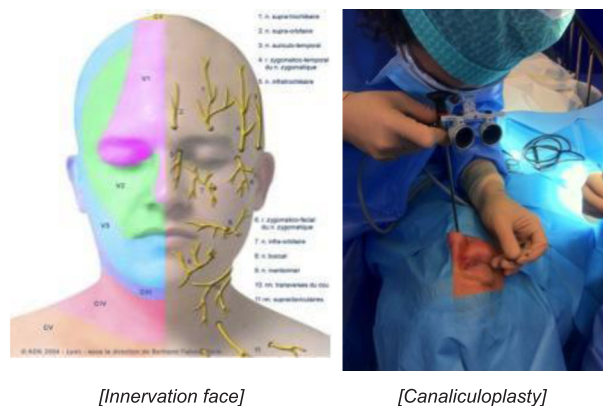
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MONO OR BICACANALICULAR INTUBATION UNDER LOCOREGIONAL ANAESTHESIA : A SIMPLE WAY TO DO IT

G. Destruhaut *Clinique St Louis, Le Bouscat, France.*

Background and aims: The aim of this study was to evaluate the use of the combination of infraorbital and infratrochlear block in addition of nasal dressing with xylocaine 5%+ naphazolin for patients undergoing Mono or Bicanalicular intubation.

We audited current practice in our institution looking at the approach adopted by our regional anaesthetists and its implication for success, adverse events and patient satisfaction.



[Innervation face]

[Canaliculoplasty]

Methods: We obtained prospective data on 36 consecutive patients undergoing ambulatory lacrimal surgery under locoregional anaesthesia with for this procedure (January to April 2012). The surgery was awake, no sedation was added. Data collected were:

- Patient age
- ASA Status

- Volume of local anaesthetic (LA)
- Propofol sedation (mg)
- Numerical Rating Scale (0-10) at incision (NRS inc)
- Numerical Rating Scale (0-10) at intubation (NRS int)
- Patient satisfaction (Scale 0-10)
- Duration of surgery procedure

Results:

Age	ASA	Propofol (mg)	Local Anesth	NRS Inc	NRS int	Satisfaction	Duration
72,9 (±11,1)	2,3 (±0,6)	99,3 (±27)	6,4 (±0,7)	0	0,4 (±0,9)	9,9 (±0,3)	10,4 (±7)

[Results]

The duration of surgery varied from 5 to 45 minutes (mean 10,4 min). Over the 36 patients included in the study, none had a NRS int >3 and none needed a sedation to complete the surgery.

Patient's satisfaction and acceptance of the procedure was excellent. 72% of the patients had bilateral surgery the week after. All patients choose to have the same procedure instead of general anaesthesia.

No complications were noted. The average length of hospital stays was 192 minutes.

Conclusions: The combination of infraorbital and infratrochlear block in addition of nasal dressing is a reproducible and efficient procedure for the Mono or Bicacanalicular intubation.

176**EMERGENCIES DURING PERIPHERAL NERVE BLOCKADE; HOW PREPARED IS THE ANAESTHETIST?**

O. D'Mello, S. Black, R. Ramasundaram, I. Ahmad *Anaesthesia, Guy's and St Thomas' NHS Foundation Trust, London, UK.*

Background and aims: Most peripheral nerve blocks are used to provide awake surgical anaesthesia avoiding the complications of GA.

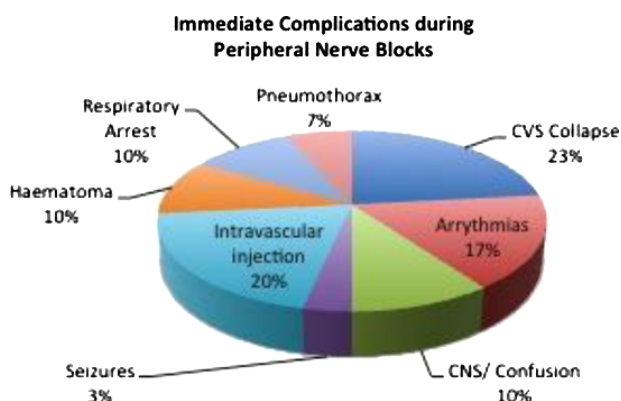
Peripheral nerve blocks, although safe, have the potential to cause serious immediate cardiovascular and central nervous complications.

Our aim is to establish the immediate common complications that can occur during awake peripheral nerve blocks and to determine how well prepared the anaesthetist is to deal with such complications.

Methods: We conducted an online survey, and received 41 responses from Consultant Anaesthetists and senior registrars across London.

58% of respondents have experienced an immediate complication, while performing a peripheral nerve block.

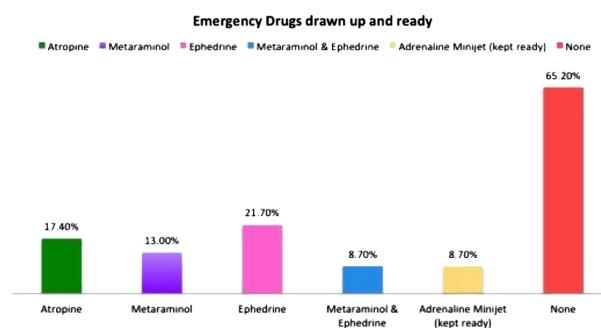
The most common complications are indicated in the graph:



[Immediate Complications during peripheral nerve bl]

Axillary BPB's were associated with more complications (37%) than other blocks.

Only 35% of our respondents drew up emergency drugs as below:



[Emergency drugs drawn up and ready]

30% of respondents drew up Propofol and 7.4% drew up Suxamethonium, both of which can be used in seizures.

Surprisingly, 22% of our respondents did not know where Intralipid is stored in their hospital, while 37% did not know the correct dosage.

Conclusions: Being prepared and having emergency drugs drawn up can help to prevent catastrophic consequences.

Resuscitation equipment, emergency drugs and Intralipid should be readily available in all areas where peripheral nerve blocks are performed.

References:

Association of Anaesthetists, Great Britain & Ireland (AAGBI) 2010 guidelines for the management of severe local anaesthetic toxicity, London, AAGBI

177**A SURVEY OF SURGEONS' PERCEPTIONS AND ATTITUDES TOWARDS REGIONAL ANAESTHESIA**

O. D'Mello, R. Ramasundaram, A. Pawa, E. Aziz *Anaesthesia, Guy's and St Thomas' NHS Foundation Trust, London, UK.*

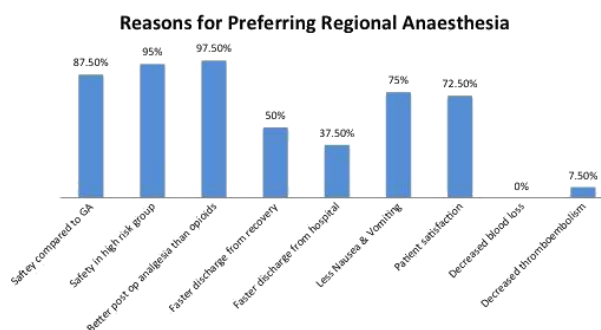
Background and aims: Surgeons play an important role in influencing their patients' choice of anaesthesia.

Regional Anaesthesia (RA) is however not universally accepted in surgery despite its advantages.

We thus conducted a survey to determine surgeons' perception and attitudes towards RA.

Methods: We carried out a survey and received 40 responses. These included 5 Plastic- Limb Surgeons & 35 orthopaedic surgeons (consultants and senior registrars) from London.

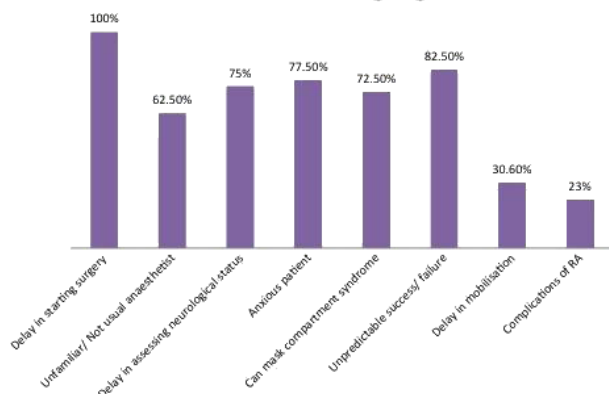
Results: Perceptions of RA are shown in the figure. Most respondents believe that RA is safer than GA, prefer it, in high risk patients and that, it provides better post-op analgesia than opioids.



[Reasons for preferring RA]

100% of our respondents, felt that RA delayed the start of surgery. 82% also thought that RA was unpredictable. Surprisingly 62.5% respondents did not trust an unfamiliar anaesthetist to perform a block on their patient.

Reasons for not favouring Regional Anaesthesia



[Reasons for preferring RA]

Conclusions: We advocate the use of a 'Block' room/ area for performing RA and thus avoiding delays in starting surgery. However many hospitals in the UK, including our own do not regularly use/ have facilities of a block room.

We also recommend better training in Ultrasound guided- RA to prevent unpredictable RA success rates.

Joint training days together with surgeons, will improve their perceptions of RA and help to overcome the problem of an unfamiliar anaesthetist.

References:

A Survey of Orthopedic Surgeons' Attitudes and Knowledge Regarding Regional Anesthesia. *Anesth Analg* 2004;98:1486-90

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ULTRASOUND-GUIDED BRACHIAL PLEXUS NERVE BLOCK VS PROCEDURAL SEDATION FOR SHOULDER DISLOCATION IN "FULL STOMACH" EMERGENT PATIENTS

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Background and aims: Dislocation of upper extremity is frequent in emergency department and require a quickly treatment. Procedural sedation is frequently used but it is associated with rare but potentially, serious adverse effects.

The aim of this study was to compare the efficacy, complications and postoperative length of stay (LOS) between the procedural sedation and the ultrasound-guided interscalene brachial plexus (IBP) block for shoulder reduction in "full stomach" patients.

Methods: Twenty patients with upper limb dislocation were assigned to receive an ultrasound guided IBP block (US group) or procedural sedation (Sedation group) in emergency department. Level of sedation, procedural pain, side effects, LOS were measured. IBP was accomplished by ultrasound imaging using a high-frequency probe that showed local anesthetic (mepivacaine 1% 15 mL) spread during injection. Procedural sedation was achieved by I.V. administration of fentanyl 50 to 100 mcg and 2 mg/kg propofol 1% bolus. We used the *t*-Student test.

Results: Are shown in table (*= *p* < 0.05):

	US (n=10)	SEDATION (n=10)
Procedural Reduction Pain (NRS)	0	3
Rescue dose n (%)	0	2 (20%)
Nausea n (%)	0	2 (20%)
Vomiting n (%)	0	2 (20%)
Postoperative LOS (min±sd)*	78±25	190±60
mAP during procedure (mmHg±sd)	89±14	82±19

Conclusions: The full stomach patients undergoing emergent shoulder dislocation reduction using US-guided IBP had not procedural pain, they had less complication and spent less time in the hospital than those receiving procedural sedation with propofol. IBP nerve block by ultrasound guidance for upper limb dislocation reduction is advantageous in non-fasting patients.

References:

Richard Brull et al.: Regional Anesthesia and Pain Medicine 2010 March-April;35:S68-S73

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SUPER-SELECTIVE SCALP BLOCK DURING PROLONGED AWAKE CRANIOTOMIES: EFFECTIVE DURATION, PATIENT COMFORT AND CLINICAL VALUE

D. Ferson¹, L. Chi², F. Lang³, A.-T. Nguyen¹, T. Rahlfs¹ ¹Department of Anesthesiology and Perioperative Medicine, ²Diagnostic Imaging, Neuroradiology Section, ³Neurosurgery, M. D. Anderson Cancer Center, Houston, TX, USA.

Background and aims: Scalp block, using the infiltration technique, has been used for years in awake brain surgeries. The limitation of this technique is the relatively short (4-6 hours), duration of scalp analgesia. We have developed a new technique of the super-selective scalp block (SSSB) and evaluated its effectiveness in patients undergoing awake craniotomies lasting more than ten hours.

Methods: After obtaining Institutional Review Board approval, we reviewed surgical and anesthesia records of patients undergoing awake craniotomies lasting greater than 10 hours. Our SSSB technique consists of bolus injections, in direct proximity to the small-diameter scalp nerves, using 0.5% Ropivacaine (3-4 mg/kg) mixed with epinephrine 1:200,000.

The duration of the SSSB was evaluated using the pain scale (0-10) to assess patient comfort during awake craniotomies.

Results: There were 38 patients in our study. The average duration of the surgery was 11.6 hours (range 10-17 hours). In all patients, SSSB provided complete scalp analgesia during the entire procedure, even for surgeries lasting up to 17 hours.

Conclusions: Super-selective scalp block provides excellent and prolonged scalp analgesia during awake craniotomies lasting more than 10 hours. This is in contrast to the traditional infiltration scalp block, which lasts only 4-6 hours. The SSSB offers significantly longer duration of scalp analgesia and warrants further investigations in awake and conventional craniotomies because of its potential to provide a longer and more effective pain control during perioperative period.

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ELECTROSTATIC MODELLING OF A NEEDLE-STIMULATING CATHETER SYSTEM USED IN PERIPHERAL NERVE BLOCKS

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Background: Computational models describing the electrical properties of needles demonstrated that the size of the conducting surface influences the way the current is propagated.

The aim of this study was to describe the electrostatic properties of stimulating catheters commonly used in clinical practice.

Methods: A model was constructed using the Finite Element Method, simulating an insulated 18-gauge, Tuohy needle and its corresponding stimulating catheter (Stimulong Plus®; Pajunk, Geisingen, Germany). The electric potential and current density vectors produced by the needle and the catheter in the surrounding tissue were obtained.

Results: Current density vectors produced by the catheter's conducting tip were larger and had a wider spatial distribution than the ones produced by the insulated- tip needle (Fig. 1).

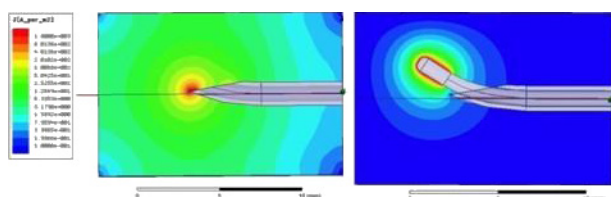


FIGURE 1. A tissue of volume $1.0 \times 1.0 \times 1.5$ [cm]³ with an average conductivity of 0.2 [S/m] and an ionic solution with a conductivity of 0.1 [S/m] are considered. A stimulation of 5 [V] is used first in the needle, and then in the catheter, connecting the needle to 0 [V].

Conclusions: Compared with the needle, the stimulating catheter displayed different distributions of current density vectors and electrical potential. These differences could explain the different electrical behaviour between needles and catheters observed in clinical practice.

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OPTICAL DETECTION OF PERIPHERAL NERVES: AN IN VIVO HUMAN STUDY

A. Balthasar¹, A. Desjardins², M. van der Voort², G. Lucassen², S. Roggeveen², A. Kessels³, M. van Kleef¹, M. Sommer¹ ¹Anesthesiology and Pain Medicine, Maastricht University Medical Center, Maastricht, ²Philips Research, Eindhoven, ³Department of Clinical Epidemiology & Medical Technology Assessment, Maastricht University Medical Center, Maastricht, The Netherlands.

Background and aims: A critical challenge encountered in interventional pain management procedures is to accurately identify the peripheral nerve targets. Current methods, which include ultrasound guidance and nerve stimulation, are not perfect. In this pilot study, we investigated the feasibility of identifying tissue transitions encountered during insertions towards peripheral nerve targets using optical spectroscopy. The essential principle of optical reflectance spectroscopy is that light is delivered to tissue and the reflected light is spectrally resolved.

Methods: The study was conducted with Medical Ethics Committee approval and all patients provided written informed consent for their participation. Using a custom needle stylet with integrated optical fibers, ultrasound-guided insertions towards six different peripheral nerves were performed in 20 human patients. During each insertion, optical reflectance spectra were acquired with the needle tip in subcutaneous fat, skeletal muscle, and at the nerve target region. Differences in the spectra were quantified with two parameters that provide contrast for lipid and hemoglobin, respectively.

Results: The transition of the needle tip from subcutaneous fat to muscle was associated with lower lipid parameter values ($P = 0.003$) and higher hemoglobin parameter values ($P = 0.023$). The transition of the needle tip from muscle to the nerve target region was associated with higher lipid parameter values ($P = 0.008$).

Conclusions: The results indicate that the spectroscopic information provided by the needle stylet could potentially allow for reliable identification of transitions from subcutaneous fat to skeletal muscle and from muscle to the nerve target region during peripheral nerve blocks.

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ULTRASOUND-GUIDED PERIBULBAR BLOCK: A 17 PATIENTS CASE SERIE

L. Beylaccq, A. Lasserre, M. Chouraqui, M. Penna, P. Maurette, K. Nouette-Gaulain CHU Bordeaux, Bordeaux, France.

Background: Sonographic guidance for retrobulbar and peribulbar injections has been described in cadavers but never in patients. The objective is to evaluate efficiency and easiness in patients of ultrasound-guided PBA we have described in cadaver.

Methods: Patients scheduled for eye surgery with PBA were included after informed consent. We used a multi-task US device (Logiq e GE) with specific eye settings (B-mode IM < 0.23 and IT < 1) and a curve array probe 8C. The classical technique with infero external injection completed, if need, with supero internal was used. The local anesthetic (LA) target diffusion was a crescent surrounded the posterior side of the globe. If the diffusion was great or after 8 ml max a test was performed. If successful (complete akinesia with a ptosis), a Honan balloon compression was applied, in case of failure, a supero

internal injection was performed. We recorded volume of LA, akinesia, ptosis, chemosis, eyelid swelling, complications, needle and LA visualization and patient satisfaction.

Results: All 17 patients had a successful UGPBA. For all, a superior injection was performed to achieve ptosis and 2 times to obtain the crescent diffusion. The needle was easily seen in plane in all cases. Patients satisfaction was excellent and no complications were reported. The average volume injected was 10ml AL. We achieved a PBA safely in a patient with myopic posterior staphyloma thanks to sonographic guidance.

Conclusions: This UGPBA technic seems efficient and easy in patients. Seen the needle during all the block could permit to extend PBA indications.

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PEDIATRIC ACL REPAIR: THE EFFECTS OF LOWER EXTREMITY NERVE BLOCKS ON SAME DAY SURGERY DISCHARGE

K. Boretzky, S. Cunningham, J. Grudziak, K. Boretzky, L. Broadman University of Pittsburgh Medical Center, Pittsburgh, PA, USA.

Background and aims: Anterior cruciate ligament (ACL) repair is a notoriously painful procedure. Adult studies demonstrate the benefit of lower extremity nerve blocks in providing high quality postoperative analgesia which can facilitate same day surgery (SDS) discharge. We performed an observational study involving pediatric patients who underwent an ACL repair on an ambulatory basis that either did or did not receive lower extremity nerve blocks and compared their opioid consumption and need for unscheduled hospital admission (UHA).

Methods: We retrospectively reviewed the charts of 123 sequential patients undergoing SDS ACL repair at the Children's Hospital of Pittsburgh from January 2009 through April 2012. Patients were divided into three groups: the control group (CG) received no nerve blocks ($n=39$); group-1 (GP-1) received single shot femoral and sciatic nerve blocks ($n=58$); and group-2 (GP-2) received femoral perineural catheters with disposable elastomeric pumps and single shot sciatic blocks ($n=26$). We analyzed the incidence of UHA (chi-squared) and opioid consumption (Mg/kg in morphine equivalents) [mg/kgMSE] in the PACU1 and PACU2 (scheffe).

Results:

	CG	GP-1	GP-2
UHA for pain/nausea/vomiting	17.95%	8.62%	3.85% **
PACU 1 opioid consumption, [mg/kg-MS equiv]	.111	.059	.058 *
PACU 2 opioid consumption (4hr), [mg/kg - MS equiv]	.058	.028	.034 *

* The comparison of both GP-1 and GR-2 to CG reached critical values but comparison between GP-1 and GP-2 did not. ** Differences in UHA rates failed to achieve statistical significance.

Conclusions: The use of lower extremity nerve blocks following ACL repair in pediatric patients facilitates reliable SDS discharge, and a significant reduction in opioid consumption. Data trends towards increased SDS discharge with the use of continuous catheters.

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CLONIDINE AS AN ADJUVANT TO BUPIVACAINE IN INTERSCALENE BLOCKS DOES NOT INCREASE DURATION OF ANALGESIA IN SHOULDER SURGERY

A. Burumdayal, S. Benham, J. Chantler Nuffield Division of Anaesthetics, Oxford University Hospitals NHS Trust, Oxford, UK.

Background and aims: Although the addition of clonidine to intermediate-acting local anaesthetics for peripheral nerve blocks appears to increase the duration of sensory block and analgesia, the evidence for prolonging analgesia with longer-acting local anaesthetics is controversial¹. We performed a prospective audit to evaluate the effect of adding clonidine to bupivacaine in interscalene nerve blocks (ISB) for shoulder surgery.

Methods: Over an 8-month period, all patients undergoing shoulder surgery with general anaesthesia and ISB under ultrasound guidance using 0.5% bupivacaine and up to 150 µg of clonidine were followed up. Ethical approval was waived under our institution's policy for audit of current practice. Data about peri-operative drug dosages, pain scores and analgesic requirements and intra and post-operative haemodynamic variables were recorded. Block duration (time until return of pain) was determined by structured telephone

interview at 48 hours. These data were compared to our similar study using the same methodology without clonidine in 2010.

Results: One patient had intraoperative bradycardia requiring atropine.

TABLE 1. Comparison of 2010 and 2012 data

Year	2010	2012
Number of patients	46	48
Mean block duration (h)	19.8	20.5
Mean dose of clonidine (µg)	-	138

Conclusions: Clonidine appears to only marginally increase ISB duration and is probably of little statistical or clinical significance. Based on these results, we feel there is insufficient evidence currently to recommend the routine addition of clonidine to bupivacaine for ISB for our patients.

References: 1. McCartney CJL, Duggan E, Apatu E. Should We Add Clonidine to Local Anesthetic for Peripheral Nerve Blockade? A Qualitative Systematic Review of the Literature. *Reg Anesth Pain Med* 2007;32:330-338

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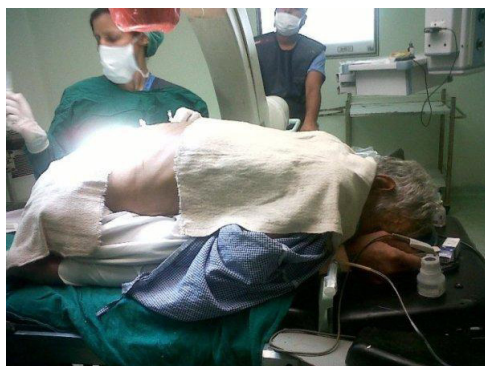
FLUOROSCOPY GUIDED CELIAC PLEXUS BLOCKADE IN MODIFIED KNEE CHEST POSITION

R. Anand, A. Aggarwal, K.K. Girdhar, V. Saith, A. Bhalotra, A. Misra, G. Manchanda *Department of Anesthesiology, MAMC and Lok Nayak Hospital, New Delhi, India.*

Background and aims: The celiac plexus block can be given in both supine and prone positions via anterior and posterior approaches respectively. Both approaches have their own merits and demerits. In posterior approach, the patient lies prone with a pillow underneath the abdomen to alleviate lumbar lordosis and the block is given under fluoroscopic or CT guidance. Some patients have difficulty in tolerating the prone position because of pain and distension. In USG guided anterior approach, the needle passes through liver, intestine, stomach, pancreas and vessels. It includes risk of infection, hemorrhage and fistula formation.

Our aim was to give celiac plexus block in knee chest position in patients not tolerating prone position.

Methods: After signed informed consent we gave celiac plexus block in two patients with carcinoma head of pancreas in the modified knee chest position under fluoroscopic guidance. In this position the abdomen comes to lie in between the flexed knees so that femur is away from midline.



[Fig. 1]

Results: The patient maintained this position comfortably and was cooperative. We had no problems in imaging the vertebral bodies in AP and lateral view. No pillow was required as lumbar lordosis was abolished in this position. We gave the block bilaterally using 8% phenol 20 ml both sides using 15 cm chiba needle and follow up showed successful blockade.

Conclusions: Modified Knee Chest position can be used to give celiac plexus blockade in patients not tolerating prone position.

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VALIDATION OF SPANISH SHORT VERSION OF THE BRIEF PAIN INVENTORY (BPI-SF) IN NON CANCER POPULATION

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Background and aims: The Brief Pain Inventory (BPI) is one of the most widely measurement tools used for assessing pain in clinical research. Until now, the long version of BPI (BPI-LP) was the only validated version in Spanish, for cancer population, for this reason we tried to validate a short version of BPI (BPI-SF) in non cancer population.

Methods: A sample of 710 patients (20% of total study sample) from approximately 10% of participating sites (selected by aleatorization) was required to complete BPI-LP & BPI-SF. Two dimensions, "pain intensity-PI (severity)" and "the impact of pain on functionality-IPF (interference)" of BPI-SF regarding BPI-LP were validated. Convergent validity, longitudinal validity, reliability and internal consistency were evaluated. Statistics were analyzed using Pearson's correlation coefficient and Intraclass Correlation Coefficient (ICC). Study was approved by Ethic Committee.

Results: 714 patients completed both versions of BPI at basal (BV) and at Month 3 (M3) visits. Linguistic validation was performed by coordinators. Concordance was observed in the mentioned dimensions at BV: ICC-PI: 0.943 CI95%(0.935-0.951), ICCIPF: 0.934 CI95%(0.934-0.943) & at M3: ICC-PI: 0.960 CI95%(0.954-0.966), ICCIPF: 0.976 CI95%(0.973-0.980). Regarding longitudinal validity, there was concordance between differences (M3-BV): ICC-PI: 0.946 CI95%(0.939-0.954) and ICCIPF: 0.940 CI95%(0.931-0.948). Absolute differences between short and long versions (BV&M3) were in PI: difference=0 points 61.5%&59.5%, difference=0.1-1 36.8%&38.7% and >1 1.7%&1.8% and in IPF: difference=0 53.6%&51.3%, difference=1-5 42.9%&45.1% and >5 3.5%&3.6%.

Conclusions: BPI-SF reproduces dimensions contained in BPI-LP with reliability, validity and consistency. All of these were also confirmed in longitudinal measures.

BPI-SF is valid to be used in clinical practice in Spanish non cancer population.

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PAIN CONTROL FOLLOWING TOTAL KNEE ARTHROPLASTY: A PROSPECTIVE COHORT STUDY COMPARING FEMORAL NERVE BLOCK/LOCAL ANAESTHETIC INFILTRATION AND FEMORAL NERVE CATHETER INFUSION/SCIATIC NERVE BLOCK

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Optimising analgesia following total knee arthroplasty is challenging, this study aimed to find the fine balance between analgesia & mobilization.

Group A: received femoral nerve block/local anaesthetic infiltration.

Group B: received femoral nerve catheter/sciatic nerve block.

Each cohort included 50 ASA II patients. Postoperative morphine consumption, range of motion, mobilisation, patient satisfaction & admission duration were measured.

All patients had spinal anaesthesia: heavy bupivacaine 0.5%, 2.5 mL with diamorphine 300 mcg.

Group A: femoral nerve block with 20 mL of levobupivacaine (L.B.) 0.25% and infiltration with mixture of L.B. 0.5% 30 mL; adrenaline 0.1 mg/mL, 5 mL; ketorolac 30 mg/mL, 1 mL; saline 0.9% 24 mL.

Group B: femoral nerve block with 10 mL of L.B. 0.25% & femoral nerve catheter connected to 400 mL of L.B. 0.0325% infusing 10 mL/h. Mid-thigh sciatic nerve block with 20 mL of L.B. 0.5%.

Nerve blocks were guided by ultrasonography/nerve stimulation.

Group B: Mean 2.78 days admission (range, 2-5 days). **Group A:** Mean 4.34 days (range, 3-7 days) (P=.21).

Group B: mobilized out of bed and walked without assistance 1 day before group A ($P < .001$).

No differences in postoperative day 1 ROM ($P = .48$) & extension deficit ($P = .30$). Significantly more patients had full extension by discharge in **group B:** ($P = .031$). Morphine consumption was greater in **group A.**

Group B: had better VAS 4 through 6 ($P = .050$) and of VAS 7 through 10 ($P = .032$), & were significantly more satisfied ($P = .03$).

Conclusion: Femoral Nerve Catheter/Sciatic Nerve Block technique achieved better analgesia & mobilization following TKA.

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ENHANCED RECOVERY PATHWAY REDUCES LENGTH OF STAY AFTER HIP AND KNEE REPLACEMENTS IN A LARGE ORTHOPAEDIC CENTRE - RESULTS AFTER THE FIRST 3700 PATIENTS

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Background and aims: The study aims to measure outcomes after introduction of an enhanced recovery pathway in an elective orthopaedic centre performing high volume arthroplasty surgery. We compared it to the year before.

Methods: All consecutive primary hip (THR) and knee (TKR) replacements performed between April 2010-November 2011 were compared to all patients between March 09- March 10. Average inpatient stay (LOS) calculated from date of operation to discharge date was recorded along with % of patients discharged on day 3 for THRs and day 4 for TKRs. The primary analgesic technique for THRs in the 2009-10 group was 0.2mg intrathecal morphine and single shot femoral and sciatic blocks for TKRs. Details of the ER protocol are given in the table.

Oswestry Enhanced Recovery protocol for

TKRs

Omeprazole 20 mg, Pregabalin 150 mg, as premed (75 mg if > 70 yrs)
Spinal with 0.5% Heavy Marcain 2ml, lying down with operated side down * 10 min
Tranexamic acid 500 mg IV at induction and 500 mg at tourniquet deflation
Sedate/ GA if needed (N2O free GA)
IV Paracetamol, Parecoxib 40 mg IV, 8mg Dexamethasone, 4mg Ondansetron, Ketamine 0.3-0.5mg/kg IV (give all drugs before tourniquet inflation)
Local infiltration by surgeon(150ml 0.2% Ropivacaine, 1 mg Adrenaline)
Paracetamol 1 gm Q6H, Etoricoxib 120mg OD * 5 days regular Omeprazole 20 mg OD
Pregabalin 75mg BD* 5 days (OD if > 70 yrs) regular
Oxycontin 20 mg BD * 4 doses regular, first dose in recovery before spinal wears off
Tranexamic acid 500mg IV 6hr postop single dose
Lactulose 10 ml nocte regular
Oxynorm 10 mg PRN 3h, Ondansetron 4 mg IV PRN

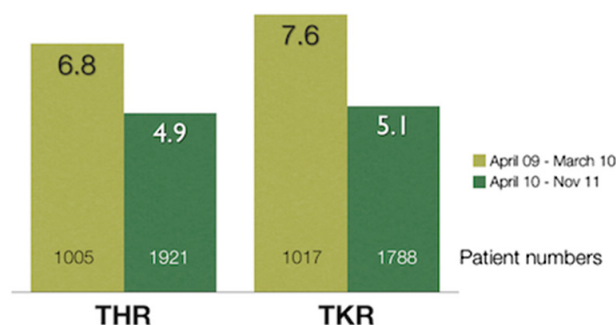
If unable to do a spinal, fentanyl boluses as required in theatre and 3-5 mg Diamorphine at the end. 5gm Mg will assist in controlling the hypertensive response to pain

[Anaesthetic protocol]

An attempt at mobilisation was made within 3-4 hours after surgery in the enhanced recovery group while this attempt was only made the next day in the historical group.

Results: 3709 patients in the ER group were compared to 2022 patients in the historical group. Average LOS decreased from 6.8 to 4.9 for THRs and 7.1 to 5.1 for TKRs.

Mean LOS

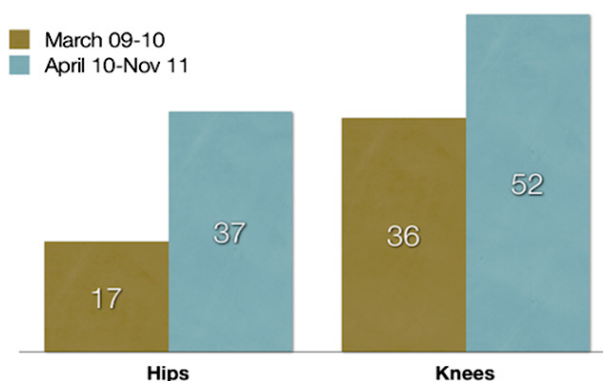


[Mean length of stay]

The % discharged by day 3/4 was almost doubled.

% of patients discharged <=

3 days for THRs, 4 days for TKRs



[% discharged by day 3/4]

Conclusions: Enhanced recovery pathway has demonstrated a significant reduction in hospital stay. Readmissions were not increased and a 30% reduction in deep vein thrombosis was also seen.

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PLASMA LEVOBUPIVACAINE CONCENTRATION AFTER RECTUS SHEATH BLOCK

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Background and aims: In lower abdominal surgery, the rectus sheath block is becoming the most common technique for midline incisions. It is well known that injection of a large doses of local anaesthetics may result in toxic plasma concentrations, however, excess volume more than maximum dose recommended by the pharmaceutical company is sometimes needed in clinical status. Levobupivacaine is commonly used for this technique, however, plasma concentrations of levobupivacaine after this block have not been previously reported.

Methods: This study has been approved by the Hospital Ethics Committee and written informed consent were obtained. Eighteen adult patients undergoing elective lower abdominal laparoscopic surgery were recruited and received bilateral ultrasound-guided rectus sheath blocks before operation (150 mg of levobupivacaine diluted to 60 ml). Arterial blood was collected every 15 min for the first hour, then every 30 min for the following hours until the patient returned to the ward.

Results: In the patients, the mean (SD) peak total levobupivacaine concentration occurred 45 min post-injection and was 1.249 (SD 0.62) mcg/ml.

Mean total concentrations remained under 1.30 mcg/ml for up to 240 min post-injection.

Conclusions: Rectus sheath block using 150 mg of levobupivacaine produces relatively low blood plasma concentrations that are well below the neurotoxic level. Therefore, there is the possibility of safely increasing the anesthetic dose of levobupivacaine in the rectus sheath blocks for lower abdominal surgery.

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COMPARISON OF POSTOPERATIVE ANALGESIA BY SINGLE AND MULTIPLE INJECTION OF PARAVERTEBRAL BLOCK IN PARTIAL MASTECTOMY

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Background and aims: Paravertebral block is effective for postoperative analgesia of mastectomy. The present study was performed to clarify whether single or multiple injections are better on postoperative analgesia of mastectomy.

Methods: After the approval of the IRB and informed consent, 40 female aged 40 to 65 years for partial mastectomy were divided into two groups, single and multiple groups. In the single group, paravertebral block using 0.25% bupivacaine 15 mL was performed at T4, and in the multiple group, the block was performed at T3, 4, and 5 with each 0.25% bupivacaine 5 mL. In both groups, general anesthesia was induced with midazolam, fentanyl, propofol and vecuronium. Laryngeal mask airway #3 was inserted. Anesthesia was maintained with propofol 5-7 mg/kg/h and 50% nitrous oxide. Fentanyl 50 µg was administered as necessary. Intramuscular pentazocine 15 mg was used as a rescue postoperative analgesia. The dose of fentanyl used during anesthesia, frequency of analgesic required and pain measured by a visual analog scale (VAS, 0-10) in 24 hours after surgery were compared between the groups.

Results: The dose of fentanyl, frequency of analgesic, and the VAS score were not different between the two groups. Time spent for the block was significantly shorter in the single group.

Conclusions: For anesthesia and post operative analgesia in partial mastectomy, paravertebral block at T4 with 0.25% bupivacaine 15 mL and that at T3, 4, and 5 with 0.25% bupivacaine 5 mL were equally effective, while it took more time for multiple.

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ELECTRICAL NERVE STIMULATION TRESHOLD OF THE SCIATIC NERVE IN DIABETIC PATIENTS WITH ISCHEMIC GANGRENE OF THE FOOT. A COMPARISON WITH NONDIABETIC PATIENTS

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Background and aims: Peripheral neuropathy may affect electrical nerve stimulation threshold in patients with diabetes mellitus. The aim of this study was to evaluate whether the minimal current required to elicit a motor response of the sciatic nerve is increased in patients suffering from diabetic gangrene compared to nondiabetic patients.

Methods: With approval of the local ethics committee, 30 patients (mean age 74 ± 7 years) scheduled for minor amputation and 20 nondiabetic patients (mean age 65 ± 12 years) undergoing orthopedic surgery of the lower leg were studied. We performed an ultrasound guided lateral sciatic nerve block using an in-line approach. The electrical threshold was assessed with the needle tip located directly adjacent to the peroneal branch of the sciatic nerve, and was defined as the minimal current required to elicit a typical motor response (dorsiflexion or eversion of the foot) at a pulse width of 1 ms and a stimulation frequency of 1 Hz (stimulating needle Stimuplex D Plus® 8 cm; nerve stimulator Stimuplex HNS®; Braun Melsungen AG, Melsungen, Germany).

Results: The stimulation threshold was 1.90 mA (1.40; 2.70) (median (25th; 75th percentile)) in diabetic patients compared to 0.27 mA (0.24; 0.30) (median (25th; 75th percentile)) in nondiabetic patients ($p < 0.001$ between groups, two-sided Mann-Whitney U Test). **Conclusions:** Electrical nerve stimulation for localization of the sciatic nerve may be inferior to ultrasound guidance in patients with diabetes mellitus, at least under the clinical conditions of the current study.

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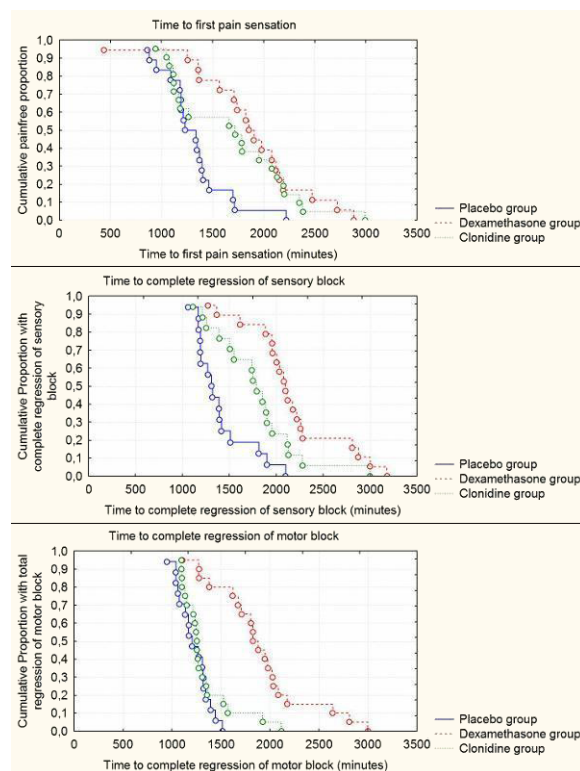
COMPARISON OF THE DURATION OF POSTOPERATIVE ANALGESIA USING A POPLITEAL BLOCK WITH OR WITHOUT DEXAMETHASONE OR CLONIDINE

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Background and aims: Foot surgery is often associated with severe and long-lasting postoperative pain requiring large amounts of parenteral opioids. Time-limitation of effective analgesia after single shot popliteal fossa block (SSPFB) is an important issue. The aim of this study was the effect of additives on block characteristics.

Methods: In a double-blinded randomized placebo controlled study we evaluate the effect of clonidine or dexamethasone as an additive to a SSPFB with ropivacaine as analgesic technique for hallux valgus surgery. All patients received an ultrasound guided SSPFB with 30cc of ropivacaine 0.75% and research medication containing placebo, clonidine 100µg or dexamethasone 5mg. Patients were randomized in 3 treatment groups. Primary endpoint was time to first pain sensation. Secondary endpoints were time to complete motor and sensory block regression.

Results: After obtaining institutional ethics research board approval and written informed consent, we selected 57 ASA 1 and 2 patients. There were no demographic differences between groups. Onset of sensory and motor block was not statistically different between groups. Postoperative analgesia was significantly prolonged by both dexamethasone and clonidine compared to placebo ($p=0.008$), as were times to complete regression of sensory ($p=0.0005$) and motor blockade ($p=0.0001$). Incidence of side-effects was not increased.



[Fig: Kaplan-Meier curve: time to first pain (a), t]

FIG: Kaplan-Meier curve: time to first pain (a), total regression sensory (b) and motor (c) block responses.

Conclusion: Dexamethasone - and to a lesser extent, clonidine - prolong the duration of analgesia significantly when added to a single shot popliteal fossa block with ropivacaine.

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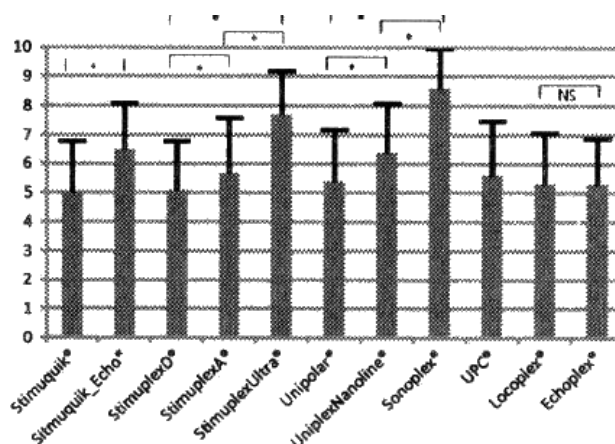
PROSPECTIVE, RANDOMISED STUDY ASSESSING THE ECHOGENICITY OF NEEDLES FOR PERIPHERAL NERVE BLOCKS

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Background and aims: Several manufacturers now provide peripheral nerve block needles which have been engineered to have better visibility than needles of a traditional design. However, this remains untested. The aim of this study was to evaluate the echogenicity of 11 different needles during a standardised insertion into a phantom.

Methods: A selection of hyper-echoic or normo-echoic needles was provided by five different manufacturers. A short video clip was recorded of each needle being inserted into a phantom at a constant angle of 45°. The ultrasound machine settings were standardized and unchanged between each needle insertion. A specific website was created for the study (www.epi2i.fr/epi_01) where an observer could view the video of each needle insertion. The viewing order of each video clip was randomised for each observer. At the end of each video, the observer evaluated the echogenicity of each needle (numeric scale and choice between “normo-echoic” or “hyper-echoic” design).

Results: The 202 observers, working mainly in a teaching hospital (48%), individually had considerable experience in ultrasound-guided regional anaesthesia (> 24 months = 57%; UGRA >75% of blocks = 74% of cases). The echogenicity of hyper-echoic needles was generally judged to be higher when compared to normo-echoic needle (figure 1). The 4 hyperechoic needles were ranked as hyperechoic in 21 to 98% of cases.



[Figure 1]

Conclusions: This study confirms the large difference in echogenicity between peripheral nerve block needles inserted at a constant angle. Some needles sold as hyperechoic do not seem to perform very differently from normo-echoic ones.

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ROUTINE URINARY CATHETERISATION IN PATIENTS RECEIVING INTRA-THECAL OPIOIDS - IS IT NECESSARY?

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Background: Post-operative urinary retention is a recognised side effect of intra-theal opioids (ITO) regardless of dose [1]. Routine catheterisation can hinder early post-operative mobilisation. We aimed to audit the incidence of urinary catheterisation in the first 24 hours post-operatively in elective primary hip and knee arthroplasty (THR/TKR) patients who had Traditional or Enhanced recovery analgesic techniques.

Methods: Caldicott guardian approval was granted. Prospective data was collected and divided into patients receiving ITO (GroupA) or no ITO (GroupB). Morphine (0.05 - 0.1mg) and Diamorphine (0.1 - 0.3mg) were

used as ITO. All received standard post-operative pain relief including regular Oxycontin and rescue Oramorph.

Results:

Variables	Group A (n=26)	Group B (n=21)	P value
Age (Standard Deviation-SD)/ ASA-median	67.1 (9.15) / 2	66.5 (5.01) / 2	Not significant (NS)
Gender M/F (No. of patients)	15/11	13/8	-
THR/TKR (No. of patients)	10/16	10/11	-
Intra-op fluids in mls (SD)	1098 (504)	958 (394)	NS
Bupivacaine in mg (SD)	13.96 (2.65)	11.9 (2.1)	NS
Blood loss in mls (SD) (THR patients only)	819 (499)	497 (263)	NS
Duration of surgery in minutes (SD)	82.3 (23.6)	78.6 (15.7)	NS
First micturition, in minutes (SD)	543 (190.7)	406 (150)	0.007
Needing Post-op catheter (%)	4 (15.4%)	1 (4.8%)	NS (0.49)

[Comparison of patients (n=47) with or without ITO]

Conclusions: We have found a low incidence(10.6%) of post-operative urinary catheterisation that does not support routine pre-operative catheterisation. The incidence was greater in patients who received intra-theal opiate.

Reference:

1. Raffaelli W et al. Opioid-related side-effects after intrathecal morphine: a prospective, randomized, double-blind dose-response study. 2006 July; 23(7):605-10.

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USE OF MODIFIED EPIDURAL INFORMATION CARD FOR IMPROVING INFORMATION FOR OBSTETRIC EPIDURAL IN ANTE-NATAL WARD

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Background and aims: An audit was performed to measure the level of knowledge in women who had used the epidural analgesia during labour and who had got the epidural information by verbal discussion at the time of labour. (Non EIC) The audit was repeated in a group of women who got the information after going through modified Epidural information card in addition to a verbal discussion (EIC) in ante- natal ward.

Methods: Approval by Hospital audit committee.

The three stages of audit project was an audit of current practice, the introduction of new practice and a re-audit thus completing an audit cycle.

Fifty women who had used epidural analgesia for labour were included in first phase of the audit (Non EIC). All patients had received a verbal discussion about risks and benefits of epidural analgesia. On the first post-partum day, the interview aimed to establish what the woman had understood when she gave her consent rather than what she had discovered afterwards. There were 12 questions. The interviewer chose the answer closest to that given by the patient.

Based on the hospital guidelines, a modified version of A4 laminated epidural information card (EIC) was prepared. Women to be induced with prostaglandins for labour planning to have an epidural, were visited in antenatal ward and EIC explained to them. Fifty women who had seen the modified EIC and had used the epidural analgesia (EIC) group were interviewed on the first post-partum day using the same format as Non EIC group.

Results: In nine out of 12 questions there was a significant improvement in the number of correct answers in modified EIC group.

Conclusions: EIC modified according to Local hospital guidelines and risk figures should be made available in labour wards, ante-natal clinics for making informed consent legally more valid.

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CAUDAL BLOCK AND ADJUNCTS TRAMADOL VS FENTANYL, IN CHILDREN FOR ORTHOPEDIC SURGERY

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Background and aims: This study was designed to compare the analgesic effects and side-effects of opioids: fentanyl and tramadol, when added

to bupivacaine for caudal analgesia in children undergoing lower limb surgery at orthopedic department.

Methods: Fifty ASA I-II patient age 2-8 yr were enrolled in study. After general anesthesia patients were placed in lateral position and caudal block was performed with 0.25% bupivacaine 0.5ml/kg with fentanyl 1 µg/kg for Group F, while Group T (Tramadol group) received 0.25% bupivacaine 0.5ml/kg with 1mg/kg tramadol. patients were monitored and HR, NIBP and SpO₂ were recorded every 5 min till patient were transferred to PACU. In PACU HR, NIBP, SpO₂ postoperative analgesia, other side effects like nausea, vomiting, respiratory depression, pruritus hypotension and bradycardia were noted.

Results: Both groups (each 25 patients) were comparable for age, weight, gender, duration of general anesthesia, duration of surgery, time from caudal block to incision and tracheal tube removal after discontinuation of the volatile agent and had no statistical difference. MAP, HR SpO₂ at induction, intra and post operatively showed values with no statistical difference. MAP and HR decreased and then increased after the anesthesia with no statistical relevance. Postoperative analgesic requirement was similar to both groups till six hours after the operation 1.56 ± 0.6 for group F and 1.53 ± 0.5 for group T with no statistical difference. After this period analgesic requirements were equally higher for both groups.

Conclusions: Caudal bupivacaine combined with fentanyl or tramadol were equally effective regarding postoperative pain in pediatric patient undergoing lower limb orthopedic surgery, in the first six hours of the postoperative period. Adding fentanyl or tramadol to bupivacaine for caudal block increases and improves quality of analgesia during and after the surgery.

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INSERTION OF AN INTRATHECAL CATHETER AFTER ACCIDENTAL DURAL PUNCTURE IS A PROMISING INTERVENTION FOR THE MANAGEMENT OF HEADACHE: A META-ANALYSIS

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Background and aims: Inserting an intrathecal catheter after accidental dural puncture (ADP) in parturients as a measure to prevent postdural puncture headache (PDPH) is becoming increasingly popular. We aimed to identify relevant articles investigating this intervention and subjected the data to a meta-analysis.

Methods: A systematic literature search was performed in databases, paralleled by a hand search of abstract publications. Studies that reported on the dichotomous outcome parameters postdural puncture headache or the need for an epidural blood patch were considered eligible. Risk ratios (RR) were calculated with 95% confidence intervals (CI).

Results: We identified 9 reports investigating placement of intrathecal catheters after ADP. The RR for an epidural blood patch after intrathecal catheter insertion was 0.64 (95% CI 0.49-0.84, p=0.001). The RR for postdural puncture headache was 0.82 (95% CI 0.67-1.01, p=0.06).

Conclusions: Inserting an intrathecal catheter significantly reduced the RR for an epidural blood patch, whereas the incidence of postdural puncture headache was not significantly different. ADP is a rare complication and therefore trials on interventions for ADP need to include a large number of patients; they would be time-consuming and costly. Intrathecal catheterisation is a promising approach for the prevention of PDPH and should be evaluated in a trial. This intervention has additional benefits including a reduced risk of another dural tap, excellent anaesthesia conditions, and rapid onset.

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DEXAMETHASONE AS ADJUVANT TO CAUDAL ROPIVACAINE AS ANALGESIA OF LABOR PAIN

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Background and aims: To evaluate analgesic yield of dexamethasone as adjuvant to caudal ropivacaine for labor pain.

Methods: 414 primigravida in their active phase of the first stage of labour divided randomly into two groups: ROP group received caudal ropivacaine and DEX group received caudal combination of ropivacaine and dexameth-

asone. Assessment included extent of sensory and motor blockade and requirement of anaesthesia for episiotomy repair and evaluation of post-episiotomy pain and postpartum complications.

Results: Sensory blockade data showed a profound analgesic effect in both groups with superior effect in DEX group manifested as significantly earlier onset of analgesia in association with significantly prolonged duration of analgesia. Caudal block did not disturb process of delivery with non-significant difference between both groups. Twenty nine parturient had caesarean section and 385 had vaginal delivery. Episiotomy was repaired without perineal infiltration anaesthesia. Postpartum perineal pain scores were significantly lower in DEX group with significantly higher low pain scores and significantly request for analgesia for episiotomy related pain

Conclusions: Caudal ropivacaine/dexamethasone provided safe profound labor analgesia without interruption of progress of labor and spared the need for perineal anaesthesia for episiotomy repair and minimized the need for subsequent analgesia.

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PROLONGED EPIDURAL ANALGESIA AS A CONSERVATIVE TREATMENT COMPONENT OF LARGE JOINTS CONTRACTURES IN CHILDREN WITH CEREBRAL PALSY

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Aim: To improve the quality of conservative treatment of large joints contractures in children with cerebral palsy, and to shorten rehabilitation.

Methods: 12 patients aged from 9 to 16 years with large joints contractures of the lower limbs were included into the study. Epidural catheter was installed at the level Th12-L1. For analgesia Ropivikain (0.5%; 2.0 - 2.5 mg/kg) was used one hour before the start of motor rehabilitation. The time interval between injections was 5 hours. Epidural analgesia was performed within 3-4 weeks during rehabilitation period. Adequacy of analgesia was assessed by the 10-point visual analog scale.

Results: As a result complete contractures elimination and increase in the range of motion to 20°-40° have been achieved in 9 patients (75%). In 2 patients range of motion increased to 15°-17° (16.6%), and 1 patients did not have significant increased in dynamic range of motion - 7° (8.4%). Subjective evaluation of pain was carried out during the conservative correction. In all patients VAS score was 1-2. Electromyography and electroneuromyography was performed to verify the neurophysiological mechanisms. The data showed increased amplitude of muscle electrogenesis indicators on m.tibialis anterior and m.rectus femoris for 26-32%, and m.biceps femoris for 18-22%. The amplitude of the M-response decreased by 22-26%, and the speed of impulse transmission by 15-21%. The structure of the myogram and H-reflex did not undergo significant changes.

Conclusions: The use of prolonged epidural analgesia creates the necessary conditions for adequate motor rehabilitation and prerequisites for the development of walking.

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RE-AUDIT ON THE MANAGEMENT OF GRADE 1 CAESAREAN SECTION IN A TEACHING HOSPITAL, UNITED KINGDOM

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Background and aims: Caesarean section accounts for 20-25% of all deliveries in the UK¹. Delivery at emergency Caesarean section for immediate threat to life of mother or fetus should be accomplished as quickly as possible. Recommendations from audit done in our institution in 2009 included formal grading of caesarean section to 1-4, use of crash bleep and direct communication between obstetrician and anaesthetist. The aim of our re-audit was to compare current practice with our existing institutional policy and to implement effective changes.

Methods: Prospective audit done over 3 months in 2011. All obstetric anaesthetists were asked to complete the audit forms.

Results: In total there were eight grade 1 caesarean sections. Four women (50%) were turned onto their side while being transferred. Oxygen

was administered immediately in seven cases(87%). Crash bleep was activated in four cases(50%). Seven women(87%) were moved into theatre immediately. In seven cases(87%), the obstetrician spoke directly to the anaesthetist. Foetal monitoring was continued in theatre in six cases. Sodium citrate was administered in five cases(62%). In one case, the other team member tried to influence the anaesthetist's clinical decision. WHO checklist was used in five cases(62%). Attempts at fetal heart rate monitoring delayed anaesthetic induction in two cases.

Conclusion: We were excellent in some areas like administering oxygen, speed of transfer and obstetrician speaking directly to the anaesthetist. However there was room for improvement in areas like turning onto side, stopping syntocinon, starting IV fluids and activating crash bleep.

Reference:

- 1) Caesarean section, NICE Clinical Guideline (November 2011)

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POSTOPERATIVE PAIN RELIEF USING ULTRASOUND GUIDED ILIOINGUINAL BLOCK VS. MULTIMODAL ANALGESIA FOLLOWING INGUINAL HERNIA REPAIR SURGERY IN YOUNG CHILDREN

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Background and aims: Peripheral ultrasound guided ilioinguinal block (UGIIB) might be effective method of providing pain relief and a good alternative to multimodal drugs approach after inguinal hernia repair surgery in children. We compared efficacy of UGIIB vs. multimodal parenteral analgesia approach (MPA) for postoperative pain relief, as well as paracetamol and morphine consumption in small children undergoing inguinal hernia repair surgery.

Methods: Twenty patients, ASA I-II, aged from 14 months to 5 years were prospectively randomized to receive UGIIB with 0.375% levobupivacaine 0.5 ml/kg (IIB group) or paracetamol 15 mg/kg iv and morphine 0.1 mg/kg (MPA group) after induction in anesthesia. Every child was premedicated with 0.3 mg/kg midazolam syrup and general anesthesia was induced with sevoflurane followed by insertion of laryngeal mask. Anesthesia was maintained with sevoflurane in O₂ and air (FiO₂ = 0.5) and remifentanyl 0.3-0.7 mcg/kg/min. Postoperatively, CHIPPS score in combination with Face Scale were obtained 1, 6, 12 and 24 hours postoperatively. If pain score was 3 or more child received paracetamol 15 mg/kg iv and if 6 or more morphine sulphate 0.05 mg/kg intravenously was added.

Results: There were no significant differences in pain scores 1,6,12 and 24 hours after surgery in both groups and also was not statistically significant difference for morphine/ paracetamol consumption between groups (0,012/12,1 mg/kg for UGIIB and 0,010/18,3 mg/kg for MPA group.)

Conclusions: US guided ilioinguinal block provides good postoperative pain relief. The MPA approach gives almost identical results in the treatment of postoperative pain as well as UGIIB.

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AUGMENTATION OF EPIDURAL ANALGESIA TO ANAESTHESIA FOR CAESAREAN DELIVERY

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Aim: Over 93,000 emergency Caesarean sections (CS) were carried out in NHS hospitals every year. In 22% of them epidural bolus('top up') was the type of anaesthesia used. The purpose of this audit was to find out how the quality of labour analgesia affects the incidence of intraoperative pain following epidural topups for CS in our hospital.

Methods: Ethics committee approval has been requested. We prospectively collected data from 50 consecutive CS done under epidural topups over 10 week period. We encouraged the anaesthetists to test the quality of block with 3 modalities of sensation(Cold, touch and pin prick) and motor block with bromage score. We also collected information about quality of labour analgesia from labour ward notes.

Results: Nine patients complained of intraoperative pain. None of the patients required conversion to GA. Table 1 below summarises the results. Values are in median (range) or percentage. No significant differences.

	Experience of anaesthetist < 2 years (%)	Infusion rate	Number of extra boluses	Duration of labour	Duration of Epidural (hours)	Cervical dilatation at epidural insertion	Upper level of block to cold	Total amount of fentanyl in mg	Total amount of chirocaine in mg
Pain	55.5%	10 (10-12)	0 (0-2)	13 (5-29)	4.5 (1-8)	4 (2-9)	T7 (T4-T10)	105 (20-152)	71.5 (25-96)
No pain	48.6%	10 (8-15)	0 (0-3)	10 (2-57)	4 (1-14)	3 (2-10)	T8 (T3-T11)	110 (15-250)	62 (22-188)
Total	53.4%	10 (8-15)	0 (0-3)	10 (2-57)	4 (1-14)	3.5 (2-10)	T8 (T3-T11)	110 (15-250)	63 (22-188)

[Table 1. Adequacy of labour epidural analgesia.]

Conclusion: The incidence of pain (95% CI) following epidurals augmented for CS remained relatively high at 18% (7.4% to 26.6%). None of the factors pertaining to the experience of the anaesthetist, amount of local anaesthetic used, amount of opioid analgesic used and analgesic efficacy during labour were found to be associated with an increased incidence of intraoperative pain.

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LABOUR EPIDURALS AND MATERNAL VALID INFORMED CONSENT - VERBAL VS WRITTEN RISK INFORMATION RECALL

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Background & aims: Obtaining valid consent for labour epidurals concerns the Obstetric Anaesthetist^{1,2}. Various information modalities to aid this process have been described. In our Trust, we provide early written information at first antenatal booking. Prior to epidural insertion, verbal explanation is given and consent taken. As one aspect of valid informed consent is information recall³, we performed this audit assessing this recall.

Methods: We performed this prospective audit of 50 women within 48 hours of delivery who received an epidural. A PALS (Patient Advice & Liaison Service) approved questionnaire was used.

Results: 12 risks were explained in verbal and written form. Recall of these were assessed as 'spontaneous' and 'prompted'.

Maximum spontaneous verbal RR: 9 (mode = 2)

Maximum prompted verbal RR: 8 (mode = 6)

Maximum spontaneous written RR: 4 (mode = 0)

Maximum prompted written RR: 5 (mode = 0)

(RR=risk recall)

Conclusion: Either modality recall was poor, but women demonstrated better verbal information recall.

Following this audit highlighting the difficulty in obtaining valid consent, we designed a modified OAA epidural information card⁴. This will be made available in the labour room and induction suite. Our second proposal is to encourage midwives to discuss analgesic options during antenatal care. The key is frequent information sharing, and not relying on a single modality to enhance understanding.

References:

1. Knapp RM. Legal View of Informed Consent for Anesthesia During Labor. *Anesthesiology* 1990;72:211
2. AAGBI - Consent for Anaesthesia (Revised Edition January 2006)
3. DCA, Mental Capacity Act 2005: Code of Practice
4. Epidural information card (<http://www.oaa-anaes.ac.uk>)

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THE INFLUENCE OF OXYGEN INHALATION ON FREQUENCY OF INTRAOPERATIVE NAUSEA AND VOMITING IN PARTURIENTS UNDERGOING CAESAREAN SECTION UNDER SPINAL ANAESTHESIA

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Background and aims: The choice of agents during Caesarean section under spinal anaesthesia may significantly impact on the incidence of intraoperative nausea and vomiting IONV. Avoidance of hypotension, adequate hydration, and the administration of supplemental oxygen may be parts of effective antiemetic tactics. Hypotension during spinal anaesthesia may lead to brain stem ischemia, which is thought to activate the circulatory, respiratory,

and vomiting centers grouped together in the medulla. Consequently, supplemental oxygen can relieve nausea in such circumstances [1]. The goal of the study was to prove this assumption.

Methods: After ethics committee approval 200 healthy parturients undergoing selective Caesarean section were randomized into two groups (100/group). No statistically significant differences were found between these groups in anthropometrical data and haemodynamic status during intraoperative period. 2.5 ml of isobaric 0.5% bupivacaine was administered to provide spinal anaesthesia in all patients. 500 ml of Ringer solution was used for preload. The inhalation of moistened oxygen at 5 liters per minute was provided for parturients of group A. Patients of group B were anaesthetized without administration of supplemental oxygen.

Results: No complications of anaesthesia and labor except episodes of IONV were observed in both groups. The incidence of IONV was lower in group A (10 vs 21), RR = 0.48 95%CI 0.24 to 0.96.

Conclusions: Oxygen inhalation significantly decreases risk of IONV during Caesarean section under spinal anaesthesia.

References:

1. Ratna CK, Badola RP, Bhargava KP: A study of factors concerned in emesis during spinal anaesthesia. *Br J Anaesth* 1972; 44:1208-11

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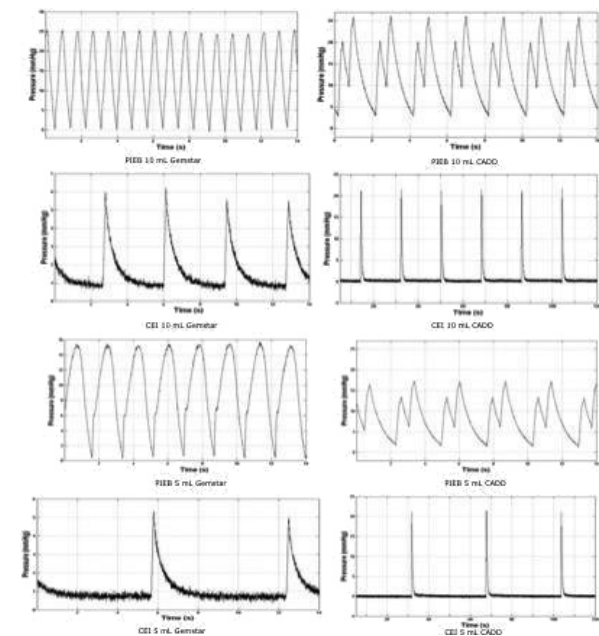
AN IN VITRO EVALUATION OF PRESSURE GENERATED BY PROGRAMMED INTERMITTENT EPIDURAL BOLUS (PIEB) OR CONTINUOUS EPIDURAL INFUSION (CEI)

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Background and aims: The aim of this "in vitro" study is to measure the pressures generated by the PIEB or CEI technique, at 2 commonly used rates of infusion. For the purpose of the study, we compared the only 2 commercially available pumps capable of delivering both PIEB and CEI.

Methods: The CADD (linear peristaltic) and Gemstar (volumetric) pumps were set to deliver 0.0625% levobupivacaine at four rates CEI: 5 or 10 ml/h; PIEB: 5 or 10 ml every h through a flat 0.2 µm filter connected to the epidural catheter (Portex). The system was linked to a pressure transducer to determine the pressures applied to the epidural catheter.

Results:



[Results]

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Pump	PIEB bolus per hour (ml)	PIEB infusion rate (ml/h)	PIEB Peak pressure (mmHg)	PIEB Frequency (Hz)	CEI Infusion rate (ml/h)	CEI Peak pressure (mmHg)	CEI Frequency (Hz)
Gemstar	10	5	35	1.2	10	6	0.3
	5	2.5	35	0.5	5	5.8	0.15
CADD	10	5	36	0.5	10	23	0.06
	5	2.5	36.5	0.4	5	23	0.025

[Table]

Conclusions: Results may be compatible with better diffusion of the LA in the epidural space due to the greater and more prolonged pressures generated by CADD when compared with Gemstar. The epidural diffusion depends on the pressure generated by the pump as well as the mode of delivery of the bolus.

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TRANSVERSUS ABDOMINIS PLAIN BLOCK IN ROBOTIC RADICAL PROSTATECTOMY

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Background and aims: The US-TAP block has been used to provide postoperative analgesia for laparoscopic surgery. The aim of this study is to evaluate the effects of the US-TAP block in term of postoperative pain and functional recovery in robotic radical prostatectomy.

Methods: Twenty male scheduled to robotic radical prostatectomy under GA were allocated into two groups: TAP group (10 patients received preoperative bilateral US-TAP block), and Control group (10 patients without block).

In the C group, the postoperative pain control was performed with I.V. bolus of morphine (0.1-0.15 mg/kg) followed by continuous infusion.

The US-TAP block was performed using a 100 mm long needle (Echoplex®, Vygon) injecting Levobupivacaine 0.25% 20 mL for each side between the Internal Oblique (IO) and the Transversus Abdominis (TA) muscles. Multimodal analgesic consisted of an I.V. bolus of tramadol 1.5 mg/kg followed by continuous infusion (tramadol 300 mg).

Results:

NRS > 4 time after operation	TAP (n=10)	C (n=10)	Postoperative data up to 48 h	TAP (n=10)	C (n=10)
20 min n (%)	0	0	HR(bpm)	78.7±5	79±8
30 min n (%)	1 (10)	4 (40)	mAP(mmHg)	78.3±5	81.6±3
60 min n (%)	1 (10)	4 (40)	SpO2 (%)	99	98
6 h n (%)	1 (10)	4 (40)	nausea/vomiting n (%)	0	3 (30)
12 h n (%)	0	1 (10)	Ileus n (%)	0	4 (40)
24 h n (%)	0	1 (10)	rescue analgesia n (%)	2 (20)	4 (40)
			patient satisfaction (%)	100	70
			ready to hospital discharge (day)	1	2
			Catheter-Related Bladder Discomfort n (%)	7 (70)	8 (80)

Conclusions: Our case series showed that US-TAP block clinically provided an effective pain relief for several hours minimizing analgesic rescue doses and a lower incidence of side effects. The patients achieved earlier time to hospital discharge then control group, even if the results not statistically significant due to small sample size.

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COMPARISON OF ANALGESIC EFFICACY OF KETOROLAC VS TRAMADOL IN THE POSTOPERATIVE PAIN AFTER MAXILLOFACIAL SURGERY

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Background and aims: The goal of this study is to assess analgesic efficacy of ketorolac and tramadol in treatment of postoperative pain, incidence of side effects and patient satisfaction.

Methods: After their informed consent, 64 patients ASA I-II, aged 18-65 years, undergoing maxillofacial surgery, were enrolled in this double blind, randomized clinical study. The patients were randomly allocated in two equal groups: group KTR n=32 received ketorolac 30 mg IV and group TMD n=32 tramadol 100 mg IV. The time of the first administration of both drugs was at the time of skin closure and repeated every 8 hrs in first 24 hrs. postoperatively. Morphine 3-5 mg IV was used as a rescue analgesic. Analgesic efficacy was assessed using a visual analog scale VAS from 1-10, in 2 (T0), 4 (T1), 6 (T2), 8 (T3), 12 (T4), and 24 (T5) hours from the end of surgery. The side effects: nausea, vomiting, allergic reactions, itching, headache, disorientation were assessed and recorded. Patient satisfaction was assessed through Satisfaction Rating Scale -SRS (0=not satisfied, 1=not very satisfied, 2=quite satisfied, 3=satisfied, 4=very satisfied).

Results: There were no significant differences between the groups with respect to demographic data and duration of anesthesia. Good postoperative analgesia was recorded in both groups. VAS score (KTR vs. TRD) were 4.1 vs 5.0 p=NS at T0, 2.8 vs. 5.9, p<0.05 at T1, 2.2 vs. 2.6, p=NS at T2, 2.0 vs. 2.5, p=NS at T3, 2.7 vs. 2.4, p=NS at T4, 1.1 vs. 1.2, p=NS at T5. Only a 3 patients in TRD group at T3 required rescue analgesic.

Nausea were reported in 23% of TRD group and in 4.0% of KTR group (p<0.005). Treatment with ketorolac was considered satisfactory by patients with SRS > 3, whereas with tramadol SRS was < 2 (p<0.05).

Conclusions: Ketorolac and tramadol produced comparable effective post-operative analgesia. Ketorolac showed significant advantage over tramadol considering side effects.

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HOW WELL DO WE LOOK AFTER OUR EPIDURALS? - 8 YEAR REVIEW IN A TEACHING HOSPITAL

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Background and aims: Displacement of the epidural catheter and disconnection from the filter are not infrequent but they lead to considerable discomfort to the patient when the epidural has to be abandoned for those reasons. It not only provides inadequate analgesia, but could adversely affect post operative recovery, respiratory function, provision of chest physiotherapy and patient satisfaction.

Methods: We did a review into the reasons of early discontinuation of epidural at our hospital over the last 8 years.

Results: 3034 patients had received epidural analgesia during this period. The epidural had to be inappropriately discontinued in 562 patients (16%).

Catheter fell out/ disconnection	298 (53%)
Side effects/complications	122 (22%)
Stopped by medical/surgical team	70 (12%)
Technical problems with pump	34 (6%)
Patient request/lack of trained staff	21 (4%)
Unrelated medical complications	17 (3%)

[Reasons for inappropriate discontinuation]

Only in 79 of these patients, the pain relief offered by the epidural was "poor".

Conclusions: The care of epidural catheter begins from securing to the removal of the catheter. Many techniques of dressing ranging from the tegaderm dressing with shoulder fixation to Epifix, Lock it, Epifuse have been evaluated for efficacy but none of them have been found to be nurse/patient/fool proof. The most important aspect is to ensure frequent and regular checks of the filter and the catheter site to prevent or minimise these unwanted occurrences and their consequences.

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SERVICE DEVELOPMENT BY USE OF CONTINUOUS CATHETERS FOR POST OPERATIVE ANALGESIA IN PATIENTS UNDERGOING SURGERY FOR FRACTURE NECK OF FEMURS

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Background and aims: Hip fractures are a serious and painful condition. Systemic opioid have significant adverse effects. We conducted a local audit

of our current practice in pain management hip fracture patients and found high pain scores and a reluctance to prescribe and administer opioid. Our aim is to investigate whether continuous fascia iliaca compartment block (FICB) provides more effective postoperative analgesia measured by pain score, opioid consumption, and length of stay (LOS).

Method: Local ethics approval was sought but waived. An 18 G Tuoy needle was placed ultrasound-guided into fascia iliaca compartment, a standard 20-gauge epidural catheter was introduced following initial bolus of 0.25% L-Bupivacaine. Intra-operative analgesia was supplemented with paracetamol and/or opioid. An infusion of 0.125%L-Bupivacaine (5 mL/h) was initiated in recovery for 48 hrs. Pain scores (VRS) (0-3) and presence of sensory block on medial and lateral aspect of the thigh were recorded in PACU.

Patients were followed up on Day 1&2 post-operatively. Data collected were pain scores at rest and passive flexion, average LOS and opioid use.

Results: Our Study is on going. Preliminary results (12 patients) show average pain scores of < 1 on Day1, < 1 on Day 2. Average LOS 17.1 days (unit average 19.6). Average morphine consumption for 48 hours was 10mg. 3 catheters were dislodged. There was no catheter related infection.

Conclusion: There is an overall reduction in average pain scores and opioid consumption post operatively. Patients were mobilised often as early as the day of surgery. LOS was reduced but the study group is too small to comment.

References:

www.ncbi.nlm.nih.gov/pubmed/17413915

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THE INFLUENCE OF PERIPHERAL NERVE BLOCKS ON PERCEIVED PERSONALITY STRUCTURE. PRELIMINARY RESULTS OF A RANDOMIZED CLINICAL TRIAL

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Background and aims: Personality is important since it determines coping style, providing stability against external challenges. The most fundamental personality structure comprises a scenario of five traits specific to each individual. We wanted to determine if patients' perception of their personality is sufficiently robust to withstand challenges imposed by postoperative pain.

Methods: Preliminary data from a double-blind, randomized, placebo-controlled trial were extracted from 28 patients undergoing primary total hip arthroplasty, randomized to either peripheral nerve blocks (femoral, obturator (anterior branch) and lateral femoral cutaneous nerve (LFCN) or placebo blocks. A standardized pain protocol was employed, and patients' perception of their personality was assessed throughout a 48-hour postoperative period using the Big Five Inventory (John OP et al, Institute of Personality and Social Research 1991).

Results: 81 patients are scheduled to participate. Preliminary results: 19 patients were randomized to active groups, and 9 patients to the placebo group. Changes in personality traits are presented in Table 1. Changes less than +/- 9% are listed as "No change".

Personality trait (Big five inventory)	Active groups	Placebo group
Openness, day 1/day 2	No change/No change	-15%/No change
Conscientiousness, day 1/day 2	No change/No change	-10%/-11%
Extroversion, day 1/day 2	No change/No change	No change/No change
Agreeableness, day 1/day 2	No change/No change	No change/No change
Neuroticism, day 1/day 2	No change/+11%	+12%/+10%

[Personality changes according to pain protocol]

Conclusions: Patients' perception of their personality seems to change when receiving inadequate postoperative pain relief, while the personality perception of patients receiving peripheral nerve blocks remains robust. Although preliminary, these results suggest that patients in a placebo group tend to become less open to change, less conscientious, and acquire more negative thinking than patients in active treatment groups.

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FUNCTIONAL OUTCOMES AFTER MULTIPLE NERVE BLOCKS IN HIP ARTHROPLASTY. PRELIMINARY RESULTS OF A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED STUDY

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Background and aims: Postoperative pain is frequent after total hip arthroplasty. The literature is equivocal about the functional value of peripheral nerve blocks (PNBs) for postoperative analgesia. We present preliminary results from an on-going clinical trial regarding on this subject.

Methods: Preliminary data from a double-blind, randomized, placebo-controlled trial were extracted from 28 patients undergoing primary total hip arthroplasty, randomized to one of three groups: active blocks (ropivacaine) of the femoral, obturator, anterior branch (ONA) and lateral femoral cutaneous nerve (LFCN); ONA and LFCN; or placebo blocks. A standardized pain protocol consisted of morphine on demand, and functional outcomes were assessed throughout a 48-hour postoperative period using the Barthel/100 index, the short form-8 index, and measures of nausea, vomiting and the Pasero opioid sedation scale.

Results: 81 patients are scheduled to participate. Preliminary data: 19 patients were randomized to active block groups, and 9 patients to the placebo group. Main results on functional outcome are presented in Table 1. Results on postoperative pain management are presented elsewhere.

Functional outcome	Active groups	Placebo group
Physical function (Barthel), day 1/day 2 (median change)	-39%/-16%	-41%/-14%
Well-being (SF-8), day 1/day 2 (median change)	-41%/-18%	-38%/-38%
Time to mobilization (median)	22 hours	23 hours
Nausea 0-24 hours/24-48 hours postoperatively	21%/11%	44%/11%
Vomiting 0-24 hours/24-48 hours postoperatively	37%/0%	44%/0%
Sedation 0-24 hours/24-48 hours postoperatively	5%/0%	11%/0%

[Well-being and physical function after hip surgery]

Conclusions: Although preliminary, these results suggest that peripheral nerve blocks have a moderate benefit on postoperative well-being and physical function. However, the limited number of patients precludes any conclusions about the value of femoral nerve blocks.

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RE-AUDIT OF RECTUS SHEATH CATHETER BOLUS SAFETY FOR POST-OPERATIVE ANALGESIA IN HEPATO-BILIARY SURGERY

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Background: Rectus sheath catheters (RSC) block T7-T11 to provide analgesia following abdominal surgery. Surgically placed RSC have been shown to be an efficient alternative to ultrasound guided placement.¹

RSC were introduced in our unit in 2010. Initial audit proposed guidelines directing prescription, administration and observation frequency following RSC boluses at ward level.

We wanted to assess patient safety and guideline adherence. Furthermore we reviewed effectiveness by pain scores, patient controlled analgesia (PCA) and patient satisfaction.

Methods: Individuals with RSC sited during a 3month period underwent chart review of observation completion and frequency, pain scores, PCA consumption and adverse incidents.

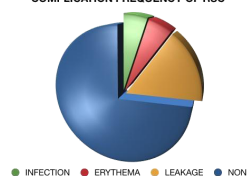
Results: 21 RSC patients received a total of 55 boluses. Average observation frequency in the first hour was 3.85 (2 - 4) and 1.4 (0 - 2) in 2nd and 3rd hours.

No serious complications or patient harm occurred. Catheters causing erythema were immediately removed.

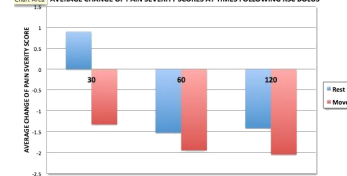
The total PCA morphine consumption (four hours before and after bolus) was compared using a Wilcoxon signed-rank test. This showed reduction of morphine ($W = 609$, $z = 4.98$, p -value < 0.001).

The reduction of pain scores is shown in the graph. Patients' comments reflected their approval of RSC post-operative analgesia with 19/22 patients being either satisfied or very satisfied.

COMPLICATION FREQUENCY OF RSC



AVERAGE CHANGE OF PAIN SEVERITY SCORES AT TIMES FOLLOWING RSC BOLUS



[Complication Frequency of RSC] [Change of Pain Scores following RSC Bolus]

Summary: Surgically placed RSC is safe and seems to be effective in hepato-biliary surgery for post-operative analgesia.

1. Cornish et al. *ANZ J Surgery*. 2007;77:8

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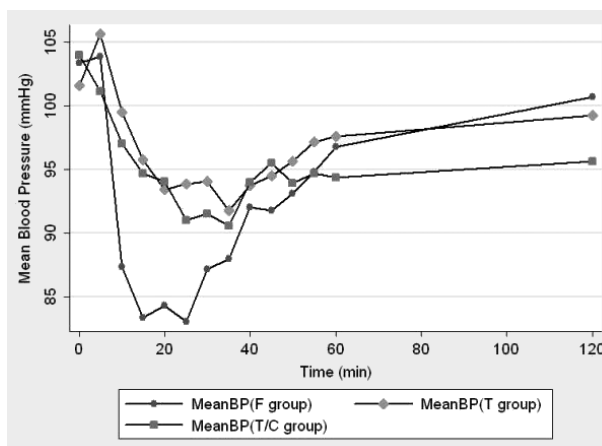
INTRATHECAL TRAMADOL AND CLONIDINE ADDED TO LEVOBUPIVACAINE PROVIDE GREATER ANALGESIC EFFECT AFTER ORTHOPAEDIC PROCEDURES UNDER SPINAL ANAESTHESIA, COMPARED TO FENTANYL OR TRAMADOL ALONE

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Background and aims: Evaluation of the analgesic effect of fentanyl, tramadol or tramadol plus clonidine when added to levobupivacaine for spinal anaesthesia (SA). Secondary objectives were to investigate safety and hemodynamic stability under these treatment conditions.

Methods: Forty five ASA I-III patients scheduled to undergo elective orthopaedic surgery were randomly allocated to receive either 15mg levobupivacaine/25µg fentanyl (n=15, F group) or 15mg levobupivacaine/25mg tramadol (n=15, T group) or 12.5mg levobupivacaine/25mg tramadol/50µg clonidine (n=15, T/C group). Analgesia duration was estimated from time of intrathecal injection to administration of rescue analgesia or VAS more than 40mm.

Results: All three groups were homogenous regarding demographic data and baseline measurements. Motor blockage (T/C group=174.6min (55.29), T group=118min(25.14), F group=140.6min(22.61)) and analgesia duration (T/C group=271min[240-271], T group=230min[210-300], F group=215min[175-285]) were significantly prolonged in the T/C group ($p=0.001$ and $p=0.063$, respectively). A significant variation of mean blood pressure was recorded over the first 35 minutes of the study in all three groups (mixed random effects model, $p<0.001$), with the F group being more hemodynamically unstable (Graph 1).



[Graph 1]

Conclusions: Tramadol and clonidine added to levobupivacaine for SA significantly prolong the pain free period when compared to fentanyl or tramadol alone.

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A RANDOMISED SINGLE BLIND STUDY COMPARING THE MOLAR ED50 OF LEVOBUPIVACAINE AND ROPIVACAINE AS A FEMORAL PERINEURAL INFUSION FOR PAIN RELIEF AFTER TOTAL KNEE REPLACEMENT

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Background: Measure molar EC50 of levobupivacaine & ropivacaine using 4-point verbal pain score at 28-30 hours when administered via femoral perineural infusion after knee arthroplasty. Secondary objectives were pain measurement (visual score- 0-100mm), Motor block (Bromage score 0-3); SLR (5-0) and EMG at 8/24 hours.

Methods: Patients were randomised to levobupivacaine or ropivacaine. Single shot Obturator & sciatic blocks (dose) - 75µM or 150µM of study drug plus femoral perineural catheter sited. Spinal anaesthesia with 3ml hyperbaric bupivacaine 0.5% , intrathecal morphine 0.1 mg performed. Measurements done at 8, 24h & 28-30h. Femoral bolus dosing at time zero used sequential allocation with starting dose of 150µM (varying 10µM) by VRS (0 or ≥1) response of previous patient at 8h. Femoral infusion dosing at 8h used sequential allocation with a starting dose of 1µM.ml⁻¹, varying 0.1µM by VRS (0 or ≥1) response of previous patient at 28-30h. Motor function assessed at 8/ 24h. ANOVA test gave group sample sizes of 12 (87% power to detect difference of 0.10 µM.ml⁻¹).

Results: 14 patients were recruited. There was no difference in molar concentration of levobupivacaine and ropivacaine for bolus, but a marked difference for the infusion. Maximum molar ropivacaine was 1.5µM.m⁻¹ and minimum levobupivacaine was 0.6µM.ml⁻¹. Mixed model analysis of EMG showed less motor block with ropivacaine compared to levobupivacaine (p< 0.01) at 24h.

Conclusions: Ropivacaine has higher molar EC50 but less motor block than levobupivacaine when administered as a femoral perineural infusion after knee arthroplasty.

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PATIENT-CONTROLLED LUMBAR EPIDURAL VERSUS WOUND INFILTRATION FOR TOTAL KNEE ARTHROPLASTY WITHIN AN ENHANCED RECOVERY PROGRAMME - A RANDOMISED CLINICAL TRIAL

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Background and aims: Lumbar epidurals (LEA) have become less popular because of well-documented side-effects, whilst local infiltration anaesthetic (LIA) has demonstrated equitable analgesia and faster rehabilitation following total knee arthroplasty (TKR) ¹. This RCT compared the effect of LIA versus LEA on TKR rehabilitation within an Enhanced Recovery Programme.

Methods: Following ethical approval, patients undergoing TKA all received standardised pre-operative education, multimodal analgesia, accelerated rehabilitation and randomised to receive either LIA or patient-controlled lumbar epidural (PC-LEA). Primary outcome measure was the proportion of patients discharged by day four from rehabilitation.

Results: 242 patients were recruited, mean age=67, BMI=32 (20 were excluded following randomisation, attributable to failed spinal anaesthesia). No statistical differences (p< 0.01) were observed between groups for any outcome, although a trend was observed that patients within the LIA group mobilised earlier. No incidence of peri-operative morbidity or mortality was observed in either group.

Conclusion: Both PC-LEA and LIA appear to enable early mobilisation, satisfactory pain management, rapid recovery and equitable clinical outcomes within an Enhanced Recovery Programme for TKR.

	PC LEA(n=109)	LIA(n=113)	P value (SS p<0.01)
No. Pt's discharged from rehabilitation by POD 4 (%)	84 (77.1)	93 (82.3)	0.332
Median length of stay in hospital days (range)	4 (2-20)	4 (2-12)	0.554
Post-Operative Urinary Catheterisation n (%)	10 (9.2)	5 (4.4)	0.159
Median VRS pain Score for first 24 Hrs. (IQR)	3(4)	3 (4)	0.278
Median usage of PRN 10mg Oxycodone over first 72 Hrs. (range)	4 (0-15)	4 (0-15)	0.554
Mobilised on Theatre Day n (%)	38 (35)	58 (51)	0.013

[Results Table]

Reference:

1. Spreng et al (2010). *BJA* 105(5), pp675-682

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IMPACT OF A SIMULATION BASED TRAINING SCENARIO ON CONFIDENCE IN THE RECOGNITION AND MANAGEMENT OF LOCAL ANAESTHETIC SYSTEMIC TOXICITY BY RECOVERY ROOM STAFF

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Background and aims: Prompt recognition and appropriate management are vital in the care of a patient with Local Anaesthetic Systemic Toxicity (LAST). Simulation training has been shown to improve medical knowledge and non-technical skills [1] across various healthcare provider groups. Torbay Hospital offers a one day simulation based course on Crisis Management training for recovery staff. In January 2012 a LAST scenario was introduced. The impact of this training intervention was assessed.

Methods: All (17) participants were asked to complete a short questionnaire rating their confidence levels in the recognition and management of LAST. They were asked to assign pre- and post-course scores ranging from 1 to 10.

Results: Response rate was 76%. Participants had a mean (range) of 19 (1-34) years of healthcare experience. 85% were nurses, 15% operating department practitioners. Confidence scores improved from a mean of 2.3 pre-course to 6.9 post course in the recognition of LAST (increase 4.6 [95% CI 3.6 - 5.6 p=0.0035x10⁻⁴]) and from 2.2 to 6.8 in the management of LAST (increase 4.6 [95% CI 3.4 - 5.8 p=0.0023x10⁻³]). 85% of participants would have the confidence to initially lead LAST resuscitation as compared with 0% pre-course.

Conclusions: A short training intervention substantially improves confidence in the recognition and initiation of management of LAST in recovery staff. A case report indicates this may improve outcome in real clinical situations [2].

References:

- [1] Okuda Y et al. Mount Sinai Journal of Medicine 2009;76(4):330-43
- [2] Smith H et al. Anesthesia Analgesia 2008;106:1581-4.

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HOW PAIN IS TREATED IN AN EMERGENCY DEPARTMENT IN A CENTRAL HOSPITAL? A PROSPECTIVE STUDY

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Background: Pain is one of the most frequent reasons that lead patients to seek emergency care. However, its' treatment is often inadequate. Studies show that only 44% receive analgesic treatment and after long waiting periods.

Aims: Prospective study to evaluate the average time of analgesic prescription (TAP) and administration (TAA) in patients with acute pain admitted to the Emergency Department (ED) of a Central Teaching Hospital.

Methods: Prospective observational study of all consecutive patients admitted to the ED between 29th February and 6th of March, and who fulfilled inclusion and exclusion criteria. Pain score at admission, TAP, TAA and other relevant parameters were recorded in 420 patients.

Results: Mean age was 51.5±20.7 and 51% were female. Initial pain score was 4.1±1.4 (0-10 scale). TAP was 41.4 minutes ± 79.5, but shorter with pain scores >5(p=0.023). The same occurred with TAA which was in average

4.6 minutes $\pm$ 11.0. Strong opioids were used when pain scores were >5 ($p=0.003$). Paracetamol, NSAIDs and opioids were used in 49%, 12% and 4%, respectively. Intravenous route was chosen in 64% of patients, while intramuscular route was preferred in 18%. Pain location was preferentially allocated to limbs (27%), abdomen (19%) and lumbar region (12%). Significant statistic association was also observed between older age and higher pain scores ($p < 0.0043$).

Conclusions: The data obtained illustrates how pain is treated in the ED studied and is in agreement with previous reports. Analgesic protocols should be implemented in order to optimize pain treatment and improve global healthcare quality.

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A SURVEY OF PHANTOM USAGE IN ULTRASOUND GUIDED REGIONAL ANAESTHESIA (UGRA) COURSES

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Background and aims: The use of ultrasound guidance in the delivery of regional anaesthesia has rapidly attained prominence and so has the requirement for training tools to practice needle guidance skills and nerve localisation techniques. The purpose of this survey was to investigate the availability, benefits and usage of phantoms in UGRA courses.

Methods: A 7 point questionnaire was emailed or telephoned to the UGRA course organisers across the United Kingdom. All courses contacted fell under the supervision of RAUK (a division of ESRA) which has 4 divisions.

Results: We received completed questionnaires from three divisions. All use phantoms in their courses. All prefer commercially available phantoms of which 75% preferred 'blue' phantoms. Homemade phantoms were second choice. The reasons for these choices were 1. Availability 2. Cost & 3. Fidelity of image. 50% use poultry, 25% do not use meat products. 50% do not pretreat meat products. 75% considered commercially available phantoms as ideal, 25% considered cadaveric tissue as ideal. 50% considered phantoms as valuable in probe handling whereas the other 50% considered needing practice as the most valuable role of phantoms. Tissue recognition was considered the second most important role.

Conclusions: The majority of UGRA courses use commercially available phantoms and consider blue phantoms as ideal. Most organisers feel phantoms are valuable in probe handling, needing practice and tissue recognition.

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INFLUENCE OF ENHANCED RECOVERY PROGRAMME ON HOSPITAL STAY

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Background: Popularity of Enhanced Recovery Programmes (ERP) is increasing due to improved outcome and early return to normal activity.

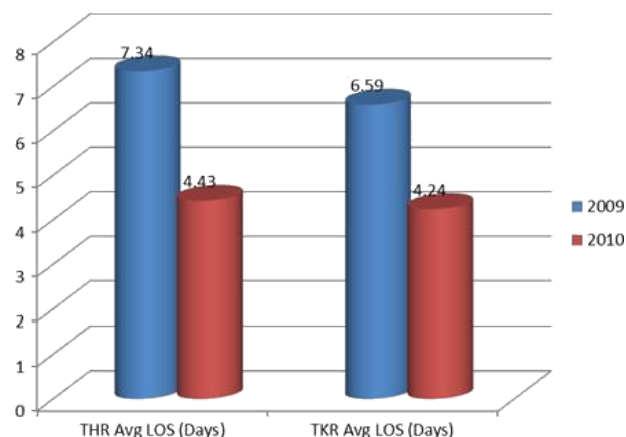
We introduced ERP for Total Hip Replacement (THR) and Total Knee Replacement (TKR) in Norwich Hospital. The protocol included combined spinal-epidural anaesthetic with propofol sedation and high volume peri-articular infiltration of 0.2% ropivacaine continuing into the postoperative period via a catheter placed intraoperatively by the surgeon. Patient were mobilised on the same day and physiotherapy was performed thrice a day. The traditional technique involved general anaesthetic with epidural or nerve block, insertion of Bellovac drain during surgery and physiotherapy once a day on first or second postoperative day. Discharge was planned considering patient's confidence and meeting specific criteria.

Aim: We aimed to look at the average Length of stay (LOS) after introduction of ERP.

Methods: We retrospectively compared the primary surgeries for THR and TKR performed by the same surgeons over a period 6 months before (Jul-Dec, 2009) and after (Jul-Dec 2010) introduction of ERP.

Results: For THR, we had total 233 patients in traditional group and 177 patients in ERP group. The average LOS decreased from 7.34 to 4.43 days with a reduction of 40%.

For TKR, there were 238 patients in traditional group and 113 patients in ERP group. The average LOS decreased from 6.60 to 4.24 days with a reduction of 36%.



[Average length of stay]

Conclusion: We conclude that ERP reduces LOS and increases throughput without compromising the quality of care.

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MULTIPLE RIB FRACTURES: A STANDARDISED ANALGESIA PATHWAY

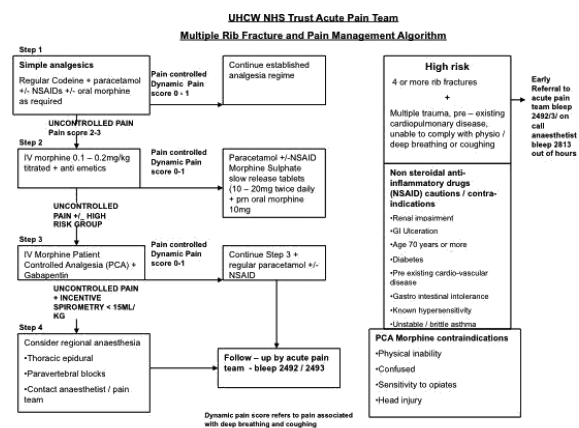
S. Millerchip, C. Hillermann *Department of Anaesthesia and Pain Management, UHCW NHS Trust, Coventry, UK.*

Background and aims: Multiple rib fractures are common; and associated with severe pain. Poor analgesia is a major contributing factor in increasing morbidity and mortality. Following a number of critical incidents in our hospital regarding analgesia in these patients we introduced a standardised analgesia protocol (Fig1) to improve analgesia outcomes.

Methods: Ethical approval was sought but waived. Following the implementation of the standardised protocol we retrospectively assessed the notes of patients admitted with multiple rib fractures in the preceding 9 months and prospectively collected data on those admitted for 3 months after the implementation. Data collected included epidemiological data, static and dynamic pain scores using the 0,1,2,3 (none, mild, moderate, severe) verbal / numeric rating scale, analgesia prescribed on day 0-5, need for anaesthetic intervention, and length of hospital stay (LOS).

Results: We assessed the notes of 33 patients pre- and 12 patients post protocol implementation.

- Epidemiological data was similar
- There was an increase in the prescription of PCA morphine, weak opioid and NSAIDs on the day of admission with a subsequent reduction in pain scores in the first 24 hours.
- No statistical difference of pain scores day 1-5.
- Regional anaesthesia techniques didn't increase.
- Average LOS reduced from 12.7 to 8.3 days.



CHS01 15/11

[Algorithm]

Conclusions: The implementation of a standardised analgesia protocol has lead to an improvement in analgesia provision in patients with multiple rib fractures with a subsequent reduction in length of hospital stay.

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TRAINING VARIATION IN ANAESTHETIC AND REGIONAL ANAESTHESIA IN A LARGE SCHOOL OF ANAESTHESIA IN THE UNITED KINGDOM

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Background and aims: Reduced working hours, modular rotational training and changes to anaesthesia practices have led to concerns as to the overall experience our trainees encounter in the UK, especially in terms of intubation and regional anaesthetic skills. I therefore evaluated trainees' logbooks to assess caseload and casemix by level of seniority of trainee in our region.

Methods: 124 trainees in the South East School of Anaesthesia were invited in summer 2011 to participate in a logbook analysis as part of their Annual Training Review. Data was requested on the duration of their placement in each hospital, the number of cases, endotracheal intubations and regional anaesthetics. Average monthly workload was noted and then median, 10th and 90th centile values calculated by grade of anaesthetist and by hospital. Estimated / combined hospital data and data from Pain and ICM trainees were excluded.

Results: 115 of 124 trainees seen took part (92.7%). 85 provided complete initial data, with 27 trainees supplying extra data later. This gave 142 data sets for 31 core and 111 senior trainees. There was very wide variation in average monthly caseload recorded by specialist trainees (ST grades 1-7). Over seven years, trainees in our school can on average expect 3321 anaesthetic cases, 1210 endotracheal intubations, but only 888 regional anaesthetics (mostly obstetric spinal and epidurals).

Conclusions: Trainees can develop excellent skills in our school but based on these numbers, some will struggle to achieve and maintain regional anaesthesia skills.

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CURRENT PRACTICE OF PAIN MANAGEMENT AMONG ACUTE ADMISSIONS IN THE SURGICAL WARD

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Background and aims: Acute abdominal pain is one of the commonest symptoms among admissions to the surgical emergency unit.¹ Analgesia plays an integral part in the diagnosis and management of these patients as it reduces the stress response and encourages patient's co-operation during physical examination.²

Methods: This was a prospective audit where 112 drug prescription charts, SEWS charts and nursing admission documents were reviewed in the surgical acute receiving ward over a period of five months. The only exclusion criterion to the audit was patients with existing chronic pain problems, who were taking strong opiate at home prior to admission.

Results: 98% of the patients admitted to the acute surgical unit had their pain score recorded by the nurses. The average time from admission until first analgesia was inversely proportional to the pain score. More than 50% of patients in each group had to wait for more than two hours. The use of morphine was directly proportional to the pain score. About two thirds of patients with pain score of 2-3 reduced to 0-1 after analgesia given.

Conclusions: There are still a large proportion of patients having to wait more than two hours before receiving their first analgesia and this need to be addressed.

References:

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2. Tait IS, Ionescu MV, Cuschieri A. Do patients with acute abdominal unduly long for analgesia?; J.R.Coll Surg Edinb 1999; 44(3): 181-184

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LUNG ULTRASONOGRAPHY AFTER SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK - AN EFFICIENT CONTROL FOR LATENT PNEUMOTHORAX IN A DAY SURGERY UNIT

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Background and aims: Supraclavicular brachial plexus block (SBPB) provides a highly effective anaesthesia but is seldom used in day surgery because of the possibility of iatrogenic latent pneumothorax. Lung ultrasonography (LUS) has shown high sensitivity and specificity for the diagnosis of pneumothorax in ICU and ER. We report our initial feasibility assessment of this method since it was introduced in our department in December 2011.

Methods: A case series of consecutive 29 patients who received an US-guided SBPB. LUS was performed postoperatively to assess four essential findings: lung sliding/seashore sign, B-lines, lung point, and lung pulse. Clinical data and postoperative complications were recorded from the patient chart and a follow-up telephone interview.

Results: There was no case of pneumothorax in our patient group. The first image of satisfying quality was obtained within 1 minute in all 29 patients. The evaluation of the findings in B-mode and M-mode took less than 2 minutes in 25 patients (86%) and one more minute in 4 (14%) patients. The examination was completed within 3 minutes in all patients. A clear-cut lung sliding sign was seen in 28 (97%) patients. B-lines, seashore sign, and lung pulse were observed in all 29 (100%) patients. Lung point sign was not observed in any patient. The examination was judged as technically simple.

Conclusions: Lung ultrasonography is time-efficient and allows a reliable evaluation of pleural function after SBPB. It may decrease the incidence of undetected pneumothorax and significantly improve the patient safety in a day surgery unit.

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EXPERIMENTAL MODEL FOR SUPPRESSION OF NOCICEPTIVE STIMULI USING PIPERINE IN THE TMJ OF RATS

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Temporomandibular joint (TMJ) pain and arthritis have been associated with peripheral sensitization of primary sensory afferents and inflammation at the dorsal horns. This study aimed to develop a model for suppression of the nociceptive stimulus in the Temporomandibular joint of *Wistar* females rats using piperine. Twenty female rats were divided into 4 groups (n=5), according to TMJ injection of with 25µl of saline, 4,0; 6,0; or 8,0µg/100ml of piperine. After 8 to 12 days, animals had the same TMJ injected with a new piperine solution (25µl, 2,0µg/100ml), and were immediately evaluated for the nociceptive behaviors. Data were quantified in rubbing and flinching the orofacial region. Data were analysed by ANOVA and Bonferroni's test ($\alpha=0.05$). For the animals that received previous injection of saline, 4,0, 6,0, or 8,0µg/100ml of piperine solutions, the means ($\pm$ standard deviations) for time (in seconds) spent rubbing the orofacial region were 54.2 (± 7.29), 63.4 (± 12.82), 55.4 (± 9.95), e 30.8 (± 4.2), respectively; for the number of head flinches, the means were 39 (± 7.17), 47.6 (± 4.91), 38.8 (± 3.76), e 25.6 (± 2.8), respectively; finally, the means for the sum of both behavior were 93.2 (± 8.45), 111 (± 10.79), 94.2 (± 9.4), e 56.4 (± 4.18), respectively. Previous injection of the TMJ with 0,08µg/ml of piperine solution has proved to reduce the sum of the nociceptive behaviors.

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REDUCING TRANSMISSION OF NOSOCOMIAL INFECTION FROM ULTRASOUND EQUIPMENT

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Background and aims: Ultrasound probes are known to be vectors for transmission of nosocomial infections. Various decontamination methods are described but may be unsuitable for all bacteria.

We aimed to establish whether using a chlorhexidine 2% alcohol: 70% cleaning regime is superior to standard soap and water in decontaminating ultrasound equipment.

Methods: 20 ultrasound probes were contaminated with *Escherichia Coli*, Vancomycin Resistant *Enterococcus* and Methicillin Resistant *Staphylococcus Aureus* (MRSA). These were then swabbed and cultured on Columbia agar with horse blood plate in an incubator for 48 hours. 10 probes were cleaned with standard soap and 10 probes with Sani-Cloth CHG 2% and reswabbed. The probes were recontaminated and re-swabbed immediately after contamination and after 24 hours. All plates were examined for colony forming units (more than 100 were heavy, less than 5 were insignificant).

Results:

	Pre cleaning	Post cleaning	Recontamination	After 24 hours
Soap and water	100	0	100	100
Sani-cloth CHG 2%	100	0	0	0

[Number of colony forming units grown]

Soap and water and Sani-Cloth CHG 2% wipes successfully decontaminating the probes initially. With recontamination, the probe cleaned with soap and water became contaminated. However, the probe cleaned with the Sani-Cloth CHG 2% wipe remained free from microbial recontamination both immediately post-cleaning and after 24 hours.

Conclusions: Sani-Cloth CHG 2% wipes are a simple and cheap way of decontaminating ultrasound probes of bacteria including *E. coli*, VRE and MRSA. Importantly, there is a lasting effect that prevents recolonisation for at least 24 hours.

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RECOVERY AND REHABILITATION FOLLOWING TOTAL HIP REPLACEMENT

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Background and aims: Pain control following total hip replacement is multi factorial and complex and depends on intraoperative anaesthetic technique, postoperative analgesia, patient related factors, psychological adaptation, surgical technique and early mobilisation. The best Anaesthetic technique which gives adequate analgesia and enhanced recovery following total hip replacement is still controversial. Our retrospective observational study aimed to find any particular any key factors that influence the recovery and length of stay following total hip replacement.

Methods: After we have obtained local trust clinical governance approval, we obtained case notes of 256 patients who underwent primary THR between Aug2009-Jul2010. We looked into the following factors such as patient age, ASA grade, date of admission and discharge, preoperative haemoglobin, anaesthetic technique, duration of procedure, intra and post operative complications, day of first physiotherapy exercise, urinary catheter insertion and total length of hospital stay.

Results:

Post operative pain modality	Average length of stay in hospital in days
Patient Controlled Epidural Analgesia(PCEA)	7.12
Patient Controlled Analgesia(PCA)	5.90
Lumbar Plexus block	5.80
Intrathecal Diamorphine	5.95
Intra-articular injection	4.00

[Post operative pain modalities]

Conclusions: In our study we found that the duration of hospital stay following total hip replacement in intra-articular injection group is significantly less compared to the other groups. We also found that patients who received

epidural analgesia had increased length of hospital stay and urinary catheterisation rate.

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PLATELET-RICH PLASMA (PRP) TO TREAT PATELLAR TENDINOPATHY: PRELIMINARY RESULTS

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Background and aims: Patellar tendinopathy often remain rebel to conservative treatments. Researches have specifically demonstrated the platelets action as mediator and/or enhancer of tissue healing. We aimed to investigate the effect of 1 injection of PRP in patients suffering from chronic patellar tendinopathy.

Methods: Patients performed imaging (US and MRI) and functional assessments, and a clinical examination using an algometer, before treatment and 6 weeks after PRP treatment. They were also invited to answer to questionnaire relative to pain and functional status. PRP was obtained from autologous blood using an apheresis system (COM.TEC, Fresenius). The injection of 6mL of PRP was realised without local anaesthesia into the proximal insertion of the patellar tendon. A 48h rest-time was recommended after infiltration. Afterwards, a submaximal eccentric reeducation was initiated 1 week after infiltration 3 times a week during 5 weeks.

Results: At this time, 10 patients were included. Pre-injection tests revealed pain of the upper part of the patellar tendon just below the patella, associated with loss of function. Imaging exams confirmed diagnosis. Six weeks post-injection, the clinical status was improved in all patients, with a significant decrease of algo-functional scores. The pain reported during functional assessments was decreased (in particular for the eccentric actions), yet no significant improvement of physical performances was observed. We found no significant differences between imaging exams before and 6 weeks after PRP injection.

Conclusions: One in situ injection of PRP clinically improved patients with patellar tendinopathy 6 weeks after treatment. All the 10 patients reported a decrease of pain during day-life and through physical activities.

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PERSISTENT PAIN FOLLOWING HYSTERECTOMY IN PRIMARY CARE

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Background and aims: Prevalence of Chronic pain after hysterectomy has been reported as between 4.7% to 26.2%. The purpose of this audit was to determine the prevalence of chronic pain after hysterectomy requiring at least one visit by the patient to the general practitioner (GP).

Methods: Ethics committee approval was sought and was deemed not necessary. We retrospectively collected data from case notes of women who underwent hysterectomy operations over past five-year period in our practice area and identified patients who developed persistent pain for more than 3 months. We also collected information about deprivation category (Scottish Neighbourhood statistics, with a 1-6505 decreasing deprivation score).

Results: 56 patients underwent hysterectomy during the audit period. Four patient's case note was missing and were excluded from the audit. 10(19.2%) patients had complaints of pain requiring at least one visit to the GP. Among them 3(5.7%) had pain or discomfort over the scar; 3 (5.7%) had pelvic/perineal pain and 4(7.7%) had abdominal pain. Eight patients were referred to secondary care for management of chronic pain. There was no statistically significant difference in Scottish Index of Multiple Deprivation (SIMD) rank median score (P-value=0.88) between patients who developed persistent pain and those who did not.

Conclusions: Prevalence of chronic pain (95% CI) following hysterectomy requiring at least one visit to GP was 19.2% (8.5 to 29.9). 80% of patients who developed chronic pain required referral to secondary care for management of pain. The incidence of chronic pain was similar among different socioeconomic groups.

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PULSED RADIOFREQUENCY IN PATIENTS WITH POSTHERPETIC NEURALGIA

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Introduction: Postherpetic neuralgia is a complication of varicella zoster virus which is characterized by severe burning neuropathic pain in the dermatome affected, which persists three months after the resolution of the skin lesions. The pathophysiology of pain is multifactorial, implicating a hyperactivity of the sympathetic system. Due to its frequency and the disabling pain multiple strategies of treatment have been developed.



[Electrodes placements]

Case report: A 75-year-old man with a 2 month history of severe costal pain was referred to our clinic for pain management. He had a neuropathic pain with allodynia, hyperalgesia, itching and frequent breakthrough pain episodes with poor response to treatment. The score on the visual analog scale (VAS) was 9 during the paroxysms and 6 at baseline. Drug treatment with oxycodone and gabapentin was initiated without response. Patches of capsaicin were added to the treatment and trigger points were infiltrated with local anesthetic, obtaining a short period of improvement. Due to the failure of drug therapy the patient is proposed for pulsed radiofrequency, decreasing the baseline VAS to 2 and reducing the dose of gabapentin and the rescue medication.

Discussion: This case demonstrates that pulsed radiofrequency is an effective alternative for the treatment of postherpetic neuralgia when first-line treatments have failed.

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COMPARING EARLY POSTOPERATIVE PERIOD ANALGESIC EFFECT OF DEXKETOPROFENE, TRAMETAMOL AND LORNOXICAM IN MEDIASTINOSCOPY CASES

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Background and aims: In this study, we aimed comparing early postoperative period analgesic effectiveness and the effects on opioid consumption of intravenous dexketoprofen and lornoxicam that are given preemptively.

Methods: Forty patients, planned elective mediastinoscopy, were included in this prospective randomized study. These patients were classified in two groups, group D for dexketoprofen trametamol and group L for lornoxicam, randomly. 20 minutes before the operation 50 mg dexketoprofen trametamol and 8 mg lornoxicam were injected intravenously for group D and group L respectively. In postoperative intensive care unit, pain scores, mean arterial

pressures, heart rates and peripheral O₂ saturations of patients were recorded at 0, 10, 20, 60, 90 and 120th minutes.

Results: When we evaluate the VAS score of the groups, there was a significant decrease in group D in all measured times statistically comparing to group L ($p < 0.001$). When both groups were evaluated in itself according to 0 minute time, in group L there was a significant decrease at 10 minutes time ($p < 0.0001$) but in group D there was not a significant decrease ($p > 0.05$).

Conclusions: Since intravenous dexketoprofen, applied preemptively, has more potent analgesic effect and causing less opioid consumption in early postoperative period, is better than intravenous lornoxicam.

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THE EFFECTS OF ADDING VARIOUS DOSES OF CLONIDINE TO ROPIVACAINE IN SPINAL ANESTHESIA

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Background and aims: In this study, we compared the clinical effects of combined doses of ropivacaine and clonidine.

Methods: Seventy-five patients between ages 18 and 75, in ASA I-III groups who were to undergo elective lower extremity surgery, were included in the study with informed consent. Subjects were randomly assigned to 3 groups. Group I: % 1 ropivacaine 12 mg, group II: % 1 ropivacaine 12 mg + clonidine 15 µg, group III: % 1 ropivacaine 12 mg + clonidine 30 µg. Mean arterial pressure, breathing, heart rate and peripheral oxygen saturation, total amount of ephedrine and atropine used, sensory and motor block levels, level of sedation, pain level and complications were monitored.

Results: The mean arterial pressure recorded in group III decreased significantly at 75, 105 and 120 min compared to groups I and II. In group I, time to two segment regression and time to sensory block to S2 was shorter when compared to the other groups ($P < 0.0001$). The time to voiding and the duration of motor blockade was significantly longer in group I in comparison to the other groups. The need for atropine in group III was significantly higher ($P < 0.001$). The incidence of hypotension and the requirement for ephedrine were significantly higher in groups II and III as compared to group I ($P < 0.01$). Similarly, sedation in group III was significantly higher compared to the other groups ($P < 0.05$).

Conclusions: In summary, our study revealed that clonidine can be added to ropivacaine for spinal anesthesia in surgical interventions to obtain deeper and longer sensory and motor block. However, hypotension, bradycardia and sedation should be monitored closely.

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COMPARISON OF PRE-EMPTIVE EFFECTS OF PREGABALIN COMPARED WITH THAT OF TRAMADOL AFTER ELECTIVE LAPAROSCOPIC CHOLECYSTECTOMY

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Background and aims: This study was undertaken to evaluate analgesic efficacy of oral pregabalin in comparison to tramadol for postoperative analgesia in elective surgical laparoscopic cholecystectomy patients.

Methods: After taking informed consent ninety patients posted for elective laparoscopic cholecystectomy were randomly allocated to three groups of 30 patients each. Along with premedication of ranitidine and lorazepam they received pregabalin 150 mg, tramadol 100 mg or placebo orally. A standardized anaesthesia of lignocaine, midazolam, fentanyl, propofol, vecuronium and sevoflurane was used in all patients. Residual muscle paralysis was reversed using neostigmine and atropine at termination of anaesthesia.

VAS scores were collected at 0, 6, 12 and 24 hr after surgery in post-operative ward. Rescue analgesia was provided by IM diclofenac sodium 25 mg at VAS score of 5 or higher.

Results: Patients in pregabalin group had lower mean VAS scores at all time points compared to those of tramadol group as were their requirements of diclofenac. Patients of pregabalin group had higher incidence of side effects; they were more sedated though none developed respiratory depression.

Conclusions:

1. Patients in pregabalin group showed a reduced analgesic requirement in the first 24 hr after surgery compared to tramadol group
2. The VAS scores in pregabalin group were lower than those in tramadol group at 0, 6, 12 and 24 hr after surgery.
3. There was higher incidence of somnolence in patients of pregabalin group compared to tramadol group though none required any medical intervention.

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COMPARISON OF CONTINUOUS LOCAL ANESTHETIC AND SYSTEMIC PAIN TREATMENT AFTER AXILLARY LYMPHADENECTOMY IN BREAST CARCINOMA PATIENTS - A PROSPECTIVE RANDOMIZED STUDY - FINAL RESULTS

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Background and aims: Acute pain after axillary lymphadenectomy is often related mainly to axillary surgery. The aim of the prospective randomized study was to find out if continuous wound infusion of local anesthetic reduces postoperative pain, consumption of opioids and the incidence of chronic pain compared to the standard intravenous piritramide analgesia after axillary lymphadenectomy in breast carcinoma patients.

Methods: Altogether 60 patients were enrolled in our study from December 2010 to July 2011; half in wound infusion of local anesthetic and half in the standard (piritramide) group.

Results: In the recovery room and on the first day after surgical procedure, the wound infusion of local anesthetic group reported less acute pain, a lower consumption of piritramide and metoclopramide, but their alertness after the surgical procedure was higher compared to the standard group. Chronic pain three months after surgical procedure was less frequent in the test group.

Conclusions: After axillary lymphadenectomy in breast carcinoma patients, a continuous wound infusion of local anesthetic reduces acute pain and enables reduced opioid consumption, resulting in less postoperative sedation and a reduced need for antiemetic drugs. Moreover, wound infusion of local anesthetic also reduces chronic pain.

The study was reviewed and approved by the appropriate Ethics Committee (no. 22pk/12/10 from 24/11-2010).

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EFFICACY OF CONTINUOUS BRACHIAL PLEXUS BLOCK UNDER ULTRASOUND GUIDANCE AFTER ORTHOPAEDIC UPPER EXTREMITY SURGERY

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Background and aims: In this prospective study we evaluated the efficacy and complication rate of continuous brachial plexus block (CBPB) for postoperative pain management after orthopaedic upper extremity surgery.

Methods: After local ethics committee approval, 22 consecutive patients were enrolled. Ultrasound-guided continuous interscalene BPB (IS) and continuous infraclavicular BPB (IC) were performed. Preoperatively all patients got 10 ml of lidocaine 2% plus 10 ml of levobupivacaine 0.5% (IS-group) or 10 ml of lidocaine 2% plus 20 ml of levobupivacaine 0.5% (IC-group). Postoperatively, levobupivacaine 0.1% (basal rate 6 ml/h; bolus 4 ml) was administered for at least 48 hours. We recorded the percentage of patients that experienced mild pain according to numeric rating scale (NRS 0-10) of ≤ 3 and morphine consumption at 12, 24, 36, 48, 60, 72 hours.

Results: In 7 IS- and 15 IC-patients catheters were maintained for 3 (1-5) days. Mild pain at 12, 24, 36, 48, 60, 72 hours occurred in 81.8%, 100%, 100%, 100%, 100%, 100% (resting), and 77.3%, 77.3%, 90.9%, 86.4%, 90.9%, 95.5% (movement) of patients respectively. Accumulative morphine requirement at 24, 48, 72 hours was 5.0 (0-20), 10.0 (0-45), 13.5 (0-75)mg respectively. All patients were satisfied with the pain management. Complications were dislodgement (n=5), leakage (n=9), nausea/vomiting (n=3), reversible radial and ulnar nerve injury (n=1; IC-group-patient). This nerve injury was caused from surgery proved by electromyography.

Conclusions: Continuous ultrasound-guided brachial plexus block provides an effective method of postoperative pain management for upper extremity surgery.

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BLIND FASCIA ILIACA BLOCKS IN TRAUMA HIP SURGERY: NEEDLE PLACEMENT AS OBSERVED BY ULTRASOUND

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Background and aims: The introduction of ultrasound-guided fascia iliaca (FI) blocks cast doubt on the efficacy of the blind, "double-pop" technique⁽¹⁾.

Not all anaesthetists agree, as blind techniques have proven easy, safe and effective. Currently no study has observed the needle-tip position in the blind technique as seen by ultrasound.

Methods: As per the usual practice of two experienced anaesthetists, when indicated, trauma patients received a blind FI block using an 18-gauge Tuohy needle. After needle insertion, two ultrasound-experienced anaesthetists observed the final needle position. Correct needle position was defined as the tip just between the FI and iliopsoas muscle. If incorrect, the needle was repositioned using direct US guidance and local anaesthetic injected.

Results: Of twenty patients studied, seven (35%) had the needle-tip positioned correctly, in eleven (55%) the tip was within the iliopsoas muscle. In two patients (10%), the needle did not pierce the FI despite two "pops". These patients had a BMI >30.

Conclusions: The high incidence of intramuscular needle-tip placement may be due to the 'cushion effect'² of a large blunt needle on the FI. Although blind injection into the superficial layers of iliopsoas can lead to a successful block, the use of ultrasound can more accurately identify the correct plane, possibly leading to a more efficacious block. This 'cushion effect' may not occur with smaller gauged needles - we suggest further studies looking into this.

References:

1. RAPM 2008 Nov-Dec;33(6):526-31
2. ISRN Anesthesiology (2011), Article ID 421505

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COMBINED SUPRACLAVICULAR AND FOREARM BLOCKS PROVIDE MORE DESIRABLE BLOCK CHARACTERISTICS COMPARED WITH AXILLARY BLOCK FOR HAND SURGERY

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Background and aims: One of the risks of brachial plexus block (BPB) is damage to the insensate limb post-operatively. Patients may also complain of an unpleasant numbness until the block recedes. We compared two ultrasound-guided techniques used in our centre for their block-characteristics and acceptability for hand surgery.

Methods: We prospectively audited 20 patients undergoing axillary block (AB) with a mixture of short and long acting local anaesthetic and 20 patients undergoing a "combined block" (CB) - a short-acting supraclavicular block plus long-acting mid-forearm blocks. We compared block time (procedure + onset time). Five hours post-block we assessed sensation in the forearm, motor power at the elbow using a 0-5 scale, analgesia in the hand and patient satisfaction.

Results: At five hours post-block 90% of the AB group had a power of 0-1 out of 5. 85% of the CB group had power of ≥ 4 out of 5. Return of forearm sensation was 0% in the AB group and 75% in the CB group. All patients had analgesia of the hand. The median (IQR) block times were similar; AB group: 17min (15-20 min), CB group: 20 min (15-25 min). Total dose of local anaesthetic in both groups was similar. There were no complications and satisfaction was 100%.

Conclusions: The "combined block" provides quicker return of motor and sensory function in the arm and forearm compared to axillary block whilst providing ongoing analgesia in the hand, so may be a more favourable technique for hand surgery.

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UNITED KINGDOM NATIONAL SURVEY ON REGIONAL ANAESTHESIA FOR UPPER LIMB SURGERY IN PATIENTS WITH ALTERED COAGULATION AND PLATELET FUNCTION

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Background and aims: Advances in ultrasound technology have resulted in increasing popularity of regional anaesthesia for upper limb surgery, coinciding with an increasing number of patients prescribed anti-coagulation and anti-platelet medications. There are no specific guidelines for upper limb regional anaesthesia and neuraxial guidelines are used as a surrogate. Risks of anticoagulation during plexus blockade are appreciably different.

Methods: A survey was developed and distributed to consultant regional anesthesiologists at 33 teaching hospitals and 9 advanced hand centres in UK. Questions included range of INR, platelet count and days for discontinuing clopidogrel at which operator would perform plexus block with or without ultrasound.

Results: The response rate was 55% (139 /252).

INR	With USS	No USS	Platelet Count	With USS	No USS	Clopidogrel stopped	With USS	No USS
<1.5	35%	74%	> 30,000	17%	4%	0 days	50%	22%
1.5-2.0	36%	20%	> 50,000	48%	36%	3 days	8%	4%
2.0-2.5	17%	5%	> 75,000	23%	21%	5 days	8%	10%
>2.5	12%	1%	>100,000	12%	39%	>7 days	34%	64%

[Table 1]

Conclusions: Ultrasound guided technique appears to have enhanced the confidence to perform upper limb regional anaesthesia in patients with altered coagulation. This survey provides an insight into UK practice and could be used as a basis for development of future guidelines. It also allows application of the Bolam principle.

The authors recommend:

1. Ultrasound guided technique in patients with altered coagulation
2. INR < 2.5 (88% concordance)
3. Platelet count $\geq$ 50,000 (65% concordance)
4. Clopidogrel use: Not a contraindication (50% concordance)

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ULTRASOUND GUIDED REGIONAL ANESTHESIA: WHAT IS THE PRACTICE IN FRANCE IN 2012?

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Background and aims: The practice of ultrasound guidance in regional anesthesia (USRA) in France continues to become more widespread. Nevertheless, its practical use is still not well known. The aim of this study was to provide a snapshot of the practice of USRA in France in 2012.

Methods: 247 anesthetists were asked to answer a survey during the national meeting of ESRA (ESRA France).

The survey included:

- 1- technical use for nerve identification (Nerve Stimulation: NS - Ultrasound Guidance: US - Dual Guidance: US + NS)
- 2- approach (IP, OOP, specific "echoic" needle, hydrolocalization)
- 3- maintenance of equipment (sterile specific cover, transparent dressing, single dose sterile gel, validation of the cleaning protocol).

Results: In this group of anesthesiologists interested in regional anesthesia, NS alone was used in 16% of cases. In the US group, 40% used US alone while 60% used Dual Guidance. IP was the most common approach (IP: 81% vs OOP: 14%). Hydrolocalization was used in 24% of cases. The use of a specific "echoic" needle remained marginal (17%). Although the procedure for cleaning the probe is rarely validated by a committee (20%), the use of steril gel and a steril cover were widespread (67% and 56% respectively).

Conclusion: This survey confirms the progression of the use of USRA in France. IP approach and Dual Guidance are the most popular techniques. Some practices should be improved: hydrolocalization could be more widely used and the aseptic procedures should be more systematic.

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EVALUATION OF A MODIFIED CORACOID APPROACH FOR THE BRACHIAL PLEXUS BLOCK

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Background and aims: Different techniques have been described to perform brachial plexus block at the infraclavicular level using neurostimulation.

The block of the musculocutaneous nerve is challenging and often asks for a double stimulation technique. After a preliminary study on 29 cadaver sites, we developed a new technique combining the landmarks and the respective advantages of two established techniques. This study assessed the clinical feasibility.

Methods: Forty patients scheduled for elective, monolateral hand surgery were included and regional anesthesia was performed using the modified coracoid approach (MC-). Twenty patients received a single shot block and twenty a catheter placement both using nerve stimulation and sonographic control. Block quality (surgical anesthesia, nerves blocked), technical feasibility, complications (vascular puncture, pneumothorax) and patient satisfaction were evaluated. Twelve patients of the catheter group received an MRI to assess catheter tip placement and local anesthetic spread.

Results: Success was achieved in 38 blocks within 20 minutes (95% success rate). One single shot and one catheter placement needed despite a distal posterior cord response a rescue block of the musculocutaneous nerve. There were no technical difficulties, no complications and an excellent patient satisfaction. MRI showed a spread of 40ml ropivacaine 0.5% enclosing all cords.

Conclusions: According to our preliminary clinical results the new modified coracoid approach seems to offer an alternative for single shot and catheter placement with good spread of the local anesthetic in accordance to the findings in our previous cadaver study. A comparison with established approaches is warranted to evaluate the clinical relevance.

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FEASIBILITY OF ARTHROSCOPIC SHOULDER STABILISATION AS A DAY-CASE PROCEDURE - A THREE-YEAR EXPERIENCE

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Background and aims: Arthroscopic shoulder stabilisation is emerging as an alternative to open surgery in suitable patients, one attraction being the reduced need for inpatient stay. Upper limb blocks have opioid-sparing and fewer treatment-related side effects¹ and are indispensable for successful ambulatory shoulder surgery. We have previously presented data on use of interscalene nerve blocks (ISB) and general anaesthesia (GA) for day-case arthroscopic shoulder stabilisation, and now present a further 18 months' experience.

Methods: Between June 2011 and February 2012, all patients undergoing arthroscopic stabilisation were followed up prospectively. Ethical approval was waived under our institution's policy for audit of current practice. A standardised anaesthetic technique comprising ISB using 0.5% bupivacaine with up to 150 µg of clonidine and GA was used. Data about drug dosages, pain scores and analgesic requirements were recorded at time of surgery and immediately post-operatively. Block duration (time until return of pain) was determined by structured telephone interview at 48 hours. Failed block was defined as the requirement for strong opioids in recovery and up to 4 hours post-operatively. All patients were discharged with regular paracetamol, co-diene phosphate and diclofenac.

Results:

Year	2010-2012
No. of patients	31
Mean block duration (h)	19.7

[Table 1. Total number of patients since 2010]

Between June 2011 and February 2012, there were no failed blocks. Of the 15 patients, 11 were done as day cases. Pain was not a reason for inpatient stay for the remaining four.

Conclusions: These data are encouraging and suggest that shoulder stabilisations are feasible as day cases. Regular simple analgesia at maximal doses and careful patient preparation are important aspects of discharge planning.

Reference:

1. Klein SM, Evans H, Nielsen KC et al. Peripheral Nerve Block Techniques for Ambulatory Surgery. *Anesth Analg* 2005;101: 1663-76

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LOCOREGIONAL ANESTHESIA IN ELECTIVE HUMERUS AND SHOULDER SURGERY: THE ROLE OF ASSOCIATED GENERAL ANESTHESIA

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Background and aims: Interscalenic or supraclavicular Brachial Block(BB)-in association with General Anaesthesia(GA)-is described as adequate approach in humerus and shoulder surgery.Aim of the study is to compare patients compliance in BB associated with GA and in BB only with Benzodiazepines premedication.

Methods: We enrolled 26 patients candidate to MIROS percutaneous pinning device after proximal humerus fracture or to shoulder prosthesis placement.Population was randomly divided in two groups of 13 patients: group BBG received interscalenic BB(Mepivacaine2% and Ropivacaine1%) and GA; Group ALR,BB(Mepivacaine2% and Ropivacaine1%)by interscalenic way was administered after Midazolam(0,5-1mcg/kg)and Oxygen supply during operation.Sedation depth and anaesthesia approach compliance were evaluated in all patients with Rudkin Sedation(RS)and Ramsay Sedation Scale(RSS)in four different phases:before locoregional anaesthesia(I),after half-seated position placement(II),half-time(III)and at the end-surgery time(IV).

Results: Surgery was performed in all population without complications;two BBG and one ALR patients presented a persistent hypertension after Block and a continuative Nitroglycerine infusion was administered during surgery time.Remifentanyl infusion(0,05mcg/kg/min)was used in two ALR patients after premedication,in spontaneous breathing.RSS and RS starting mean value in BBG group were respectively 1,3 and 1;at the end-surgery time were 3,3 and 3.Based on GA and stable vital signs,sedation scale value was evaluated the highest available.In the ALR group,from an initial value of RSS=1.3 and RS=1,we arrived at the end of surgery with values,respectively,of 2.4 and 1.7;during the surgery we obtained RSS RS 2.1 and 1.7 after positioning on the operating table and 2.3 and 2.1 in half-time surgery.

Conclusions: Our study aimed to assess whether the upper limb orthopedic surgery can be performed in Locoregional anesthesia.

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EFFECT OF THE ADDUCTOR-CANAL-BLOCKADE AND FEMORAL NERVE BLOCK ON MUSCLE STRENGTH AND MOBILIZATION IN HEALTHY VOLUNTEERS: A RANDOMIZED STUDY

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Background: The Adductor-Canal-Blockade (ACB) is theoretically a predominantly sensory blockade, while the femoral nerve block (FNB) reduces quadriceps muscle strength. We hypothesized that ACB preserves quadriceps strength better than FNB when compared with placebo (primary endpoint). Secondary endpoints were adductor strength and mobilization ability.

Methods: We enrolled healthy young men into this double blind, placebo-controlled, randomized, crossover study. On two separate study days subjects received both an ACB and a FNB, but only one active block at the time (30 ml of 0.1% ropivacaine) with placebo (saline) in the opposite limb. Maximum voluntary isometric contraction (MVIC) was assessed for both quadriceps and adductor muscles and subjects performed three standardized mobilization tests. Clinicaltrials.gov Identifier: NCT01449097.

Results: Twelve subjects were randomized and 11 analyzed. Quadriceps MVIC (area under the curve, 0.5-6 h) was significantly reduced when comparing placebo with ACB (5.0 ± 1.0 vs. 5.9 ± 0.6 , $P = 0.02$, CI -1.5 - -0.2), and FNB ($P = 0.0004$), and when comparing ACB with FNB ($P = 0.002$). The reduction from baseline MVIC was 8% with ACB and 49% with FNB. The only significant difference in adductor strength was between placebo and FNB ($P = 0.007$). Performance in all mobilization tests was significantly reduced after a FNB compared with an ACB ($P < 0.05$).

Conclusions: This study verifies that the ACB is predominately a sensory blockade. ACB preserved quadriceps strength and mobilization ability sig-

nificantly better than FNB. Compared with placebo ACB significantly reduced quadriceps strength, but the reduction was only 8% from baseline.

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FASCIA ILIACA BLOCK AND CATHETER FOR NECK OF FEMUR FRACTURE

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Background and aims: Fascia iliaca block can reduce pain and morphine requirements in patients with hip fractures [1]. We evaluated a pre-operative fascia iliaca block followed by local anaesthetic infusion via catheter.

Methods: After ethical review, we treated 17 patients presenting with a neck of femur fracture. Using ultrasound, 40 ml 0.25% levobupivacaine was injected under the fascia iliaca with a 19G Pajunk PlexoLong Sono needle (Pajunk GmbH, Germany). The catheter was fed 4-5cm into the space. An elastomeric pump containing 0.125% levobupivacaine was attached (Easy-pump 5ml/h, B. Braun Melsungen AG, Germany). Pain scores are expressed as none, mild, moderate, severe (0-3). Opioids were recorded as I.V. morphine equivalent dose (NHS Lothian Palliative Care Guidelines 2010). 20 untreated patients were used for comparison. Results are given as median (IQR), p was determined with the permutations test.

Results: Patients given fascia iliaca catheters required 18.5 (5-27) mg morphine in the first 24 hours or until surgery whereas patients in the control group required 15 (10-19) mg morphine ($p=0.16$). Table 1 shows pain scores.

Treatment group n=17	Pain at rest	Pain on movement	Control group	Pain at rest	Pain on movement
Before block	1 (1-2)	3 (3-3)		2 (2-3) (n=17)	2 (2-3)
1 h later	0 (0-1)	2 (1-3)		Not measured	
24 h later	0 (0-1)*	2.5 (2-3)		2 (1-2) (n=5)	2 (1-2)

[Table 1]

* $p=0.006$ compared with control

Conclusions: Fascia iliaca catheters were effective to reduce pain at rest and to a lesser degree on movement. Morphine administration was unaffected.

Reference:

1. Foss NB. Anesthesiology 2007; 106:773- 8

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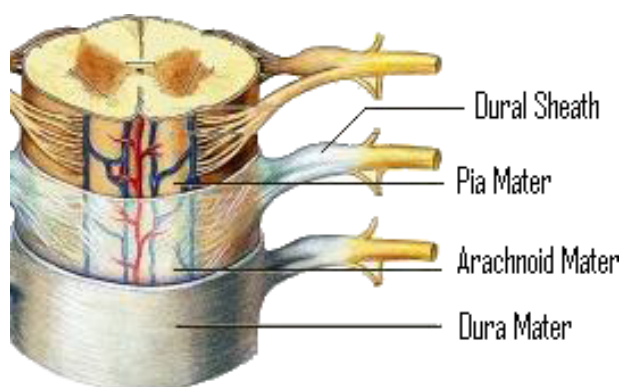
WHEN A REGIONAL ANESTHETIC ISN'T SO REGIONAL

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Introduction: A case is presented of a total spinal anesthetic after placing a lumbar plexus nerve block.

Case report: A 56 year old female with diabetes, Hypertension, and ESRD was admitted with osteomyelitis for above-knee amputation. She was consented for placement of sciatic and lumbar plexus nerve blocks as the primary anesthetic. She was placed into appropriate position with pulse oximetry, EKG, and blood pressure monitoring. The sciatic block was first performed with 18ml of 1.5% mepivacaine without complications. The lumbar plexus block was then performed using landmarks with nerve stimulation. A twitch of the right quadriceps at 0.2 mA was elicited, and 18ml of 1.5% mepivacaine was injected. The patient immediately became apneic with fixed and dilated pupils. She was intubated and ventilated for 110 minutes but notably remained hemodynamically stable. The surgery was completed after 139 minutes and the patient was extubated uneventfully.

Discussion: Total spinal anesthesia is a known, albeit rare, complication of lumbar plexus nerve blocks. It is thought that close proximity to the dural sheath of a nerve root can result in the subsequent subarachnoid or epidural injection of local anesthetic. This can result in sudden apnea or cardiopulmonary arrest. We hypothesize that our patient already suffered from autonomic dysfunction from diabetes, and thus was spared from hemodynamic instability.



[total spinal image]

Reference:

Pousman, Robert M. D.O.; Mansoor, Zia M.D., Sciard, Didier. *Total Spinal Anesthetic after Continuous Posterior Lumbar Plexus Block*. *Anesthesiology*. 98(5):1281-1282, May 2003.

245**COMBINED EPIDURAL ANESTHESIA + TIVA VS TIVA FOR MAJOR ABDOMINAL SURGERY**

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Objective: In a prospective, randomized, parallel-group study the aim was to compare combined Epidural Anesthesia(EA) + TIVA with TIVA in major abdominal surgery. In the TIVA, anesthesia was maintained with propofol and remifentanyl.

Methods: A prospective randomized double-blind trial, Sixty patients in 2 groups more than 65 years old and ASA physical status III were studied. Patients were randomized to EA + TIVA (n = 30) group or TIVA (n = 30) group. After epidural catheterization, the anesthesia induction and endotracheal intubation was made and a standard anesthesia procedure was administered for both groups. In EA + TIVA group, the patients received epidural anesthesia (EA) with 0.166% bupivacaine +2 µg/mL fentanyl (bolus 12 - 16ml) firstly and then infused continuously with 0.15 ml x kg(-1) x h(-1)). While in TIVA group, the patients received 0.9% saline via epidural catheter just with the same bolus volume and same infusion rate as in EA + TIVA group. TIVA was infused and titrated to maintain a BIS value between 40-50.

At the end of operation, time to extubation, Aldrete recovery score, total remifentanyl and propofol consumption were recorded. Side effects were recorded.

The results of this study showed that the time of recovery discharge in EA + TIVA group was more rapid than TIVA (p < 0.001). We found approximately 30% higher costs in the TIVA-group compared to the EA+TIVA-group.

We conclude that BIS guided EA+ TIVA anesthesia is superior to TIVA in this type of surgery.

246**EFFECTIVE LENGTH OF NON-LUER SPINAL NEEDLES**

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Background: Anaesthetists use an introducer for spinal neuraxial blockade as it reduces needle deflection, particularly in the obese patient. However, it significantly reduces the "effective" spinal needle length. This is particularly relevant when ultrasound is used to measure the actual depth to the dura. Ultrasound has been shown to be especially useful in obese patients.

This study aimed to evaluate whether our anaesthetists chose the appropriate length of needle for the depth of the dura visualised on ultrasound.

Methods: We conducted a simulator based study using a Blue Phantom model™ combined with a questionnaire to assess the correct choice of needle.

Results: Spinal needles from 4 different manufacturers were measured to ascertain the effective length (versus stated length):

- 73mm (90mm)
- 106mm (120mm)
- 75mm (90mm)
- 75mm (90mm)
- 76mm (90mm)
- 101mm (115mm)

The evaluations were based on two groups; dural depths for non-obese patients (≤80mm) and obese patients (≤120mm). 94 evaluations demonstrated correct needle length selection was 60% for non-obese patients, but only 6.8% in obese.

Conclusions: No manufacturer states "effective" spinal needle length, instead stating the length of both the spinal needle and the introducer separately.

Our study has shown that a low percentage of anaesthetists are aware of this reduction in "effective" length, which varies between manufacturers, and as a result may choose a needle inappropriate for the intended depth.

Awareness of the "effective" needle length can influence an anaesthetists' choice of needle, reducing the number of unnecessary attempts at neuraxial blockade.

247**NO OPIOID INDUCED HYPERALGESIA AFTER INTRATHECAL FENTANYL**

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Background and aims: Opioids are useful adjuvants in spinal anesthesia. However, opioids have been related to postoperative Hyperalgesia (OIH). Our aim is to determine if fentanyl addition to spinal bupivacaine anesthesia produces OIH, measured by cutaneous mechanical thresholds.

Methods: Ethical Committee approved this study. Preliminary results on 36 patients are presented. Patients ASA I-III, 18 to 65 year old, Anterior Cruciate Ligament repair with semitendinosus-gracilis tendon, who requested spinal anesthesia and consented for the study. Blinded randomized controlled study. Intervention: 20 mcg intrathecal fentanyl or no fentanyl addition to spinal anesthesia. Mechanical painful threshold was measured before, 6 and 24 hrs. post spinal injection, at the arm and nonsurgical leg. Statistics: natural logarithm with 2-way repeated measures ANOVA adjusted for baseline. Significance p < 0.05.

Results: In the arm lower thresholds were measured post anesthesia. Larger decrement was measured in non-fentanyl group (p = 0.014). In the leg, within interaction was present however the magnitude of the change was not different between groups.

Mechanical threshold (pressure in g) (avg ± CI 95)

	Pre spinal	6hr post spinal	24hr post spinal	between group comparison
Arm no fentanyl	184.4 ± 66.9	109.1 ± 50.4	49.6 ± 17.9	arm no fentanyl vs fentanyl p= 0.014
Arm + fentanyl	152.4 ± 54.4	145.1 ± 54.0	138.7 ± 58.3	
Leg no fentanyl	148.3 ± 60.9	126.8 ± 54.9	108.3 ± 55.6	leg fentanyl vs no fentanyl ns
Leg + fentanyl	150.9 ± 51.6	211.2 ± 55.6	187.8 ± 61.7	

[Results]

Conclusions: OIH cannot be supported with this study. On the contrary a protective effect may be suggested.

248**A RETROSPECTIVE COHORT STUDY OF ANAESTHETIC FACTORS AFFECTING OUTCOME IN LOWER LIMB ARTHROPLASTY SURGERY**

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Background and aims: In 2011, more than 160,000 patients underwent total knee and hip replacements in the UK alone. Our large retrospective study aimed to answer the question of the association between length of stay and type of anaesthesia employed.

Methods: Anonymised data was collected prospectively as part of an audit process, and analysed retrospectively, using multiple linear regression models, with the dependent factor as the length of inpatient stay. Ethical approval was granted under the NHS service evaluation framework. Patients presenting to a UK District General Hospital for elective primary lower limb arthroplasty were eligible. The study lasted between Jan 2008 and Dec 2010. Data included baseline demographics, operation type, co-morbidities and type of anaesthesia. These models were checked for normality and extreme outliers using normalized P-P plots and box and whisker plots.

Results: 740 participants were recruited. 427 (57.7%) participants underwent knee arthroplasty, 294 (39.7%) were male and the mean age was 69.9 years (SD 10.3). After removal of extreme outliers (n=17) the data were normally distributed. Multiple regression modeling revealed that the only significant coefficients were for age and sex. Neither general anaesthesia, patient controlled analgesia, central nor peripheral neuraxial blockade significantly improved the model. The respective estimates of the coefficients were all small and not significant.

Conclusions: We have investigated the relationship between type of anaesthesia and the length of stay. We have found no evidence of any association. This study does not support development of a large randomised controlled trial to address this issue.

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SURGICAL STRESS RESPONSE DURING CONTINUOUS EPIDURAL ANALGESIA IN PATIENTS UNDERGOING HIGH INTENSITY SPINE FUSION

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Background and aims: The effects of epidural analgesia with local anesthetic and opioid on the perioperative stress responses have not been fully investigated in patients undergoing spine surgery of high intensity. We hypothesized that the stress response after a major spine surgery would be attenuated by continuous epidural analgesia with ropivacaine, fentanyl and epinephrine. This study assessed the efficacy and the influence of two anesthetic methods on surgical stress response in patients during perioperative period of high intensity spine surgery.

Methods: The study included 165 patients. All patients were divided into two groups. Group E (n=105) had epidural analgesia (ropivacaine, fentanyl, and epinephrine) and endotracheal anesthesia with sevoflurane during surgery and continuous epidural analgesia with ropivacaine, fentanyl and epinephrine after surgery; Group G (n=60) had general anesthesia with sevoflurane and fentanyl and systemic administration of opioids after surgery. Demographics, pain at rest and in motion, plasma levels of stress hormones, cytokines were assessed before, during and after surgery and on postoperative days. The results showed that thoracic epidural analgesia provided the most adequate analgesic protection during and after spine surgery. The use of epidural analgesia contributes to limiting the surgical stress-response and level changes in hemostasis/fibrinolysis during these operations.

Results: In the Group E there was significantly less pain at rest and in motion, improved bowel activity, and higher patient satisfaction. In comparison with Group G, significantly less plasma levels of glucose, cortisol, interleukin IL-1 β , IL-6, IL-10.

Conclusions: Combined epidural/general anesthesia and PCEA with ropivacaine, fentanyl and epinephrine provides better analgesia, patient satisfaction and attenuation of stress response and immune reaction after spinal fusion surgery.

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PERIOPERATIVE EPIDURAL ANALGESIA BEFORE AND AFTER POSTERIOR CORRECTION OF ADOLESCENTS IDIOPATHIC SCOLIOSIS

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Background and aims: Postoperative continuous epidural analgesia through two epidural catheters has been described with good success only after posterior scoliosis correction.

To date, there are no reports dealing with the use of epidural analgesia with local anesthetic before posterior spinal surgery. This study assessed the efficacy of two-level epidural analgesia (EA) compared with general anesthesia during and after posterior spinal fusion (PSF) and segmental spinal instrumentation (SSI) in adolescent idiopathic scoliosis (AIS).

Methods: Eighty adolescent patients with idiopathic scoliosis scheduled for PFS and SSI were prospectively randomized into general (G) or epidural (E) group. In the group E (n = 45) before the surgery patients had epidural puncture consistently on two levels with 0.75% solution of ropivacaine and endotracheal anesthesia with sevoflurane during surgery. After surgery analgesia was performed by prolonged EA by setting at the end of surgery two epidural catheters with 0.2% ropivacaine, fentanyl and epinephrine. In the G group (n = 35) patients had general anesthesia of sevoflurane and fentanyl. After surgery patients had systemic administration of opioids by controlled analgesia.

Results: In the E group there was significantly reduction in the intraoperative blood loss on 50%, less pain at rest and in motion, improved bowel activity, and higher patient satisfaction. The incidence of side effects was significantly higher in G group.

Conclusions: Two-level epidural analgesia for PFS and SSI in AIS can be successfully used both during and after surgery, providing a reliable multi-level nociception, less blood loss and patient satisfaction.

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INTRATHECAL INJECTION OF MAGNESIUM SULFATE: SHIVERING PREVENTION DURING CESAREAN SECTION: A RANDOMIZED, DOUBLE-BLINDED, CONTROLLED STUDY

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Background and aims: A few clinical trials have examined the effect of adding intrathecal magnesium sulfate to anesthetic agents such as bupivacaine (Marcaine) to suppress anesthesia-related shivering. Our study hypothesized that the addition of intrathecal injection of magnesium sulfate to bupivacaine could improve perioperative shivering in women undergoing elective caesarean section.

Methods: In a randomized, double-blinded, controlled trial, 72 patients, 18-37 years of age and ASA physical status I-II who were scheduled for caesarean section during spinal anesthesia were enrolled in the study. The patients were selected by block randomization into two groups. In the case group, 2 mL of bupivacaine 0.5% plus 25 mg MgSO₄(0.5 mL) and in control group 2mL bupivacaine 0.5% plus 0.5 mL normal saline were injected intrathecally. Core temperature was measured before and after drug injection in selected.

Results: Regarding appearance of shivering, no significant intergroup differences were seen immediately after blocking, and also at 5, 30, 40, 50, 60, and 90 minutes after that. However, in the 10th, 15th, and 20th minute, there was a significant difference (P< 0.05) between the groups where group administered Magnesium sulfate shows lower shiver grades compared with the control group. No differences were observed between the groups in the grade of sedation at different time points after blocking. Core temperature was unchanged significantly in the Magnesium sulfate group compared to the normal saline group at the 90 minutes of blocking.

Conclusions: Intrathecal injection of magnesium sulfate and marcaine can improve perioperative shivering in women undergoing elective caesarean section.

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OBJECTIVE QUANTIFICATION OF ULTRASOUND IMAGE QUALITY ON ADULT OBESE & NON-OBESE SPINE

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Introduction: Current limitations of spine imaging include lack of image resolution in obese patients secondary to mismatch of acoustic impedance at fat/muscle interface. This is a prospective observational study to better

define visualization of neuraxial elements in different color scheme for healthy obese and non-obese patients.

Methods: A total of 40 non-pregnant patients ages 18-45 were enrolled with 20 patients per group. Using a curved array low frequency transducer, transverse (TS), paramedian sagittal (PMS), and paramedian oblique sagittal (PMOS) scans of spine interspaces L5-S1, L4-5, and L3-4 were recorded with the patient in the left lateral decubitus position. Images were recorded with both gray/white and sepia hue imaging. The visibility of neuraxial elements (lamina, interlaminar space, ligamentum flavum, epidural space, posterior dura, thecal sac, cauda equina, and anterior complex) were evaluated by blind evaluators. Ultrasound visibility scores (UVS) between different planes (TS, PMS, PMOS) were compared for best visibility (0=no visibility; 3=maximum visibility). Data was analyzed using SPSS version 18.0. The Mann-Whitney test and Wilcoxon Rank sum test with ($p < 0.05$) was used for comparison between groups.

Results: Tables 1

Table 1: Comparative UVS stratified by BMI <30 & BMI >30

	Gray/White Scale Mean UVS	P Value	Sepia Scale Mean UVS (20-40)	P Value
BMI < 30				
PMOS L5/S1	0.25	0.003	10.22	0.004
PMOS L5/S1	14.50		14.00	
PMOS L4/5	0.07	0.003	11.20	0.003
PMOS L4/5	14.75		17.43	
PMOS L3/4	0.00	0.000	11.00	0.007
PMOS L3/4	14.50		17.40	
TS L5/S1	0.00	0.173	11.07	0.002
TS L5/S1	14.50		14.00	
TS L4/5	11.50	0.126	10.25	0.000
TS L4/5	14.75		17.43	
TS L3/4	0.00	0.019	10.00	0.003
TS L3/4	14.50		17.00	
BMI > 30				
PMOS L5/S1	4.75	0.004	4.50	0.747
PMOS L5/S1	4.00		4.33	
PMOS L4/5	0.00	0.270	4.00	0.400
PMOS L4/5	7.75		8.00	
PMOS L3/4	4.00	0.143	4.17	0.800
PMOS L3/4	6.75		7.60	
TS L5/S1	5.75	0.776	4.50	0.004
TS L5/S1	6.00		4.33	
TS L4/5	4.75	0.123	4.43	0.340
TS L4/5	7.50		6.00	
TS L3/4	2.50	0.004	2.50	0.126
TS L3/4	6.75		6.00	

p value based on non-parametric paired Wilcoxon Rank Sum Test

[Table 1]

Discussion: Our results shows that mean ultrasound visibility score (UVS) of spinal elements are superior in non-obese patients. The sepia hue in PMOS scan demonstrates higher visibility in non-obese patients. There was no significant difference between gray/white and sepia scores in patients with BMI >30. The PMOS view in gray/white contrast may demonstrate better visualization of spine elements in obese patients.

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AVOIDING BAD NEWS. A BIBLIOGRAPHIC STUDY OF BENEFIT VS HARM IN THE SCIENTIFIC LITERATURE ON EPIDURAL BLOCKS

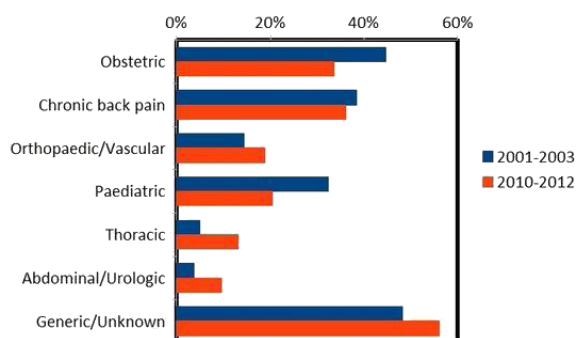
K. Jensen, J. Børglum *Anaesthesia and Intensive Care, University Hospital of Copenhagen: Bispebjerg, Copenhagen, Denmark.*

Background and aims: Every clinical study contains headline information regarding the efficacy of an intervention. However, with increasing knowledge on efficacy, more knowledge accumulates on harmful side effects and potential risks in clinical use. We wanted to determine whether headline reports on epidural blocks adequately balanced benefit vs harm, and if such reporting has changed recently.

Methods: We conducted a comprehensive Medline search on human studies on epidural or caudal nerve block for two periods, 2001-2003 and 2010-2012. We excluded all studies relating to veterinary use, sacral stimulation or neuraxial tumours. Abstracts of reports were classified according to clinical indication and their primary reporting purpose: benefit or harm.

Results: A total of 2,525 reports were included (Figure 1). Overall, the proportion of publications highlighting harmful effects did not change (2001-2003: 35%; 2010-2012: 33%). However, studies on thoracic and abdominal/urologic surgery almost exclusively reported on positive efficacy outcomes, and the reporting of bad news was left to generic reports or unknown surgical interventions. When analyzing cohort studies alone, similar results emerged (harmful effects in thoracic surgery, 2-7%; in abdominal/urologic surgery, 1-13%).

Number of reports listing harmful effects of epidural blocks as their primary purpose.



[Reporting of harmful effects]

Conclusions: A disproportionate optimism is evident in both old and current reports relative to epidural blockade as the primary analgesic method; i.e. particularly regarding high-risk surgery. While adverse events are often presented in the complete text, we encourage investigators and publishers not to neglect a focus on harmful effects in headline news.

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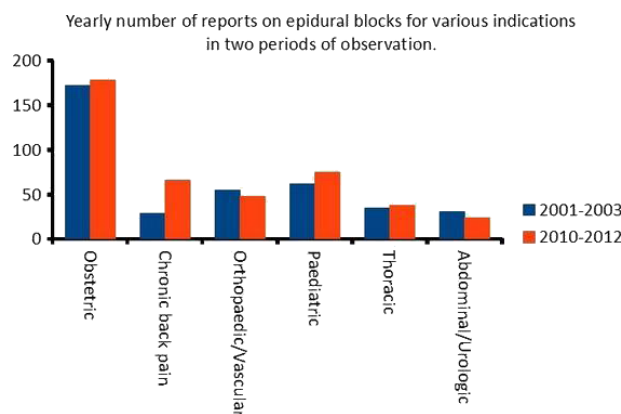
THE FATE OF EPIDURALS. A BIBLIOGRAPHIC STUDY OF EPIDURAL BLOCKS FOR CLINICAL USE

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Background and aims: While the beneficial effects of postoperative analgesia are indisputable in many clinical settings, recent reports question the role of the epidural blockade as the single gold standard of perioperative analgesia in major surgery with the advent of new ultrasound-guided technologies to anaesthetize the thorax and the abdominal wall. We wanted to explore trends in the scientific literature on epidural block outcomes from September 2001 through April 2012.

Methods: We conducted a comprehensive Medline search on human studies on epidural or caudal nerve block for two periods, 2001-2003 and 2010-2012. We excluded all studies relating to veterinary use, sacral stimulation or neuraxial tumours. Titles and abstracts were classified according to subject matter.

Results: The total number of annual reports on epidural blocks listing outcome effects in the two observation periods remained the same (554 vs 568; Figure 1). Table 1 lists qualitative advantages of epidurals over new technologies, and the importance of effective analgesia: a pattern is identified.



[Figure 1.]

Qualitative assessment of the clinical need for epidurals.		
	Epidural as an indispensable technology	Analgesia improving mortality
Group 1:		
Obstetric surgery	Yes	Rarely
Group 2:		
Abdominal/urologic surgery	No	Yes
Thoracic surgery	No	Yes
Group 3:		
Chronic back pain	No	No
Orthopaedic/vascular surgery	No	Rarely

[Table 1.]

Conclusions: The annual frequency of clinical reports on epidurals vary according to clinical setting. The disparity in reporting between settings in which epidurals are indispensable, compete with other technologies, or rarely reduce mortality seem to reflect not only differences in clinical imperatives but also differences in reporting traditions. Cohort studies in thoracic and abdominal surgery (Group 2) are curiously few, given that competing techniques are emerging to undermine their superiority.

255 ULTRASOUND AND THORACIC OUTLET SYNDROME

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Background and aims: Neurogenic thoracic outlet syndrome (TOS) is a cause of upper extremity pain and paraesthesia due to neural compression in the area of the neck above the first rib. It is commonly associated with refractory radicular pain in 'whiplash'. It has, hitherto, been a clinical diagnosis of exclusion. Diagnostic tests such as magnetic resonance imaging and electrophysiology have poor utility (sensitivity/specificity). Ultrasound imaging and guided injections have made a significant advance in recent years.

Methods: Through a clinical case series we will outline sonoanatomy of the condition. Its diagnostic utility with small volume local anaesthetic injections in association with provocative clinical tests. Its therapeutic utility with ultrasound guided botulinum toxin injections. Between the clavicle and first rib is an important source of entrapment in this condition. We will present previously unpublished information regarding sonoanatomy of the subclavius muscle and its relevance to this condition. A series of 10 adult patients will be presented to illustrate novel information indicated above plus patient outcome data. Data from current perception thresholds is also presented. This test allows useful dynamic testing unlike previously mentioned magnetic resonance imaging and conventional electrophysiology.

Results: The patient's pain intensity decreased at three days. Function improved. These improvements were maintained at 12 weeks. Ultrasound guided Botulinum toxin injection of the subclavius muscle resulted in persistent pain relief in all these cases of refractory thoracic outlet syndrome.

Conclusions: Ultrasound guided Botulinum toxin injection of the subclavius muscle is a novel method of pain relief in all these cases of refractory thoracic outlet syndrome.

256 AUDIT OF TRIAL OF SPINAL CORD STIMULATION IN PATIENTS WITH FAILED BACK SURGERY (FBSS) AND CHRONIC REGIONAL PAIN SYNDROME (CRPS)

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Background and aims: Spinal cord stimulation (SCS) is an effective therapy in Failed Back Surgery Syndrome (FBSS) and Chronic Regional Pain Syndrome (CRPS) resistant to conventional treatment.

From our clinical experience there is tendency of the SCS electrode to take the midline position if delivered midline and stayed midline.

This audit supports our recommendation that there is no need to put the electrode in paramedian position.

Methods: Patients who had SCS trial for FBSS and unilateral lower limb pains secondary to CRPS were included and those with non-available images, bilateral symptoms and failed trial of SCS were excluded. Data was collected from patient's notes for spinal cord stimulation mapping and C-arm images were reviewed for the electrode position.

Results:

Paramedian Electrode	Midline Electrode	Side of Symptom	Post SCS side of Paraesthesia
	3	3 Left	3 Left
2 Right	1	3 Right	3 Right

[Patients with CRPS]

Table 1

4 of 6 patients with unilateral limb pain had SCS electrode positioned midline and had significant reduction in pain on the affected side.

Total	Included	Excluded
35	25	10

[Total Pts with FBSS]

Paramedian Electrode	Midline Electrode	Side of Symptom	Post SCS side of Paraesthesia
2 Right	8	10 Right	10 Right
5 Left	10	15 Left	15 Left

[Patients with FBSS]

Table 2 and Table 3

18 of 25 patients with unilateral limb pain had SCS electrode positioned midline and had significant reduction in pain on the affected side.

Conclusions: SCS midline electrode should non-preferentially stimulate bilateral dorsal columns. Patients who had midline position of the electrode had preferential projection of stimulation to the affected side.

This is only possible if the neural structures serving pain near the electrode on affected side has lower threshold of activation.

From this we hypothesize that there is threshold change in the neural network serving the painful area at the spinal level.

257 REVIEW OVER ONE YEAR OF 130 CRPS PATIENTS WHO RECEIVED A PERINEURAL CATHETER IN A LONG TERM

B. Bouche, J. Lemarie *Clinique Breteche, Nantes, France.*

Aim: Perineural catheter analgesia to block pain message and the effect of sympathetic nervous system in Complex Regional Pain Syndrome could be considered as a useful tool in the management of this pain condition, in combination with usual drug treatments and manual behavioral therapies. We observed in our practice the use of this treatment over of year.

Methods: After failure of usual medical treatment for CRPS and intravenous sympathetic block, perineural catheters were implanted in 130 patients suffering from CRPS. Catheters were kept in place for the longest period tolerated by the patient; patients were monitored on a daily basis at home by a nurse or a physiotherapist. We report here the pain relief observed in this outpatient program, 6 months after the catheter removal.

Results: 130 patients (84 women, 46 men) suffering from CRPS (> 60 upper limb pain, 70 lower limb pain) benefited from this therapy. Only 13 patients received catheter within 6 months of disease progression. Mean duration of catheter implantation was 20 days. 53 patients had a pain relief of more than 50% and good satisfaction. 40 patients were not satisfied and considered for spinal cord stimulation. The other patients were lost to follow up, continued the medical treatment or were considered for surgery. Regarding adverse events, we have noted only 3 infections with early withdrawal of the catheter.

Conclusions: Perineural catheter in the long term could be a part of the algorithm management of CRPS before other therapies like neuromodulation. No serious incidents were noted.

258 PERIPHERAL NERVE STIMULATION IN LOW BACK PAIN

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Aim of investigation: Back pain following failed back surgery syndrome or other etiologies is common in our pain consultation. As reported in the

literature, spinal cord stimulation is increasingly used for the treatment of back pain. However, spinal cord stimulation is not achieving pain relief for all patients. Few teams only have reported the use of perinervous (peripheral nerve) stimulation, ie superior cluneal, middle cluneal, lumbar medial branch stimulation, for the treatment of these pain conditions. We present our experience with peripheral nerve stimulation (PNS) for low back pain.

Methods: 20 patients with low back pain (ie 8 post laminectomy, 10 post arthrodesis and 2 Facet syndrome after radiofrequency) have been rejected for spinal cord stimulation and therefore considered for PNS. Each patient had a nerve block test which induced a temporary improvement of at least 70 % and was therefore considered for PNS implantation. Quadripolar percutaneous leads were used during 2 weeks for the stimulation trials. Implantation technique used ultrasound and X-Ray guidance. 10 patients had permanent superior cluneal stimulation, 5 permanent stimulation of dorsal roots S1S2S3 and 5 permanent lumbar branch stimulation.

Results: All patients have been followed during 6 months. We observed an average pain relief of 70 %. Regarding adverse events, we have noted only 2 lead migration for patient stimulated at the superior cluneal nerve.

Conclusions: These results suggest that PNS can be considered for the treatment of back pain for well selected patients.

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AMBULATORY EPIDUROSCOPY FOR CHRONIC PAIN MANAGEMENT - WHAT ARE WE DOING?

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Background and aims: Epiduroscopy is a minimally invasive procedure that allows looking inside the epidural space. Because of its reliability on determining where pathology lies, it's indicated in cases of refractory low back pain. It also allows targeted therapy¹.

Aim: Review the practice of our unit in handling patients submitted to epiduroscopy.

Methods: Descriptive analysis of our experience between January 2007-2012.

Results:- Population: 11 ♂ || 29 ♀ . 97, 5% were referred after back surgery.

- Selection criteria: at least one spine surgery, no additional surgical indication, refractory lumbar/multisegmental pain, MRI fibrosis/adhesions.
- Exclusion: pregnancy, coagulation disorder, renal or liver insufficiency.
- Procedures were done at the Ambulatory Unit under conscious sedation. A mixture of methylprednisolone + ropivacaine 2mg/ml was injected at different column levels; whenever possible adhesiolysis was executed.
- Major complications: none. In the literature, post-dural puncture headache, fluid overload, limb spasms and transient blindness are described.
- Follow-up: 1, 3, 6 and 12 months post-procedure. 62, 5% patients reported pain decrease on the 1st month, 64% of which sustained it on the 3rd.
- Recently, functional tools like the Oswestry Scale, Roland Morris Disability Questionnaire and Short-Form 36 started being used for evaluation.

Conclusions: Intractable pain may be relieved through interventional approaches¹. A recent prospective trial by Donato et al. showed epiduroscopy's effectiveness for up to 48 months.

Long follow-up and systematized data analysis are necessary to establish the efficacy of our approach.

Reference: 1. Avellanal M. Epiduroscopy. Rev Esp Anestesiol Reanim. 2011 Aug-Sep; 58(7):426-33

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SPINAL CORD STIMULATION WITH A SLIMLINE PADDLE LEAD INTRODUCED UNDER LOCAL ANAESTHESIA: A NEW TECHNIQUE FOR THE TREATMENT OF FAILED BACK SURGERY SYNDROME

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Background and aims: Spinal cord stimulation (SCS) is used to treat chronic pain of the Failed Back Surgical Syndrome and requires an awake patient for optimized lead positioning in the epidural space to locate parasthesias. Paddle type leads offer several advantages over cylindrical type leads. However, when paddle leads need to be placed using a laminectomy

incision additional anesthesia is required which can complicate intraoperative testing. A new delivery system (Epiducer TM, St. Jude Medical Neuromodulation Division, Plano, TX) has been developed to introduce only in local anesthesia a percutaneous delivery of S-Series TM paddle leads (St. Jude Medical Neuromodulation Division, Plano, TX).

Methods: We performed an observational, single center study to evaluate the safety and efficacy of percutaneous introduction of a slimline surgical lead into the epidural space under local anaesthesia.

Results: The result in our study demonstrate that the percutaneous introduction of a slimline surgical lead into the epidural space under local anaesthesia is a suitable technique for SCS paddle lead implant.

Conclusions: This study demonstrated the safety of percutaneous implantation and advancement of the S-Series paddle lead using the Epiducer lead delivery system in 52 patients.

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ULTRASOUND-GUIDED PERIPHERAL NERVE STIMULATOR PLACEMENT, FEASIBILITY, APPLICABILITY AND SELECTION CRITERIA

F. Elahi Anesthesia, Pain Medicine, University Hospital, Iowa City, IA, USA.

Background and aims: Peripheral nerve stimulation is analgesic for some neuropathic pain syndromes. Peripheral nerve stimulation currently involves open surgical placement of electrode(s). Minimally invasive placement of peripheral nerve stimulation electrodes for peripheral nerve targets using ultrasound guidance has not been widely reported.

Methods: This presentation includes six different cases with clinical diagnosis of neuropathic pain due to different etiology. After successful trial of ultrasound guided peripheral nerve stimulation on outpatient basis all of them underwent peripheral nerve stimulation permanent placement with ultrasound guidance under local anesthetic administration.

Results: Documented pain diary using numerical and visual analog pain scale showed more than 90% pain improvement in this highly selective small group of patients. Pain assessment documented prior and after the trial period also during the permanent placement of the peripheral nerve stimulation with a minimum 2 months follow up (range from 2 months to 6 months).

Conclusions: Feasibility of ultrasound guided peripheral nerve stimulation placement demonstrated in this small group of patients. Further clinical data needed.

To the committee: I would like to give this lecture in oral presentation format.

I will discuss patient's selection. I will demonstrate ultrasound pictures and movies, pictures of intraoperative and postoperative approaches. with pre-operative and post operative management strategies.

This lecture will demonstrate the feasibility of the technique.

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THE DIFFERENT ASSOCIATIONS BETWEEN PAIN-DRAWING AND PSYCHOLOGICAL CHARACTERISTICS IN DIFFERENT BODY REGION PAINS

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Background and aims: Pain drawings have been used for the documentation of pain and as tools for diagnosis. A number of researches have mainly focused on the value of pain drawings for assessing psychological characteristics in patients with chronic back pain. Conversely, few researches have investigated pain-drawing as tools for psychological evaluation of pain in the other regions. The aim was to investigate the pain, pain-drawing, and psychological characteristics in the head, neck-shoulder (NS), and low-back/lower-limb (LB-LL) regions among chronic pain patients.

Methods: Two hundreds and ninety-six were included (headache, 48; NS pain, 90; LB-LL pain, 158). The pain-drawing and scores of Hospital Anxiety and Depression Scale (HADS), visual analog scale (VAS), and Pain Disability Assessment Scale (PDAS) were extracted from medical records. Pain drawings were classified into organic or nonorganic and then the correlation between these data were investigated in each body region group.

Results: The percent of the pain drawings classified as nonorganic in the head, NS, and LB-LL regions were 54%, 43%, and 33%, respectively. Scores

of HADS, VAS, and PDAS of nonorganic group tended to be higher than those of organic group in the NS, and LB-LL regions. However, the drawings of the head did not show the same tendency as those of the other two regions did.

Conclusions: Generally nonorganic pain drawings would be associated with psychological disturbances. However, the patients with headache even if they don't have psychological disturbances could be more likely to draw nonorganic pain drawings.

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THE ANALGESIC EFFICACY OF DULOXETINE IN DIABETIC NEUROPATHIC PAIN

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Background and aims: We studied the analgesic efficacy of duloxetine in patients with diabetic neuropathic pain who visited the pain management department the year 2011.

Methods: Duloxetine 60 mg per day was administered to 15 patients who suffered from diabetic neuropathic pain according to DN4 questionnaire while they visited for the 1st time the pain clinic. We studied retrospectively the demographic data and the previous analgesic medications while we studied prospectively the pain scores using the NRS (Numeric Rating Scale) in four successive weekly visits. NRS scores were analyzed using paired t-test. $P < 0,05$ was considered statistically significant result. Results We studied 10 women and 5 men, 65 ± 3 years of age. 12 patients were receiving inappropriate medications for their pain problem (NSAIDs and opioids). During their 1st visit they rated their pain 7,2 (0,261) [Statistic Mean (Std.Error)], during the 2nd visit 5,2(0,261), during the 3rd 4,13(0,215) and during the 4th 3,9(0,206). The analysis revealed that duloxetine reduced the pain scores until the 3rd visit at a statistic significant level, but not until the 4th visit.

Visits	2nd -1st	3rd-1st	4th -1st	3rd -2nd	4th -3rd
p-value	0,000	0,000	0,000	0,01	0,082
[Pain scores]					

Conclusions:

1. Diabetic neuropathic pain is still treated with inappropriate drugs.
2. All the patients suffered from intense pain during the 1st visit.
3. Adding duloxetine 60 mg per day had a significant analgesic effect, however more patients should be included in the study in order to have more reliable results.

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ULTRASOUND-GUIDED (USG) NERVE BLOCK COMBINATIONS. FEMORAL (FEM), SAPHENOUS (SAPH) AND OBTURATOR, RAMUS POSTERIOR (ONP) FOR ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION (ACL-R): DOUBLE-BLINDED, RANDOMIZED, PLACEBO-CONTROLLED TRIAL

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Background and aims: ACL-R is a routine surgical procedure. Traditional femoral /sciatic block-combinations effectively reduce postoperative pain (PP), but results in considerable motor blockade. We aimed to evaluate PP relief and the degree of motor block with block combinations of FEM and ONP (FEM-ONP), versus SAPH and ONP (SAPH-ONP), versus placebo blocks. All patients had standard Patient-Controlled-Analgesia with morphine.

Methods: Randomized, placebo-controlled and double-blinded trial. Following IRB approval 81 patients were randomized to an USG block combination of:

- (1) active FEM-ONP + sham SAPH
- (2) active SAPH-ONP + sham FEM
- (3) placebo

Ropivacaine 0.75% was used for all active blocks following induction of general anaesthesia. Outcome measures were PACU pain scores at rest,

degree of motor blockade, opioid consumption, opioid related side-effects, PACU time, motor-abilities of daily living scores, perceived ill health scores.

Results: Active blocks of the FEM-ONP resulted in significantly more motor blockade ($p < 0.01$). Statistical evaluation between groups comparing differences in pain scores, opioid consumption, related side-effects, logistic data and perceived ill health are presented.

Conclusions: Different USG block combinations used for ACL-R results in significantly different motor blockade and pain scores. Various block combinations can be used and results in significantly different outcome measures.



[The ACL-R nerve block combinations]

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EFFECT OF FRACTURED NECK OF FEMUR ON FEMORAL NERVE ANATOMY

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Background and aims: Femoral nerve block is commonly used for analgesia following fractured neck of femur surgery. Recent NICE guidance in the UK recommends consideration of a femoral nerve block for pre-operative analgesia. The femoral artery provides a landmark for identifying the nerve which lies laterally. Following the anatomical disturbance of a femoral neck fracture, it was hypothesised that the relative position of the femoral nerve would alter.

Methods: A non invasive, observational study was carried out. Local ethics committee approval was obtained. After informed consent, 30 patients with fractured neck of femur had femoral nerve ultrasound scanning performed bilaterally. Distance from skin to nerve, skin to artery and artery to nerve at inguinal crease level were measured. Age, gender, height and weight were also recorded. Results were analysed using a paired T test.

Results: A statistically significant difference was demonstrated in the nerve-artery distance between the fractured and contra-lateral sides ($p=0.008$), distance on the fractured side being greater. No other measured variable had a significant effect on femoral nerve position.

Conclusion: There is a change to the position of the femoral nerve in relation to the femoral artery following a femoral neck fracture. Performance of a femoral nerve block using the landmark technique, which depends on the predictable position of the femoral artery and nerve, may need modifying. It would be prudent to consider the use of ultrasound in performing a femoral nerve block in patients with a femoral neck fracture.

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DOES CATHETER ORIFICE CONFIGURATION OF A CONTINUOUS INTERSCALENE BRACHIAL PLEXUS BLOCKADE AFFECT POSTOPERATIVE ANALGESIA AND LOCAL ANAESTHETIC LEAKAGE ALONG THE CATHETER?

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Background and aims: Perineural catheters are of 2 types—end-hole and side-hole—depending on the orifice configuration. Here, we evaluate whether orifice configuration affects postoperative analgesia and local anaesthetic leakage along the catheter.

Methods: We randomised 42 patients without diabetes, who were scheduled to undergo shoulder surgery, into an end-hole catheter (E-group; 21 patients) or a side-hole catheter group (S-group; 21 patients). A Tuohy needle was advanced towards the interscalene brachial plexus using an ultrasound-guided in-plane posterior approach while the patients were under light sedation. Once the needle reached the plexus, 25 mL of 0.5% ropivacaine was injected and its circumferential spread around the brachial plexus roots was confirmed. An end-hole or side-hole catheter was advanced through the needle until the tip reached a few millimetres beyond the plexus medially. Postoperatively, 200 mL of 0.2% ropivacaine was administered at 6 mL/h with rescue therapy, including NSAIDs and pentazocine hydrochloride. The number of rescue administrations required and leakage score (0-5) were recorded until termination of the nerve blockade, when anaesthetic administration was completed.

Results: No significant differences in the number of rescue administrations required (1.5 ± 1.6 vs. 2.4 ± 2.0 ; $P < 0.05$) and amount of leakage (0.0083 ± 0.204 vs. 0.286 ± 0.570 ; $P < 0.05$) were observed between the E- and S-groups.

Conclusions: Thus, the catheter orifice configuration of a continuous brachial plexus blockade does not affect postoperative analgesia and local anaesthetic leakage along the catheter.

Ethical committee in Hakodate Goryokaku Hospital approved this study.

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COMPARISON OF NITROGLYCERINE AND DILTIAZEM AS ADJUNCTS TO LIDOCAINE IN INTRAVENOUS REGIONAL ANESTHESIA

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Background and aims: Nitroglycerin (NTG) has strong direct vasodilatory effect that might promote distribution of lignocaine to nerves. Calcium channel blockers potentiate the analgesic effect of local anesthetics. This prospective, randomized, double blind study compared the efficacy of NTG and Diltiazem as adjuncts to lignocaine in IVRA with regard to tourniquet tolerance, perioperative analgesia and quality of anesthesia.

Methods: Sixty patients undergoing elective hand surgery under IVRA were randomly assigned into 3 groups LD, LN and L and were administered IVRA with 3mg/kg lignocaine (40 ml) with an adjunct [LD- 0.2mg/kg Diltiazem, LN- 200 microgram NTG and L Control (normal saline)]. Hemodynamic parameters, onset of the complete sensory blockade, motor blockade, tourniquet pain scores; perioperative fentanyl consumption was noted.

Results: Sensory block was established in 2.5 ± 0.688 min in Group LD Vs 3.9 ± 0.552 and 5.5 ± 0.606 min in Groups LN and L respectively. Motor blockade was established in 8.65 ± 0.933 min in Group LD Vs. 10.75 ± 0.638 and 13.46 ± 0.604 min in Groups LN and L respectively. Post tourniquet deflation, the mean VAS scores >3 were attained at 30 min (3.8 ± 0.41) in group L and at 2 hours (3.1 ± 1.05) in the group LN. Significantly, it remained <3 in the group LD intraoperatively and postoperatively. Patients in Group L requested rescue analgesic at 28.80 ± 7.77 min. Vs 45.71 ± 4.49 and 37.5 ± 6.21 min in Groups LD and LN.

Conclusions: Onset of sensory block and motor block was faster in LD group in comparison with LN and L group. Diltiazem provided better perioperative analgesia for the longest duration.

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INTERSCALENE BRACHIAL PLEXUS BLOCK VERSUS GENERAL ANESTHESIA FOR SHOULDER SURGERY

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Background and aims: The aim of our study was the comparison between general anesthesia and interscalene brachial plexus block for shoulder surgery.

Methods: After written consent of our hospital's Ethic Committee, we included fifty patients, aged 43 ± 15 years, ASA I-II, with similar demographic data, randomized blindly in two groups. Group A (n:25) received general anesthesia. Anesthesia was induced with propofol 2mg/kg, suxamethonium 1mg/kg and fentanyl 1μ/kg. For maintenance, we used desflurane 6%, a mixture of N₂O/O₂ 50%, fentanyl 2 γ/kg and continuous infusion of cis-atracurium. Group B (n:25) received an interscalene brachial plexus block with 29ml of ropivacaine 0.75% and 150γ of clonidine. Blood pressure, heart rate, EtCO₂, SpO₂ were monitored intraoperatively in both groups. We studied the onset ready to surgery time, the presence of any postoperative complications and the postoperative need of analgesic-drugs administration. To assess group differences for measures that were taken repeatedly over time, a mixed effects ANOVA model was fit in order to taken into account the correlation between adjacent observations.

Results: The onset ready to surgery time was 8.5 ± 2.5 min in Group A and in Group B was 39 ± 8.5 min ($p < 0.005$). Nausea and vomiting was recorded in two patients of Group A, during recovery, and ondasetron was administered. There was no significant evidence for difference concerning the haemodynamic parameters in both groups. Postoperative analgesia for patients in Group A was first administered after 45 ± 12.5 min and in Group B 503 ± 45 min ($p < 0.005$).

Conclusions: Both anesthetic techniques are suitable for major surgery at the shoulder.

Nevertheless, interscalene brachial plexus block has many advantages compared to general anesthesia for major surgery at the area of shoulder and it should be preferred in most cases.

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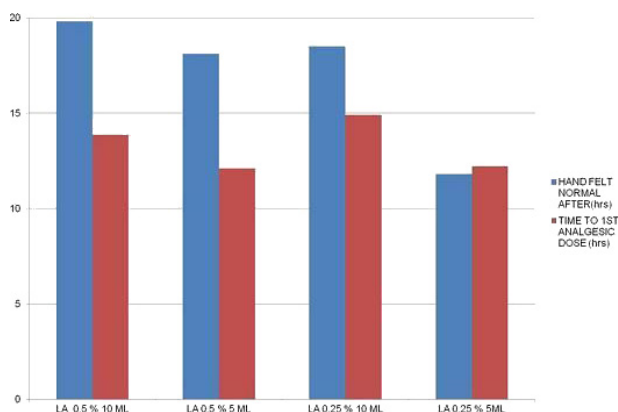
PERIPHERAL NERVE BLOCK (PNB): MAKING THE FIRST 24 HOURS POST HAND SURGERY PAIN FREE?

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Background and aims: The best post operative outcomes after hand-surgery are achieved not just with meticulous surgery but also early post-operative physiotherapy. A stumbling block to this is post-operative pain. We aimed to overcome this by providing PNB that should render the patient able to have physiotherapy within 24 hours.

Methods: Data was collected from 40 patients over a 6 month period, that were undergoing hand surgery in the day-case unit. All PNB were done under ultrasound guidance (USS), with an in-plane technique & followed by a general anaesthetic. Patients were randomised to receive 1 of 4 local anaesthetic (LA) mixtures, and 1 of 2 volumes advocated in the protocol. We collected data on patient demographics, LA & volume used, pain at incision, intra & post-operative pain, anaesthetist grade. Telephone follow-up was done at 24 hours to assess the time scale for hand to feel normal, duration to first analgesia requirement and analgesia taken.

Results: Total of 67 PNB performed. In addition to 100 mcg of fentanyl at induction, 1 patient needed analgesia at incision, intra-op and in recovery. Two patients required analgesia intra-operatively. Mean time to sensory normality and first dose analgesia required is show below:



[Results]

Conclusions: USS guided PNB is an excellent form of intra & post-operative analgesia. This facilitates early physiotherapy. The other interesting outcome is that the time to first dose analgesia requirement is roughly the same irrespective of concentration or volume of LA used.

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FASCIAL PLANE CONCEPT

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Background and aims: Fascial plan concept is another view on the objective anatomical reality. In typical anesthesia literature we find only a few remarks on the importance of the anesthetics distribution on the quality of the blockade. Thus effective regional anesthesia is primarily dependent on the administration of local anesthetics into perineural space. Into many parts of the body we find peripheral nerves between anatomically well-defined muscle fascia sheaths. Application of anesthetic into the fascia compartment makes the assumption that the anesthetic can find their nerves. In fact, compliance and permeability of the tissue around the nerve plays an important role in the distribution of the anesthetic.

Methods: 1. Histological studies of the nerve surrounding. 2. CT and MRI studies performed on healthy volunteers and on the author himself. 3. Clinical studies using ultrasound imaging.

Results: Even a relatively small volume of anesthetic, penetrating thin connective tissue between the fat cells in a narrow space with low compliance, can reach a considerable distance. We suggest that application of local anesthetic into "optimal" space outlined by the fascia planes, in particular under ultrasound guidance, largely determines the quality of the peripheral nerve block.

Conclusions: In brief, the muscular fascias surrounding peripheral nerves create an enclosed space, where their elasticity is crucial in forming the size and shape of the space thus affecting the distribution of local anesthetics. In contrast, an effort to apply local anesthetics as close as possible to the peripheral nerve increases the risk of peripheral nerve damage.

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DOES STERILE COVERS OF ULTRASOUND PROBE MODIFY IMAGE ACQUISITION? A BLINDED AND RANDOMIZED STUDY

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Aims: Clinical practice of puncture with ultrasound guidance may be carried with different methods of sterile covering of the ultrasound probe. In this prospective, randomized, blind study we pretend to determine if they cause differences in the acquisition of ultrasound images.

Methods: A total of 40 ultrasound images obtained from four common approaches (interscalene, axillary, and popliteal sciatic TAP) and using four different probe covers: Film Tegaderm (3M Health Care, Germany), Flexanorm (PRIM GmbH, Germany), Civ-Flex Cover (CIVCO, USA), Protector Latex Vygon (Vygon, France), and Coverage of transparent polyvinyl Vygon. After randomizing the images and hiding the barrier material used, sharpness and contrast were assessed (score 1-5) by four experienced observers in ultrasound anatomy. The interface used was sterile gel (Aquasonic Parker Fairfield, USA). Statistical analysis was performed using SPSSv16.0; Kolmogorov-Smirnov and ANOVA testing normality and repeated measures.

Results: We obtained 320 pictures for definition and contrast analyzing. For the variable contrast, Flexanorm was the highest rated (median 3.03; CI 1.98 to 4.08, $P < 0.05$), while Civ-Flex was the lowest (median = 2.21, CI 1.45 - 2.98, $p < 0.05$). About the variable definition, Vygon Guard Latex got the highest rating (mean 2.75, CI 1.79 to 3.70) while Civ-Flex the worst (mean 2.40 ± 0.71), with no significant differences.

Conclusions: It seems likely that the coating material of the transducer may interfere the quality of ultrasound image. Evaluating and understanding differences between them would avoid adding more difficulty to the acquisition of ultrasound images.

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LOW THRESHOLD STIMULATION CURRENT MAY INCREASE SAFETY AND EFFICACY OF ULTRASOUND-GUIDED AXILLARY BRACHIAL PLEXUS BLOCK. PRELIMINARY REPORT

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Background and aims: The major benefit of ultrasound(US)-guided peripheral nerve block is real-time visual assessment of needle-nerve relationship and pattern of LA spread. Nevertheless US may prove inaccurate with regard to recognition of intraneural needle placement. Electrical nerve stimulation allows for confirmation of intraneural needle placement by assessment of threshold stimulation current. The purpose of the study was to prospectively evaluate benefits of threshold stimulation current measurement in terms of neural injury risk during US-guided axillary brachial plexus block (AXB).

Methods: Study protocol was approved by ethical committee of Warsaw Medical University. Study included patients scheduled for elective upper-extremity surgery under AXB. The 4 nerves (median, ulnar, radial, musculocutaneous) were separately localized and blocked using low LA volume (2.5-6 ml). Before LA injection threshold stimulation current was measured. In case it was ≤ 0.2 mA the needle was repositioned. After completing the procedure extent of block was assessed. 24 hours post-operatively neurological check-up targeted to diagnose neurologic injury was carried out.

Results: Study included 45 patients. 180 data sets (45 x 4 nerves) were analysed. Success rate was 89.5% (161 nerves). None of the patients demonstrated signs of nerve injury neither during block placement (nerve expansion seen on US) nor postoperatively. In successful block group the mean threshold stimulation current was significantly lower than in failed block group (respectively $0.58\text{mA} \pm 0.44$, $0.96\text{mA} \pm 0.72$, $p < 0.01$).

Conclusions:

1. Low threshold electrical current may be prognostic factor for successful peripheral nerve block.
2. Ultrasound-guided technique combined with measurement of threshold stimulating current may prevent nerve injury resulting from intraneural injection of LA.
3. US-guided AXB is effective anesthetic method (success rate 89.5%).

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SIMULTANEOUS USE OF DISTAL MEDIAN, RADIAL AND ULNAR NERVE BLOCKS WITH SUPRACLAVICULAR BLOCK IMPROVES ANESTHESIA ONSET TIME AND POSTOPERATIVE ANALGESIA: A RANDOMIZED CONTROLLED STUDY

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Background: The aim of this study was to compare the combined ultrasound-guided supraclavicular brachial plexus block with distal median, radial, and ulnar nerve blocks with supraclavicular block alone.

Methods: After ethical committee approval and informed consent 62 patients undergoing upper extremity surgery were randomized to supraclavicular (Group S, n=31) or supraclavicular + distal (Group SD, n=31) group. Patients in group S received 32 mL of lidocaine 1.5% with epinephrine 5 µg/mL and in group SD received 20 mL of lidocaine 1.5% with epinephrine 5 µg/mL followed by distal blocks using a 50:50 mixture of lidocaine 2% + levobupivacaine 0.5% (4 mL/nerve). Sensory and motor block of the ulnar, median, radial and musculocutaneous nerves were assessed. The onset and anesthesia related times (defined as the sum of the performance and onset times) and need for analgesic and first analgesic time were noted.

Results: Demographic and surgical data were similar among groups. The onset time (20 min (15-30) vs 15 min (10-25), $p < 0.001$) and anesthesia related time (22 min (16-34) vs 17 min (11-28), $p < 0.001$) were shorter in group SD. Analgesic requirement was higher in group S (88.5% vs 56.7% respectively, $p=0.009$) and among the patients who required analgesic, the

first analgesic time was shorter in group S (315 minutes (233-746) vs 625 minutes (347-1764), $p < 0.001$).

Conclusions: The addition of distal median, radial, and ulnar nerve blocks to the supraclavicular block shortens anaesthesia onset time and decreases the analgesic requirements.

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ELECTIVE CESAREAN DELIVERY IN A PATIENT WITH CEREBRAL AVM - WHICH IS THE BEST ANESTHETIC OPTION?

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Background and aims: Intracranial hemorrhage due to rupture of an arteriovenous malformation (AVM) during childbirth is rare but potentially fatal¹. Literature on these cases is scarce. We describe the anesthetic management for elective cesarean section in a patient with a cerebral AVM.

Case report: 26 year-old woman with inoperable left temporal AVM, underwent epidural anesthesia for elective cesarean delivery. Before induction of anesthesia a catheter was placed for invasive monitoring of arterial blood pressure. Epidural catheter placed at L2-L3, 10 ml of 0.75% ropivacaine with sufentanil 10 micrograms administered. 15 minutes later there were no significant blood pressure changes. Due to insufficient level of analgesia another 2 ml of 0.75% ropivacaine were administered. After 10 minutes it was decided to proceed to general anesthesia (GA). Rapid sequence induction with propofol 2.5 mg/kg and succinylcholine 1.5 mg/kg, orotracheal intubation (OTI) and maintenance with sevoflurane. Hypertensive peak (180 mmHg) associated with OTI. Effective postoperative analgesia by epidural catheter, discharged without complications.

Conclusions: The goals of anesthetic management in these cases are to maintain hemodynamic stability and avoid intracranial pressure variations. Invasive monitoring of BP allows diagnosis and treatment of its variations. Regional anesthesia was preferred to avoid the stress associated with OTI². Epidural technique allows an incremental dosage, minimizing the risk of sudden hypotension³. However, it was necessary to induce GA. OTI added a hemodynamic stress reflected by a peak elevation in systolic blood pressure which was promptly treated.

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ULTRASOUND-GUIDED SCAPULOCOSTAL SYNDROME INJECTION TECHNIQUE

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Background and aims: Scapulothoracic syndrome causes considerable morbidity but is insufficiently understood condition that causes upper back and shoulder pain & is probably often wrongly diagnosed and treated.

Methods: We describe a case report and technique for using a portable ultrasound scanner and a linear transducer (8-12MHz) (SonoSite Micromaxx SonoSite, Inc. 21919 30th) to guide serratus posterior superior muscle injection. A 43 year old female presented with chronic pain centered under her right upper portion of her scapula. For the ultrasound-guided serratus posterior superior muscle injection the patient was placed in the prone position. The ultrasound transducer was oriented in a transverse orientation at the level of the level of C6-T1 vertebrae. Here the serratus posterior superior muscle attaches to the lower portion of the ligament nuchae and the intervening interspinous ligaments. The muscle fibers run inferiorly and laterally to attach to the 2nd-5th ribs which were identified along with the lateral portion of the serratus posterior superior which is covered by the scapula. Real-time imaging was used to direct a 22G spinal needle into the trigger points of the serratus posterior superior, where solution was injected under direct vision.

Results: The patient's pain symptoms improved significantly allowing a return to work duties. Ultrasound guidance does not expose patients and personnel to radiation, and is readily accessible.

Conclusions: Ultrasound-guided injections have particular applications in the management of Scapulothoracic syndrome. Further studies are needed to prove the efficacy of serratus posterior superior injections in the treatment of chronic pain in Scapulothoracic syndrome.

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ULTRASOUND-GUIDED PRF OF GREATER OCCIPITAL NERVE TECHNIQUE FOR OCCIPITAL NEURALGIA

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Background and aims: Occipital neuralgia is a common cause of headache and is characterised by paroxysmal stabbing pain, dysaesthesia and tenderness along the course of GON. We describe a case report and technique for using a portable ultrasound scanner and a linear transducer (10 MHz) (SonoSite Micromaxx) to guide PRF of greater occipital nerve (GON) for Occipital neuralgia.

Methods: A 42 year old female presented with chronic occipital headache and neck pain for 5 months having pain on her right occipital region radiating to frontal region. Her pain averaged 7 out of 10 (numerical rating scale) and was burning and shooting in character. The patient had a good pain relief with a local anaesthetic plus steroid injection lasting few weeks. For the ultrasound-guided PRF of GON, the patient was placed in the prone position. The ultrasound transducer was oriented in a transverse orientation at the level of the C2 bifid spinous process. Here the GON was identified by moving the probe laterally and identifying GON superficial to obliquus capitis inferior muscle. This approach to GON using bifid C2 spinous process and OCI muscle is a constant anatomical identification mark used for identifying GON. A real time USG approach was used to perform 2 PRF lesions of GON using current voltage 44 Volts and current duration 40 s after stimulation with less than 0.5 V @ 50 HZ.

Results: The patients pain intensity decreased to a 2 out of 10 (numerical rating scale) for 8 weeks. Function improved and the patient was able to do her home work as usual.

Conclusions: Ultrasonography provided real-time, radiologically safe, and reliable method of GON identification. Ultrasound-guided PRF of GON has particular applications in the management of Chronic Occipital Neuralgia.

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INTRACTABLE HICCUPS FOLLOWING ULTRASOUND-GUIDED INTERSCALENE BRACHIAL PLEXUS CATHETER PLACEMENT

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Introduction: It is well-known that the incidence of temporary hemidiaphragmatic paralysis is approximately 100% following interscalene brachial plexus block (ISBPB) due to either spread of local anesthetic to the C3-C5 nerve roots or directly to the phrenic nerve in the anterior scalene fascia. Given the incidence of phrenic nerve paresis and proximity of the phrenic nerve to the brachial plexus, it is unlikely to have intractable hiccups following ISBPB. However we describe a case of intractable hiccups following ultrasound-guided interscalene brachial plexus catheter placement (ISBPC).

Case description: 39 y/o male underwent a right total shoulder revision with ultrasound-guided, nerve stimulator confirmed continuous ISBPC placed in out-of-plane technique and general endotracheal anesthesia. During uncomplicated block placement, there was no diaphragmatic stimulation. A bolus of 30 mL ropivacaine 0.5% with dexamethasone 10 mg was given prior to catheter placement and post-operatively an infusion of ropivacaine 0.2% 10 mL/hr was continued. On POD#1 patient complained of hiccups after resolution of primary block. Patient was treated with thorazine without improvement. The interscalene catheter was removed on POD#2 and the hiccups resolved on the evening of POD #2.

Conclusion: Interscalene block has been used as treatment of hiccups however no case reports have described interscalene catheter placement as a cause of intractable hiccups. Homer et al described intractable hiccups following attempted ISB and suggested direct phrenic nerve irritation as a cause. As the hiccups commenced upon resolution of the primary block, we hypothesize the catheter was contacting the phrenic nerve causing direct irritation leading to hiccups.

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LATE ONSET EPIDURAL HEMATOMA AFTER SPINAL CORD STIMULATOR LEAD PLACEMENT TRIAL

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Introduction: Epidural hematoma is a rare, but known risk factor after any invasive procedure involving the epidural space. We present a case that is unusual with respect to its late onset, delayed surgical treatment, and subsequent complete neurological recovery.

Case: A 65-year-old male with failed back surgery syndrome underwent a spinal cord stimulator lead placement trial. His medications included ASA 80 mg daily and his coagulation studies were normal. Under fluoroscopic guidance, two leads were placed via a paramedian approach with entry points and then advanced to the T8 level. Lead stimulation evoked appropriate sensory paresthesias in the hips, buttocks and legs.

24 hours later, he developed sudden onset back pain, bilateral lower extremity weakness, and was unable to void. He was admitted to an outside hospital and the following morning, the trial leads were removed and an MRI was obtained showing a large thoracolumbar epidural hematoma. Approximately 36 hours after his original procedure, he underwent emergency surgical T7-L2 laminectomy, resulting in a complete neurologic recovery within 24 hours post-operatively.

Discussion: Although there are a handful of case reports of epidural hematoma after spinal cord stimulator placements, to our knowledge, this is the first report associated with a lead placement trial. Additionally, this is the first report describing a delayed onset of 24 hours before clinical presentation of symptoms. And finally, this report is unique in that our patient experienced a complete neurologic recovery, even though the laminectomy was delayed for over 12 hours after initial onset of symptom.

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IATROGENIC EPIDURAL *PSEUDOMONAS AERUGINOSA* INFECTION

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Introduction: Iatrogenic bacterial epidural abscess is a rare but serious complication of neuraxial procedures.

Case: We report a case of a 45-year-old female with advanced left inferior limb melanoma treated by hyperthermic isolated limb perfusion with melphalan who developed neuropathic pain of the limb intractable by standard treatment. A drug delivery system for continuous epidural infusion was implanted under deep sedation and the port was positioned on right upper iliac crest.

The patient was able to be discharged home. It was necessary weekly substitution of the percutaneous needle and a drug infusion balloon (Ropivacaine 1.8mg/ml; perfusion 10ml/h) was used.

At 23th day the patient was re-admitted due to headache, photophobia, meningeal symptoms and fever, (no motor, sensorial or cognitive symptoms). The epidural system was removed. Antibiotic empirical treatment with vancomycin and meropenem was started on the presumption of epidural infection with meningeal irritation/meningitis. Meropenem was changed to ceftriaxone due to skin rash. On 5th day *Pseudomonas aeruginosa* was isolated on catheter and port. Treatment with gentamicin (7days) and ceftazidim (21days) was prescribed.

MRI 5th day: "Thickening of the posterior epidural fat space with dimensions of 9x48mm translating inflammation /infection without signs of abscess and meningeal changes".

Good evolution and home discharge at 22th day with transdermal opioid and adjuvants.

MRI 35th day: "not identified thickening of the epidural space fat or signs of abscess".

Conclusion: Catheter management with rigorous aseptic techniques is very importante in epidural analgesia.

Local infection/epidural infection is a risk, if suspected, dural tap should be delayed as it may promote liquor bacterial spread.

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MULTIMODAL THERAPEUTIC APPROACH OF VAGINISMUS: IS THERE A ROLE FOR CHRONIC PAIN TECHNIQUES?

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Background and aims: Vaginismus affects 1-7% of women worldwide¹. It's defined by an involuntary muscular spasm of the outer third of the vagina, resulting in aversion to penetration.

Methods: We describe the successful contribution of pulsed-mode radio-frequency (PRF) to the therapeutic regimen of a patient diagnosed with this disorder.

Results:

- ♀, 26-years-old, ASA II, referred to the Chronic Pain Unit due to vulvodynia and introital pain that persisted despite pharmacological and psychiatric therapy.
- Initial physical examination revealed the existence of vaginal trigger-points (TP).
- TP infiltration with clonidine and ropivacaine was executed under deep sedation, with posterior vulvodynia improvement. Afterwards, undiagnosed vaginismus and pelvic floor myofascial syndrome overcame.
- On a second phase, bilateral RFP of the pudendal nerve was performed (120 seconds x 2 cycles). During the first month post-procedure, pain declined and her sexual function progressed.

Conclusions: Vaginismus patients require an eclectic effort for achievement of a favorable outcome. Typically it includes relaxation maneuvers, cognitive behavioral therapy and at-home exercises¹.

To the author's knowledge, PRF to vaginismus treatment has not been reported. Literature suggests that through deliverance of an electromagnetic field it transforms nervous function and treats refractory painful conditions. We also chose this invasive technique due to the disease's prolonged course that was deeply affecting the patient's quality of life.

Follow-up is now required to evaluate whether the improvement will be sustained.

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LOW DOSE SPINAL ANESTHESIA IN A PATIENT WITH ARNOLD CHIARI TYPE 1 MALFORMATION

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35 years old, 2G 1A, medical history of Arnold Chiari type 1 malformation (ACM-1), history of idiopathic trigeminal neuralgia, fibromyalgia, 2 herniated discs at C4-5-6 levels and obesity, scheduled for cesarean section. The surgical decision was agreed between obstetric and neurologists to avoid Valsalva maneuvers during labor. On admission, 91 kg, 170 cm height. With the patient in sitting position, a medial approach with 27 gauge Whitacre needle at L₃ - L₄ level, 0.5% hyperbaric bupivacaine 6.5 mg, morphine 100 mcg + fentanyl 25 mcg was administered without evidence of maternal hypotension, achieving an initial sensory level D₄, Bromage 2. A female newborn, 3100g, Apgar 9/10/10, fetal cord blood pH: 7.29 E.B. -1.1 meq/l. At the end of surgery the patient had D₆ sensory level, Bromage 1, without analgesia requirements until one hour after discharge from the recovery room. She was discharged on the fifth day of admission without evidence of neurological symptoms associated.

Discussion: Anesthetic management of this disease is poorly reported in the literature and there is no consensus on which is better, cesarean vs. vaginal delivery, also what type of anesthesia would be the best vs. neuraxial anesthesia[1]^[2]. Some have questioned that the dural puncture could exacerbate neurological symptoms[3]. The multidisciplinary management of this disease

is a cornerstone and the use of spinal anesthesia has proven to be effective and technically secure.

- [1] Semple DA. *Anaesthesia*. 1996;51:580-2.
- [2] Landau R. *Anesth Analg*. 2003;97:253-5.
- [3] Hullander RM. *Anesth Analg*. 1992;75:1025-6.

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MODIFIED WEAVER DUNN PROCEDURE DONE UNDER INTER SCALENE BLOCK IN A PATIENT WITH ONE LUNG

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Background and aims: Patient is a 41 year old male with a background history of RTA 2 years back. He sustained left main bronchus rupture requiring left pneumonectomy, right lung contusion, multiple rib fractures, bilateral scapular fracture and T2-4 fracture which was treated conservatively. He had very poor exercise tolerance as his FEV1 was 44% and VC was 49%. Patient continued to experience pain and had limited movement in the left shoulder for nearly 2 years. Because of his poor lung function tests and being high risk, the patient was advised conservative management. However the patient decided to undergo operation. His recent CT of left shoulder revealed non union of lateral acromion and dislocation of the clavicle.

Methods: Intraoperatively, high interscalene block was performed using ultrasound and stimulating catheter was inserted between C5-6 roots. Ten ml of 2% lignocaine with adrenaline and 10 ml of 0.5% L-bupivacaine was injected and light GA was administered to cover the graft area. Postoperatively an infusion of 0.1% ropivacaine at 5ml/hr was prescribed for 72 hours.

Results: In view of the poor lung function, it was imperative to avoid systemic opioids and extended regional block enabled good post-operative analgesia and recovery without any adverse respiratory complications. The patient was comfortable and made uneventful recovery.

Conclusions: Advances in the field of regional anaesthesia has made it possible to do complicated operations under regional blocks with better outcomes.

References:

- Phrenic nerve-sparing USG interscalene block in a patient with a contra lateral pneumonectomy: *Reg Anesth Pain Med*. 2009 Nov-Dec; 34(6):618.

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A REVIEW OF ACCIDENTAL INTRAVENOUS INJECTIONS OF ROPIVACAINE IN HUMANS

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Background and aims: Severe toxic reactions from the use of local anaesthetics occur every year in institutions with large regional anaesthetic case loads. With the advent of lipid rescue, mortality from convulsions, coma and heart failure has been reduced, but in the age of ultrasound guidance the risk of inadvertent intravenous injections (which carry the highest risk of toxicity) still prevails. We wanted to highlight this issue by presenting a short review of case reports on the subject for the local anaesthetic ropivacaine.

Methods: An exhaustive, cross-referenced Medline search on toxic reactions arising from perineural ropivacaine administration was conducted. Relevant data were extracted from the original case reports.

Results: 15 reports were included (Figure 1). Inadvertent intravenous injections of local anaesthetics is characterized by a rapid rise in plasma levels and easily recognized within minutes.

Conclusions: While some cases seem caused by failed attention, most cases occur completely at random. Aspiration of blood is rarely observed during the block procedure. The type of reaction (if any) is not clearly related to drug dosage or patient characteristics. Interestingly, more than half the cases have occurred at ropivacaine dosages below the internationally accepted maximum allowable drug amount.

Reference	Setting	Patient	Dosage (mg)	Toxic reaction
Korman 1997	Interscalene nerve block	66-y woman	150	CNS, CV
Raeder 1999	Axillary block	Unlisted	400	CNS
Ruetsch 1999	Lumbar plexus block	74-y man	225	CNS, CV
Thong 2000	Misplaced epidural line	1-y boy	Unlisted	None
Müller 2001	Axillary block	65-y man	100	CNS
Petitjeans 2002	Femoral nerve block	25-y man	75	CNS
Gielen 2005	Sciatic nerve block	15-y girl	135	CNS, CV
Huet 2003	Popliteal nerve block	66-y woman	188	CNS, CV
Klein 2003	Sciatic nerve block	76-y woman	160	CNS, CV
Reinikainen 2003	Interscalene nerve block	34-y man	150	CV
Dermedde 2004	Misplaced epidural line	36-y man	300	CNS, CV
Leclerc 2004	Perineal infiltration	68-y woman	188	CNS
Pfeiffer 2004	Misplaced perineural line	84-y woman	380	None
Gnaho 2009	Sacral plexus block	82-y woman	100	CNS, CV
Sonsino 2009	Infraclavicular block	92-y woman	150	CNS, CV

[Published case reports on accidental iv ropivacain]

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AN ESTIMATION OF THE FEATURES AND PRINCIPLES OF LOCAL ANESTHETIC SPREADING DURING SCIATIC NERVE BLOCK

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Background and aims: To study the features of local anesthetic solution spreading during sciatic nerve block, in dependence of the anesthetic solution volume and patient anatomy peculiarities.

Methods: One hundred sixty-nine cases of sciatic nerve blocks, done under ultrasonic visualization control, were analyzed. Sciatic nerve blocks were performed by lidocaine in volumes 30; 25; 20; 15; 12.5; 10; 7.5; 6.5; 5; 4.5 ml. The cross-section area, equal to local anesthetic spreading, was determined; the extension of the anesthetic solution spreading along sciatic nerve was calculated.

Results: The anesthetic agent solution spreads along sciatic nerve in proximal and distal direction, forming a kind of cylinder. The minimum volume of the local anesthetic, which covers sciatic nerve in the whole, is 5 ml. A rare (1.77%) variation of sciatic nerve structure was described, in which tibial and common peroneal nerves develop directly from the branches of sacral plexus.

V, ml 30 (n=29)	L, cm 24,59 (23,25; 25;42)	S, cm2 1,22 (1,18; 1,29)
V, ml 25 (n=16)	L, cm 21,20 (20,16; 23,29)	S, cm2 1,18 (1,07; 1,24)
V, ml 20 (n=9)	L, cm 20,40 (18,18; 20,23)	S, cm2 0,98 (0,96; 1,10)
V, ml 15 (n=12)	L, cm 18,43 (14,85; 20,98)	S, cm2 0,81 (0,71; 1,01)
V, ml 12,5 (n=6)	L, cm 12,82 (11,90; 14,08)	S, cm2 0,78 (0,71; 0,84)
V, ml 10 (n=12)	L, cm 13,52 (12,73; 15,03)	S, cm2 0,74 (0,66; 0,78)
V, ml 7,5 (n=5)	L, cm 13,30 (13,20; 13,50)	S, cm2 0,69 (0,68; 0,70)
V, ml 6,5 (n=5)	L, cm 10,83 (10,79; 10,85)	S, cm2 0,61 (0,60; 0,62)
V, ml 5 (n=9)	L, cm 11,36 (10,41; 13,51)	S, cm2 0,44 (0,37; 0,48)
V, ml 4,5 (n=5)	L, cm 8,49 (6,92; 10,97)	S, cm2 0,53 (0,41; 0,65)

[Values of local anesthetic extension length (L) an]

Conclusions: The decrease of the local anesthetic volume leads to reduction of its spreading distance and cross-section area. Ultrasonic visualization enables to provide for sciatic nerve anatomical peculiarities, which can have an effect on the block quality.

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PROSPECTIVE AUDIT OF TOTAL KNEE REPLACEMENT AT ROYAL INFIRMARY EDINBURGH

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Background and aims: Total knee replacement (TKR) is traditionally managed with either epidural or peripheral-nerve block. More recent literature supports use of local-infiltration analgesia (LIA) as it shortens length-of-stay (LOS). Local practice varies so we wanted to evaluate our practice.

Methods: We prospectively evaluated intraoperative and postoperative care received by patients undergoing primary TKR over 1 month period. Ethical approval was deemed not necessary by our department committee. Data was collected for first 48 hours and included anaesthetic technique, analgesia and LOS.

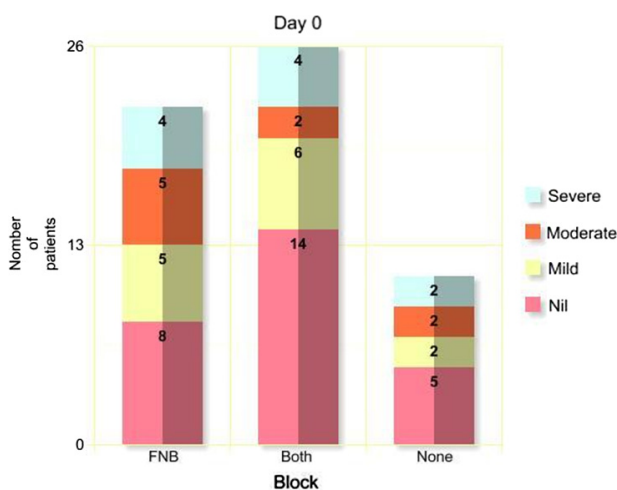
Results: Sixty-six patients underwent TKR during our audit period. Data was collected on fifty-nine patients (90%). Intraoperative care is summarised below.

Anaesthetic	Number of patients	Percentage
Spinal LA	39	66
Spinal LA+opioid	9	15
Femoral nerve block (FNB)	22	37
Femoral-sciatic nerve block (FSNB)	26	44
No block (LIA)	11 (8)	19

[Intraoperative care]

On day of surgery (DOS), patients receiving FSNB seemed more comfortable compared to patients receiving either FNB or LIA (77%vs59%vs64% had nil or mild pain; Fig). This benefit did not continue for subsequent 2 postoperative days. Median LOS was 5 and 4 days respectively for patients getting nerve-blocks compared with LIA.

Conclusions: Our audit suggests FSNB may improve analgesia on DOS while LIA may result in shorter LOS.



[Day 0]

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ROLE OF ELECTRICAL STIMULATION THRESHOLD IN ULTRASOUND-GUIDED SCIATIC NERVE BLOCK USING ROPIVACAINE

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Background and aims: Ultrasound-guided nerve block has become popular, yet we still use nerve stimulation combined with ultrasound image especially for blocks of deeply-located nerves such as the subgluteal sciatic nerve. However, its role in ultrasound-guided sciatic nerve block is not fully understood. Previously, we found that patients given mepivacaine when electrical stimulation threshold was less than 0.5 mA developed faster sensory and motor blocks (1). In this study, we tested the hypothesis that low current stimulation threshold could lead to rapid onset of ultrasound-guided subgluteal sciatic nerve block using ropivacaine.

Methods: After obtaining approval from our IRB, we reviewed three years of records of patients who received ultrasound-guided subgluteal sciatic nerve block using 20 ml ropivacaine 0.5%. We used ultrasound image to place an insulated needle adjacent to the nerve. Next, a nerve stimulator was turned on, and the minimal current producing a motor response was measured, after which anaesthetic solution was injected. Sensory and motor blockade were then assessed for 30 minutes. Patients were divided into low current (< 0.5 mA) and high current groups (> or = 0.5 mA).

Results: The number of those who responded to the low minimal current and the high minimal current was 56 and 45, respectively. The progress of sensory and motor blockade was similar in both groups of patients.

Conclusions: When ultrasound-guided subgluteal sciatic nerve block with ropivacaine was conducted, electrical stimulation threshold did not affect the progress of either sensory or motor blockade.

Reference:

(1) ESRA 2011

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COMPARISON OF TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK USING BUPIVACAINE AND BUPIVACAINE WITH DEXAMETHASONE IN BARIATRIC SURGERY

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Background and aims: In our previous audit, we found that using TAP-blocks with plain bupivacaine will reduce the amount of morphine used. Addition of dexamethasone to bupivacaine has been found to prolong the duration of analgesia. This audit was designed to assess the benefits of the adding dexamethasone in TAP-blocks.

Methods: 30 patients undergoing bariatric surgeries were consented to have TAP-blocks post-operatively. 15 patients had TAP-blocks with 30ml of plain bupivacaine 0.25% with dexamethasone 4mg on each side (TAP-Dex-group) and others had the same without dexamethasone (TAP-group).

Results: Results: Data was analysed using student t-test. There was no significant difference with the demographics of patients in the two groups. TAP-group had longer surgeries (p-value 0.02) and more analgesics intraoperatively. In recovery, their post-operative pain scores were high. But the morphine requirements were significantly higher in TAP-Dex-group (p-value 0.038) and post-operative nausea and vomiting (PONV) followed the trend. Pain scores and morphine requirements in the ward, and the total use of morphine were insignificant between the groups.

Conclusions: Addition of dexamethasone had no effect on the outcome. The increased pain score in TAP-group in recovery correlated with the duration of surgery. Increased need of morphine in the TAP-Dex-group was likely due to surgical complexities and pre-operative chronic pain issues in this group. Increased incidence of PONV and use of anti-emetics in TAP-Dex-group in recovery were associated with high morphine requirements in recovery.

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FOUNDATION TRAINING PROGRAMME ON ULTRASOUND GUIDED PERIPHERAL NERVE BLOCK - A PILOT

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Introduction: Ultrasound imaging requires acquisition of a new set of skills related to device operation and cross-sectional anatomy, which are likely to challenge the novice[1]. Feedback provided to a novice acquiring a new set of skills is an important determinant of learning. Deliberate practice has been described as critical in attaining expertise in motor skills.

Methods: Fifteen beginners in Anaesthesia attended a one-day foundation programme, consisting of didactic teaching on ultrasound, axillary brachial plexus, femoral and popliteal nerve cross-sectional anatomy. This was followed by small group teaching (4:1) with hand-on experience on human models and needle manipulation on gelatine phantoms with real time learner led feedback. All participants were assessed using a validated assessment tool and error list.^{1,2} Quality of the course was evaluated using a questionnaire. The participants were contacted at one month to follow-up on successful nerve blockade in a clinical setting.

Result: All participants completed the programme and attained proficiency in scout scanning using a 37 point check list and hand-eye coordination. All participants gave positive feedback. Suggestions for improvement included a phase 2 course with addition of more procedures. In the follow up from the first batch 4/6 of the participants had successful blocks, all were practicing scanning techniques on self, colleagues and patients.

Conclusion: An intensive training programme with real time learner led feedback and deliberate practice was shown to hasten skill acquisition in novices learning ultrasound guided peripheral nerve block. Follow-up results are pending. Whether this translates into improved clinical performance remains unanswered.

- [1] Sites BD, et al. Characterizing novice behaviour associated with learning ultrasound-guided peripheral regional anesthesia. *Reg Anesth Pain Med.* 2007 Mar-Apr;32(2):107-15.
- [2] Sultan SF, et al. A Clinical assessment tool for ultrasound-guided axillary brachial plexus block. *Acta Anaesthesiol Scand.* 2012 May;56(5):616-23.

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DOES YEARS OF EXPERIENCE IN ANAESTHESIA PREDICT NOVICE TRAINING - CAN YOU TEACH AN OLD DOG NEW TRICKS?

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Introduction: The present training programmes for learning ultrasound (US) guided peripheral nerve block extend over a period of weeks to months and are dependant on availability of patients, trainer and trainees to attain the experience and proficiency level. Our objective was to see the effect of an intense training program on novices of varying years of experience in anaesthesia learning US identification of the brachial plexus.

Methods: Sixteen anaesthetists in our department of varying experience (4 months to 33 years) were identified as being novices in identification of the brachial plexus in the axilla. An intense training program was created. This included 1:1 teaching with hands-on deliberate practice, learner led feedback on a standardized axilla using a 37 point check list. The participants were assessed at 24 hours, > 15 days and after 30 days using a validated clinical assessment tool[i] and an error list[ii].

Results: Fifteen participants completed the study. Correlation was not significant for years of experience in anaesthesia and scores (presented as mean and SD) for the assessment tool at 24 hours 30 (5.7) $r = 0.43$, > 15 days 29 (8.8) $r = 0.02$, 30 days 28 (9.7) $r = 0.19$.

Conclusions: This study suggests that there is no direct correlation between years of experience in anaesthesia and learning or attrition of a new skill.

- [i] Sultan SF, et al. A Clinical assessment tool for ultrasound-guided axillary brachial plexus block. *Acta Anaesthesiol Scand.* 2012 May;56(5):616-23

- [ii] Sites BD, et al. Characterizing novice behaviour associated with learning ultrasound-guided peripheral regional anesthesia. *Reg Anesth Pain Med.* 2007 Mar-Apr;32(2):107-15

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COMPARISON OF CONTINUOUS FEMORAL NERVE BLOCK (CFNB/SA) AND CONTINUOUS FEMORAL NERVE BLOCK WITH MINI-DOSE SPINAL MORPHINE (CFNB/SAMO) FOR POSTOPERATIVE ANALGESIA AFTER TOTAL KNEE ARTHROPLASTY (TKA)

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Background and aims: Reports of satisfactory analgesia with femoral nerve block (FNB) alone are countered by studies that found it to be inadequate. This study was to find the benefit of the additional mini-dose spinal morphine 0.035 mg to continuous FNB for postoperative pain control and to compare their associated side effects after TKA.

Methods: After Institutional Ethics Committee approval, 68 ASA PS I-III patients scheduled for elective unilateral TKA were included in the prospective, randomized controlled study. CFNB was placed in all patients and 20 ml of 0.25% levobupivacaine was administered. Group I (CFNB/SA), Spinal anesthesia (SA) with 2.8 ml levobupivacaine. Group II (CFNB/SAMO), SA with 2.8 ml levobupivacaine plus morphine 0.035 mg. At PACU, pain (VAS 0-10), motor blockade and other adverse effects were recorded. All patients were maintained by continuous infusion of 0.125% levobupivacaine rate 7 ml/hr.

Results: Patient's demographics data and residual motor blockade in each group were not different. There were no significant differences in the VAS scores for the PO1-6hr between the two groups. At PO12-24hr, the VAS scores were significantly lesser in the CFNB/SAMO group compared with the CFNB/SA group. Cumulative tramadol IV requirement for PO48hr were significantly lesser in the CFNB/SAMO group (median = 125 mg, range 50-400 mg) compared with the CFNB/SA group (median = 200 mg, range 50-500 mg) as p -value = 0.008. Patients in both groups had similar incidences of side effect.

Conclusions: The mini-dose intrathecal morphine (0.035 mg) in addition to CFNB was found to be simple, safe and inexpensive. Moreover, it provided the improvement of postoperative pain management after TKA with minimal side effects.

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WRONG SITE NERVE BLOCKS - A DEPARTMENTAL SURVEY AND THE STOP BEFORE YOU BLOCK INITIATIVE IN A DISTRICT GENERAL HOSPITAL IN SCOTLAND

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Background and aims: A UK national initiative to prevent wrong site blocks called Stop Before You Block (SBYB) has been launched in June 2011. Our aim was to find out about experience of wrong site blocks among our theatre personnel, awareness of new initiatives to prevent them and obtain suggestions for preventing wrong site blocks in a District General Hospital.

Methods: A questionnaire with 14 questions was completed by anaesthetic staff - doctors, PA(A)s, ODPs and nurses.

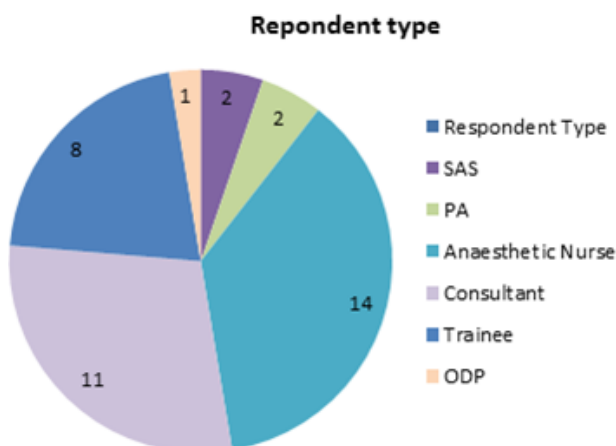
Results: 38 staff responded to the survey. 5 respondents had performed wrong site blocks on sedated patients. 6 others had witnessed wrong site blocks. Of these 6 patients, 2 were sedated, 2 had GA, 1 was awake and 1 had dementia. 4 respondents had prevented a wrong site block. 22 responders didn't know about the SBYB initiative. 41 responders felt a checking procedure should be followed. 1 responder marked her site separate to the surgeon.

Conclusions: We presented our results to the department. We have put up SBYB posters in all 8 theatres. We are encouraging the sign your site approach by anaesthetists performing regional blocks. We are considering a regional block "sticky" to be attached to the anaesthetic chart.

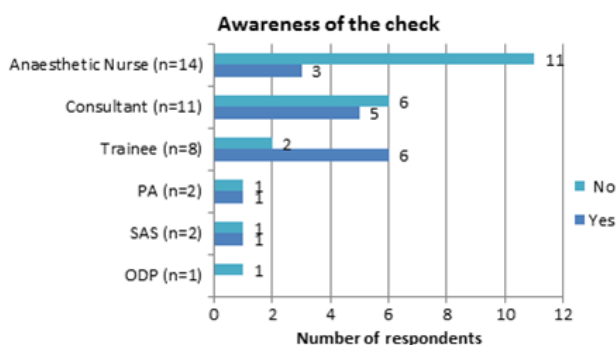
References:

1. Townsley P, Maybin J, French J, Bhandal N, Bedforth N. 'Stop-before-you-block': a national initiative to reduce wrong sided nerve blocks. AAGBI correspondence June 2011.

2. Safe Anaesthesia Liaison Group. Stop Before You Block. 2011.
<http://www.rcoa.ac.uk/index.asp?PageID=1763>.



[Responders]



[Awareness of SBYB initiative]

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BRACHIAL PLEXUS BLOCK - FOLLOW UP OF 940 PATIENTS

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Background and aims: Plastics upper limb surgery (elective and trauma) at Royal Victoria Infirmary is increasingly been done under regional anaesthesia. We have included a post operative telephone follow up as part of the care of these patients and as an audit tool. We present some of the data below.

Methods: Data was collected between October 2008 and November 2011. A performa was filled in by anaesthetist at the time of surgery including the patient details, type of brachial plexus block and quality of anaesthesia and analgesia. The patient then received telephone follow up at 24 - 48 hours to assess overall satisfaction and rule out and complications.

Results: 983 performas were completed, the patients were predominantly ASA I and II (86.5%) with 72% male 28% female. 43 patients were not reachable for follow up. Axillary block was used in 70% of cases. 940 patients were successfully followed up of which 788 (84%) rated the service good to excellent. 857 (93%) would have regional anaesthesia again.

42 patients complained of neurological symptom after the block (4.4%). All of which resolved with out intervention.

Conclusions: Regional anaesthesia for plastics upper limb surgery provides an alternative to general anaesthesia with high patient satisfaction. Follow up of patients post operatively provides valuable feedback and more importantly allows monitoring of complications. 4.4% of patients complained of neurological symptoms. This rate is higher than that quoted in literature (3%) but this group included trauma patients, some with pre existing neurological injury.

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DOCUMENTATION IN REGIONAL ANAESTHESIA; TIME FOR A MODERN SOLUTION?

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Background and aims: Documentation of ultrasound guided regional anaesthesia procedures is badly done, there are few standards of documentation and lack of agreement over descriptive terms of sonoanatomy, needle position and local anaesthetic spread. We wanted to see whether documentation had improved since our audit of 2011.

Methods: A retrospective notes audit of regional anaesthesia procedures for orthopaedics at UCLH was performed for a 1 month period. Descriptive features of consent and block performance were recorded and collated (based on NYSORA Universal Documentation proforma). REC approval was sought and not required.

Results: 36 regional anaesthetics were identified, overall documentation was poor. Of note, only 25% had documentation of negative end point descriptors such as paraesthesia, pain or aspiration of blood. Only 1 had formal description of block testing.

[Database Screenshot]

Conclusions: As a result of this reaudit we have comprehensively reorganised our regional anaesthesia documentation. We have designed a sticker system for the anaesthetic record to simplify and standardise information, along with a Filemaker Pro based audit database. This database can be interfaced with a smart-phone, including recording of still/video imagery. The ongoing audit will be used to retrospectively analyse correlations between block descriptors and subsequent efficacy, along with providing a valuable logbook for revalidation purposes.

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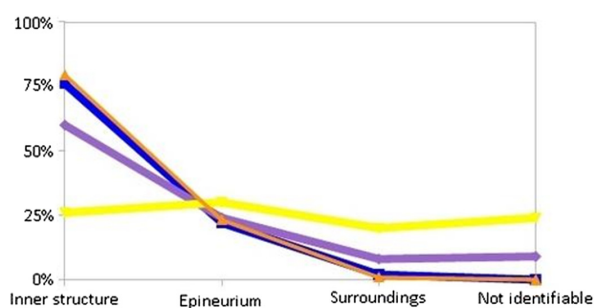
ARE ULTRASONOGRAPHIC DETAILS OF NEURAL STRUCTURES BASED ON STILL PICTURES USABLE FOR TEACHING PURPOSES?

B. Worm, M. Walsted, J. Børglum, K. Jensen Anaesthesia and Intensive Care, University Hospital of Copenhagen: Bispebjerg, Copenhagen, Denmark.

Background and aims: Describing ultrasonographic visibility of neural structures in the learning process is often the preferred method. However, in order to obtain optimal conditions, dynamic visualization might be better. Our aim was to evaluate the visibility of ultrastructures in still-pictures (based on the Vienna Scale) and compare it to a dynamic ultrasound technique

Methods: 112 optimal ultrasonic still pictures (femoral (n=18), infra-clavicular (n=20), lateral femoral cutaneous (n=11), obturator (n=18), sciatic (popliteal, n=16), saphenous (n=14) and interscalene (n=15) were evaluated by two expert and twelve trainee practitioners (according to EFSUMB guidelines) and compare the results to a prospective cohort study using dynamic ultrasound.

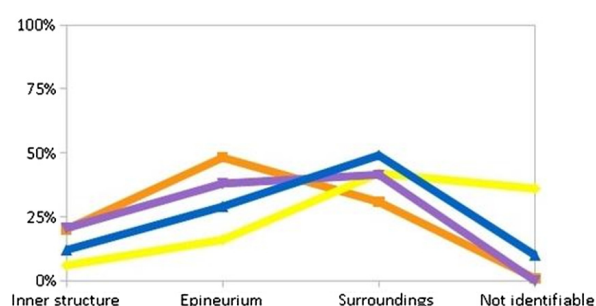
Results: Ultrasonographic recognition of anatomical structures of large/small nerves according to competence level and type of examination. For both experts and trainees, identification of large neural structures significantly improved from static picture recognition to dynamic technique (56% vs 100%, p< 0.0001; 84% vs 99%, p< 0.0001) (Figure 1).



Yellow, trainees observers using picture recognition; orange, trainee observers using dynamic ultrasound; magenta, expert observers using picture recognition; blue, expert observers using dynamic ultrasound. Fisher's exact test used for comparisons.

[Identification of large neural structures]

While the identification of small neural structures exhibited significant differences for trainees (23% vs 60%, $p < 0.0001$), this was not replicated for expert practitioners (42% vs 51%, $p = 0.19$) (Figure 2).



Yellow, trainees observers using picture recognition; orange, trainee observers using dynamic ultrasound; magenta, expert observers using picture recognition; blue, expert observers using dynamic ultrasound. Fisher's exact test used for comparisons.

[Identification of small neural structures]

Conclusions: Trainee practitioners in particular are highly dependent on the dynamic ultrasonographic aspect concerning both small and large neural structures. This may be of future interest, since the current textbooks rely primarily on still pictures.

295 ULTRASONOGRAPHIC DETAILS OF NEURAL STRUCTURES: IS THE VIENNA SCALE IN CLINICAL PRACTICE WORTHWHILE?

B. Worm, M. Walsted, J. Borglum, K. Jensen *Anaesthesia and Intensive Care, University Hospital of Copenhagen: Bispebjerg, Copenhagen, Denmark.*

Background and aims: Describing ultrasonic visibility of neural structures under optimal conditions is often a part of the clinical practice. A scale for ultrasonographic identification of nerves has previously been proposed (Jensen, *Reg Anesth Pain Med* 2011), but our earlier study (Worm, *Reg Anesth Pain Med* 2011) suggested that the clinical applicability of the Vienna Scale (Marhofer 2008) was limited. The present study was done to evaluate if the limitation was due to interobserver variability.

Methods: 112 optimal ultrasonic still pictures (femoral (n=18), infraclavicular (n=20), lateral femoral cutaneous nerve (n=11), obturator (n=18),

sciatic (popliteal, n=16), saphenous (n=14), and interscalene (n=15)) were evaluated by two experts and twelve trainee practitioners (according to EFSUMB criteria).

Results: For trainee practitioners, free-marginal kappa is lower in 7/7 nerves for determination of ultrastructure than for nerve visibility. For expert practitioners, this is only true for 3/7 nerves. The Vienna scale may therefore be inappropriate for trainees, but may have validity in the observation of large nerves for experts. When simply evaluating whether a neural structure was seen or not, kappa values only improve slightly.

	Nerve	Femoral	Infraclavicular	LFCN	Obturator	Poplitea	Saphenous	Interscalene
Trainees	Ultrastructure	0.15	0.15	0.08	0.28	0.31	0.28	0.13
	Nerve visible/not visible	0.25	0.27	0.25	0.50	0.44	0.38	0.33
Experts	Ultrastructure	0.56	0.27	0.15	0.26	0.42	0.05	0.02
	Nerve visible/not visible	0.44	0.40	-0.09	0.11	0.75	0.00	0.33

Free-marginal kappa statistics for each nerve structure evaluated by ultrasound, according to definitions and observer competence (EFSUMB criteria).

[Interobserver variation in nerve identification]

Conclusions: A scale of ultrasonographic visibility of neural structures is not suitable for clinical practice. Both dynamic and optimal view picture evaluation suggest an unacceptably high variability. A scale based on the distribution of local anaesthetics may have greater impact.

296 ULTRASOUND-GUIDED LUMBAR PLEXUS BLOCK: IN-PLANE TECHNOLOGY WITH LONGITUDINAL SCAN VERSUS OUT-OF-PLANE TECHNOLOGY WITH TRANSVERSE SCAN

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Background and aims: Ultrasound guidance has recent been introduced in lumbar plexus block (LPB), but there is some question as to which of two ultrasound techniques, the out-of-plane with longitudinal scan technique or the in-plane with vertical scan technique, can be more safely and effectively used in this procedure. This study tries to resolve this issue by comparing their success rates and incidences of complications when used in LPB.

Methods: Two hundred patients scheduled for total hip replacement received LPB with 30 ml 0.5% ropivacaine at level L3-4 either by in-plane technique with vertical scan (IPT group, n=100) or by out-of-plane technique with longitudinal scan (OPL group, n=100). The performance time, success rates and incidences of associated complications were recorded.

Results: The performance time was shorter in the OPL group than in the IPT group (126.85±50.616s Vs 142.60±52.143s, $P = 0.022$). The success rate was not significantly different in the OPL and IPT groups (97% vs 96%, $P = 0.398$). There was no significant difference in the occurrence of bilateral block between the OPL group and the IPT group (3% Vs 8%, $P = 0.121$). No other serious complications occurred.

Conclusions: Both techniques were equally effective in achieving lumbar plexus block. But sonogram acquisition is easier using out-of-plane technique with longitudinal scan than using in-plane technique with vertical scan.

This study was approved by the Shanghai Jiaotong University Affiliated Sixth People's Hospital Ethical Review Board (Approval No 2012(L)-2).

297 THE COMPARISON BETWEEN SPINAL ANESTHESIA IN SITTING POSITION AND IN LATERAL DECUBITUS POSITION FOR LOWER EXTREMITY VASCULAR SURGERY

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Background and aims: Lower extremity vascular surgeries are high risk procedures even done by experienced vascular surgeons. Employing methods of anesthesia with less hemodynamic changes is of great significance for

these procedures. In this study we compared hemodynamic changes and length of sensory block in spinal anesthesia with hyper bar bupivacaine 0.5% in sitting position and lateral decubitus position.

Methods: Forty patients age 35-70 Y/O were included and divided in two twenty members groups; A and B. In group A spinal anesthesia was done in classic sitting position with 3 milliliter bupivacaine 0.5% hyper bar, and by proper position the sensory level up to T10 was achieved. In group B all patients received the same dose of intrathecal injection in lateral decubitus position and by proper positioning unilateral T10 sensory level were achieved. The size of quinn needle was similar in all cases -25- and all spinal injections were done by first try and barbitaging clear CSF. Closed monitoring was done all during the procedure in both groups.

Results: There were esthetically significant differences between both groups in mean arterial pressure, systolic and diastolic pressure ($P < 0.05$). There were significant differences between two groups in heart rate all during sensory block ($P < 0.05$). Duration of anesthesia was more in lateral decubitus position ($P < 0.05$). fluid administration was more in sitting position ($P < 0.05$).

Conclusions: Hemodynamic changes were significantly less in lateral decubitus spinal anesthesia. Employing this method recommended for lower extremity vascular procedures.

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NEW WAY OF MONOLATERAL SPINAL ANESTHESIA WITH APPLICATION THE ELECTRONEUROSTIMULATOR AT TRAUMA OPERATIONS

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Background: The known method of monolateral spinal anesthesia (MSA). On our proposed new method of MSA, we have received a certificate for priority of invention for NIIP of RK No 0962.1 of 12.09.2011.

The aim of study: To evaluate the effectiveness of the blockade with electroneurostimulation in trauma patients.

Materials and methods: The study was conducted with the permission of the Ethics Committee SMU of Semey city from 01.08.2009. The study was conducted in 55 patients, divided into 2 groups. As I was the control group, 23 patients aged from 33 to 59 years. Men was 27, women 6. In group II had 32 patients, aged from 35 to 57 years. Men were -26, female 6. In the control group for anesthesia used standard needles size 22-25G. In the study group used for special isolated needle for electroneurostimulation "Stimuplex" size 21 G - 4 "and STIMUPLEX-HNS 12. In all patients, puncture of subarachnoid space was carried out with the patient on his side. We used the "heavy" and "easy" solution of bupivacaine.

Results: At the moment of puncture dura received a clear motor response and the subjective sensations of electrical stimulation, which allowed to determine the location of the needle tip relative to the median line. There were no complications.

Conclusions: The proposed method allows the MSA: Improve the quality of the monolateral spinal anesthesia to reduce the search time of subarachnoid space, reduce the number of failures and neurological complications as an early and a late postoperative period.

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SPINAL ANESTHESIA WITH HYPERBARIC PRILOCAINE 2%: THE INCIDENCE OF RESTRICT UNILATERAL BLOCK

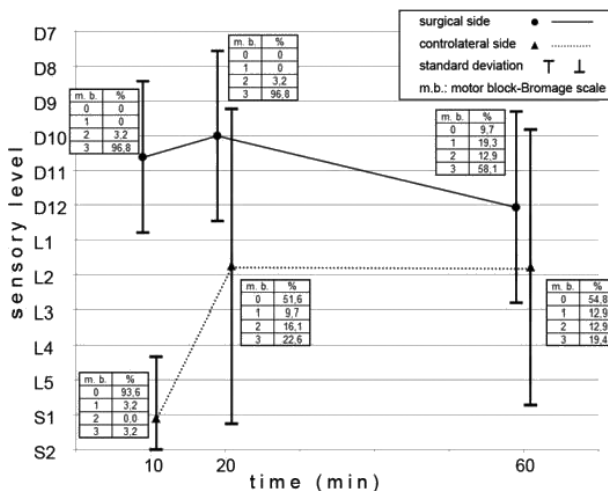
A. Manassero, C. Bailo, C. Liarou, M. Bossolasco, S. Ugues, G. Coletta 'S. Croce e Carle' Hospital, Cuneo, Italy.

Background and aims: Behaviour and characteristics data of spinal anaesthesia with prilocaïne are still now limited. We tested the incidence of restrict unilateral subarachnoid block using hyperbaric prilocaïne 2%.

Methods: This study was approved by the "S. Croce e Carle" Hospital Committee. In a prospective manner, 50 patients undergoing elective unilateral short duration (< 60min) surgery, received subarachnoid anaesthesia at L2L3 interspace in lateral position with the side to be operated on dependent. Needle orifice was turned toward the operative side, no trendelenburg was administered. Hyperbaric prilocaïne 2% (average 29,7 mg/height meter) was injected about in half a minute with the aim to obtain a T10 sensory block in the side to be operated. After 10 min, patients were returned to the supine position. Sensory and motor block levels were checked bilaterally at 10, 20 and 60 min after block placement. The primary endpoint of this study was to

evaluate the incidence of restrict unilateral spinal block defined as not superior L5 sensory block with Bromage scale = 0 in the non operative side at the end of surgery (approximately 60 min after spinal anaesthesia). Secondary endpoint was to evaluate the relationship between the anaesthetic dosage chose and the sensory level reached in the operated side.

Results: Restrict unilateral spinal block decreased from 77% at 10 min to 38% at 20 min and 35% at the end of surgery. Graphic show sensory and motor blocks data at each time point. At 20 min, all spinal blocks were successful for surgery.



[Sensory and motor blocks progression]

Conclusions: 2% hyperbaric prilocaïne spinal anaesthesia performed in lateral position for 10 min, with a mean T10 sensory block level in the operated side, was restrict unilateral in 35% of cases at the end of surgery.

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EPIDURAL ANESTHESIA INCREASES GRAFT PATENCY AFTER FEMORO-DISTAL IN SITU BYPASS. A RETROSPECTIVE STUDY OF 822 PATIENTS

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Background and aims: To examine whether anesthesia affects graft patency after lower extremity arterial in situ bypass surgery.

Methods: Design : Retrospective study using the Danish National database on vascular surgical patients

Setting: A single medical institution

Participants: 822 patients exposed to infrainguinal in situ bypass vascular surgery from January 2000 - September 2010

Interventions: None

Results: Measurements and Main Results : 822 patients (age: GA 70.4/EP 73.4) underwent infrainguinal in situ bypass (n = 885) for lower extremity revascularization in epidural (n = 386) or general anesthesia (n = 499). Co morbidity and 30-day mortality (4%) were comparable in both groups. Graft occlusion within seven days after surgery was reported in 93 patients with similar incidence in epidural and general anesthesia group (10.1% vs. 10.8%). However, for patients exposed to femoro-distal in situ bypass (n=356), epidural anesthesia (n= 145) was associated with reduced incidence of graft occlusion when compared to general (n=211) (9.7% vs. 19.4%, p = 0.012).

Conclusions: This retrospective study indicates that when graft patency is evaluated 7 days after surgery, patients undergoing femoro-distal rather than femoro-popliteal in situ bypass benefits from epidural anesthesia

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INTRATHECAL MAGNESIUM AS ANALGESIC ADJUVANT FOR SPINAL ANESTHESIA: A META-ANALYSIS OF RANDOMIZED TRIALS

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Background and aims: The efficacy and safety of intrathecal magnesium as analgesic adjuvant has been tested by several clinical trials in recent years. We performed a meta-analysis of the available literature.

Methods: Randomized clinical trials comparing a 50 to 100 mg dose of intrathecal magnesium sulfate vs. placebo in addition to an intrathecal local anesthetic and/or opiate for a below-umbilicus procedure were included. MEDLINE, LILACS, Cochrane Library and Google Scholar databases were searched. A random analysis was performed and heterogeneity was tested for. The size of the effect for quantitative outcomes was calculated as standard mean difference (SMD, neutral=0); and as odds ratio (OR, neutral=1) for dichotomous outcomes.

Results: 12 studies totaling 817 patients were included. The Time to first analgesia request was longer when intrathecal magnesium was included in the intervention (SDM 0.94, 95%CI 0.51 to 1.37, $p < 0.001$). The Onset time to sensory block (SDM 0.64, 95%CI 0.15 to 1.12, $p=0.01$) and the Time to maximal motor block (SDM 0.97, 95%CI 0.28 to 1.67, $p=0.006$) were slower with intrathecal magnesium. There was no difference in Time to full motor recovery, incidence of pruritus, postoperative nausea and vomiting, bradycardia, low blood pressure and urinary retention. There were no cases of respiratory depression or neurotoxicity.

Conclusions: The inclusion of 50 to 100 mg of intrathecal magnesium in a spinal anesthetic behaves as an effective and safe analgesic adjuvant.

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NEUROLOGICAL COMPLICATIONS AFTER ANAESTHESIA AND ANALGESIA: A FOLLOW UP OF 47,440 EPIDURALS PERFORMED OVER 16 YEARS

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Background and aims: The reported incidence of permanent neurological complications related to epidurals appears to be low at approximately 0.1 to 1 per 10,000 procedures. Our objective was to find out the incidence of neurological complications, after epidurals at our institute, from an ongoing follow up system.

Methods: Data was collected from April 1996 to April 2012 prospectively following epidural, caudal and combined spinal epidural (CSE) techniques. A standardized form was used in follow-up to identify patients with complications. Local ethical committee approval was sought and exemption given.

Results: A total of 47,440 cases were collected. This consisted of 29,180 epidurals, 9820 CSEs and 8440 caudals. Permanent neurological dysfunction was identified in 7 patients, and sustained transient paralysis (greater than 48 hours) in 2 patients. There were 3 patients with deep peroneal nerve palsies, 3 with Horner's syndrome and 2 with Meralgia paresthetica, with symptoms lasting a few hours to 8 weeks (all obstetric patients). There were 378 dural taps (4 caudals) and 271 developed severe post dural puncture headache. There were 3 epidural haematomas and no infection related complications.

Conclusions: Our results show that the overall incidence of permanent neurological complications after epidural, caudal and CSE were 1 in 6320; more than the quoted figure of 1 in 10,000 based on prospective and retrospective studies. All 4 patients had a progressive recovery of motor function over a period of weeks to months. Unfortunately, spinothalamic sensory impairment and severe spontaneous pain over the affected area persisted in 5 patients.

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CYTOKINE RESPONSE ON SURGICAL STRESS IN SPINAL ANAESTHESIA

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Background and aims: The aim of this study was to assess the effect of spinal anaesthesia on serum concentration of pro-inflammatory and anti-inflammatory cytokines, and cytokines which are secreted by Th1 helper lymphocytes.

Methods: This study involved 20 patients with ASA status I or II who were scheduled for TURP (transurethral resection of the prostate). Peripheral venous blood samples were collected 2 hours before surgery, on the first, third and fifth postoperative days. We are investigate serum concentrations of cytokines: pro-inflammatory cytokines (IL-1 α ; IL-1 β ; IL-2; IFN- γ ; TNF- α ; IL-

6; IL-8; MCP-1; VEGF; EGF) and anti-inflammatory cytokines (IL-4; IL-10) in order to establish differences in patients before and after surgery.

Results: Statistically significant differences were found in serum levels of interleukin-6 (IL-6) in spinal ($p=0.43$) anaesthesia in comparison to preoperative value. Serum concentrations of other pro-inflammatory cytokines, anti-inflammatory cytokines and cytokines which are secreted by Th1 helper lymphocytes showed no statistical difference before and after surgery under spinal anaesthesia.

Conclusions: Spinal anaesthesia attenuates stress response and the associated effect on cellular and humoral immunity. Although these effects may be of minor importance for subjects with normal immune system, immunosuppression to tissue injury may have relevance in patients with preexisting immune dysfunctions.

References:

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Acknowledgment: This work was supported by grants from the Croatian Ministry of Science (projects: 108-0000000-3433).

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REGIONAL ANAESTHESIA PROMOTES EARLY RECOGNITION OF BONE CEMENT IMPLANTATION SYNDROME AFTER HIP ARTHROPLASTY. A RETROSPECTIVE STUDY

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Background and aims: Bone cement implantation syndrome is characterized by hypotension, hypoxemia, cardiac arrhythmias, cardiac arrest complications which may be fatal in 0.6-1% of all cases. Intramedullary hypertension in the femur during the prosthesis placement in patients undergoing cemented hip arthroplasty leads to microemboli formation and venous embolization. Early signs include severe dyspnoea, hypoxaemia, hypotension, dizziness, loss of consciousness which may lead to respiratory or cardiac arrest. General anaesthesia may mask these early symptoms, on the other hand, central blocks like spinal or epidural anaesthesia keep the patient awake and alert and communication with the patient helps early recognition. We investigated a retrospective study involving these cases.

Method: In the period between April 2009 until January 2011, 1036 cases of total hip arthroplasty and hemiarthroplasty and 28 cases of revision were recorded. Patients were aged 81 ± 24 years, 61.2% female and 38.8% male. All of them were performed under regional anaesthesia.

Results: There were 15 cases involving major complications of BCIS, four of them leading to death (3 intra-operatively and one after three-month stay in the ICU). From the rest, 11 cases were treated successfully and 3 involved cardiac arrest which needed resuscitation and performance of ALS algorithm and requested postoperative care with monitoring in the ward. Two cases were associated with severe hypoxemia, which led to cardiorespiratory arrest. In all these cases, early recognition, due to regional anaesthesia, was the key for early resuscitation which was successful in most of them.

Conclusions: Bone cement syndrome may often appear after cement placement in many forms, related to cardiovascular dysfunction and respiratory distress, but its severe complications seemed to appear in a relative low incidence in our hospital with six Orthopaedic Departments. Early suspicion and diagnosis with careful intraoperative monitoring can minimize morbidity and mortality.

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ULTRASOUND-GUIDED QUADRATUS LUMBORUM BLOCK WITH A CURVED PROBE FOR A MORBIDLY OBESE PATIENT

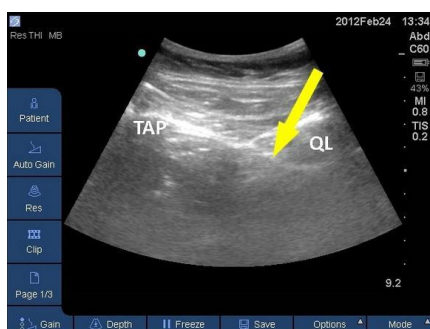
K. Jensen, J. Børglum *Anaesthesia and Intensive Care, University Hospital of Copenhagen: Bispebjerg, Copenhagen, Denmark.*

Background and aims: Pain management after extensive abdominal surgery still remains a challenge in select patient groups when technical difficulties

prohibit epidurals or TAP blocks. Some have argued that sensory nerves to the abdominal wall may be reached close to the quadratus lumborum (QL) muscle.

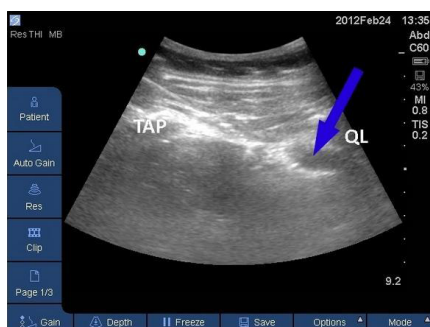
Methods: We present a case of a morbidly obese patient undergoing major laparotomy benefiting from a QL block.

Results: A 59-year old male, BMI 46, underwent emergency laparotomy for a short bowel perforation. After surgery, a VAC system was established across more than half the abdominal wall. An largely ineffective epidural blockade had been placed, and the patient had much pain. A classic and lateral intercostal TAP block were administered on the right hemiabdomen. On the left side however, massive subcutaneous oedema made identification of muscle layers impossible. By ultrasound guidance with a curved high-frequency probe and in-plane technique, 25 ml of ropivacaine 3.75 mg/ml was deposited at the point where the transversus abdominis muscle overlaps the QL muscle, and between this muscle and the perirenal fat. Pain VAS dropped within minutes from 9/10 to 2/10 bilaterally. No side effects were observed. He did not require supplemental opioid analgesics for the next 18 hours.



Yellow arrow, target for local anaesthetic; TAP, transversus abdominis plane; QL, quadratus lumborum muscle

[Ultrasonography before injection]



Blue arrow, deposition of ropivacaine; TAP, transversus abdominis plane; QL, quadratus lumborum muscle

[Ultrasonography after injection]

Conclusions: A QL block may provide excellent postoperative analgesia of the entire hemiabdomen in patients difficult to treat by other means. Although promising, the general usefulness of this block deserves further study.

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CERVICAL EPIDURAL BLOOD PATCH TO TREAT LOW PRESSURE HEADACHE AFTER SPONTANEOUS DURAL TEAR

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Background and aims: A 44 year-old female presented with 22 days of postural headache diplopia, nausea, vomiting, and nuchal rigidity. The head-

ache started without antecedent trauma or any medical procedures. MRI with contrast revealed fluid collection in C3-T3 ventral epidural space with meningeal enhancement in the cervical spine and in the supratentorial meninges. Lumbar puncture remained inconclusive. The diagnosis of spontaneous dural tear and low CSF pressure headache was made.

Methods: Cervical epidural blood patch was performed with contrast confirmation under fluoroscopy guidance at T1-2 level using 9mL of the patient's blood.

Results: The patient noted immediate improvement in her symptoms, and within one hour she was ambulatory. She was discharged home the following day and reported that despite persistence of a mild headache, she was able to resume her usual activities. Her diplopia resolved over the following one month. At the two-month follow-up, her headache was resolved.

Conclusions: Spontaneous dural tear in the cervical region is rarely recognized as a source of debilitating headache. This report adds to the few published cases, documenting the efficacy of the targeted epidural blood patch procedure, which may be the choice of treatment for patients with symptomatic, conservative treatment resistant spontaneous dural tear, even in the cervical region.

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ECOGUIDED EPIDURAL ANALGESIA FOR LABOR IN A PATIENT WITH SPINAL FUSION. A CASE REPORT

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30 yo, 2G 1A, medical history of thoracolumbar scoliosis corrected, gestational anemia and extrapyramidal syndromes after metoclopramide. At 2 cm of cervical dilation, requests analgesia. Physical examination, at back palpation of the spinous processes was impossible, we perform an echo-guided epidural. With the patient in left lateral position, we identified the sacrum and L₅ - S₁ interspace. Using paramedian approach, 18 G Tuohy needle is positioned in the epidural space at the first attempt and the loss of resistance verified with saline under ultrasound view, finally place the epidural catheter. We used bupivacaine 0.125% plus fentanyl 100 mcg, achieving a VAS of 1/10 in approximately 12 minutes. Two others bolus of bupivacaine 0.125% with fentanyl 2 mcg/mL were using at intervals of 120 minutes. A female newborn, 3450 g, Apgar score 9/10/10 and cord gasometry pH 7.28, B.E.: -2.3.

The maneuver of loss of resistance is considered the gold standard for identifying the epidural space, yet, it is a blind technique. In patients with spinal fusion, the incidence failure blocks is 22%[1]. Ultrasound is considered a very useful tool to help locating the epidural space in that kind of patients[2]. There is still no evidence to determine that the ultrasound-guided epidural exceeds the standard technique, indeed, this approach is considered even more difficult, time consuming and cumbersome[3].

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LABOR ANALGESIA IN A PATIENT WITH SPINAL FUSION AND SCOLIOSIS. A CASE REPORT

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28 yo, 1G, request obstetric analgesia at 3 cm of cervical dilation. Medical history severe scoliosis partially corrected with Harrington rods at 16 years. Physical examination 51 kg, 152 cm height, palpable ends of the Harrington rods, scar in the back, spinous processes palpable below the lower end of the instrumentation, deflected to the right of the midline. Due the left convexity of the back we putted epidural analgesia, putting the needle seeing 35° to the left, the space is reached at first attempt, 0.125% bupivacaine 10 mL plus fentanyl 100 µg, VAS 8 to 1/10, at 10 minutes. We placed two others bolus with bupivacaine 0.125% plus fentanyl 2 µg/mL at intervals of 120 min. Once arrived the expulsive period, lidocaine 1% plus Fentanyl 2 µg/mL, a newborn 3260 g, Apgar score 9/10/10, fetal gasometry negative for asphyxia.

Scoliosis is defined as the lateral curvature of the spine[1]. The incidence of scoliosis during pregnancy is relatively rare, and its occurrence from 1 in 1471 to 1 in 12000 pregnant[2] There are multiple reports of effective neuraxial techniques in parturients with scoliosis corrected and uncorrected, the review by Ko et al[3], clearly observed that the incidence of failed and/or inadequate blocks is much higher in patients with scoliosis corrected (22%) than in uncorrected patients (8%).

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THE FIRST CASE OF ANESTHESIA FOR AN AWAKE CRANIOTOMY IN THE HOSPITAL BRAGA

C. Oliveira, C. Gomes, I. Cerqueira, M.J. Pereira Hospital Braga, Braga, Portugal.

Background and aims: The major anesthetic challenge in the awake craniotomy is to provide an adequate sedation and analgesia, with hemodynamic and respiratory control during dormant and awake stages of the surgery¹. We report the first case of anesthesia for an awake craniotomy in the Hospital Braga.

Methods: Male patient, 56 years old, ASA 2, submitted for the removal of fronto-insular tumor. Asleep-awake-asleep technique was performed with intravenous general anesthesia (IGA) and ropivacaine infiltration in the incision zone.

Results: The airway was maintained with the laryngeal flexible wire mask (LM) and the craniotomy was carried out with the patient under IGA. Following the opening of dura mater, the patient woke up after 20 minutes and the LM was removed without incidents. The Aachen Aphasia test was performed to accurately map and remove the lesion. The patient experienced two episodes of absence that were immediately reversed with a cold physiological saline brain irrigation. Following the removal of the tumor the patient was again induced and maintained with IGA and the same LM was placed. After 45 minutes the patient was woken up without incidents.

Conclusions: The technique performed was efficient for the attainment of an awake and cooperative patient. The LM was essential for the permeability of the airway. Part of the success of this procedure is the establishment of a stable relationship between the patient and operating anesthetic and surgical teams. Furthermore, the success of the surgery is achieved by the prompt cooperation shown by the patient.

References: ¹Current Opinion in Anesth. 2009;22:560-5

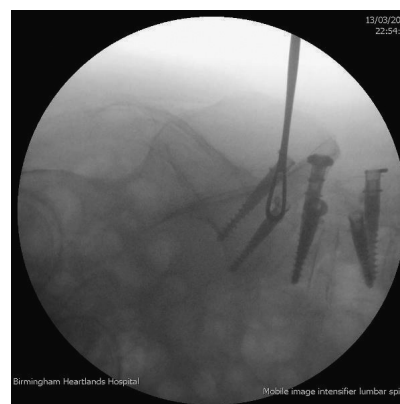
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FLUOROSCOPY GUIDED PLACEMENT OF TECHNICALLY CHALLENGING EPIDURALS AND CENTRAL NEURAXIAL CATHETERS- A CASE STUDY

S.C. Sandys, A. Doger Directorate of Anaesthetics, Heart of England Foundation Trust, Birmingham, UK.

Background: We report the use of fluoroscopy to guide the placement of a cerebrospinal fluid drainage catheter in an individual who had previously undergone surgical fusion of the lumbar spine.

Case: A 71-year-old woman underwent a complex endovascular thoraco-abdominal aortic aneurysm repair. CSF drainage catheters are routinely inserted by the anaesthetist prior to commencing surgery to reduce the risk of spinal cord ischaemia. This was not done peri-operatively as she had undergone a complex lumbar spine fusion. Postoperatively she developed significant bilateral motor and sensory deficit. Several unsuccessful attempts were made by experienced consultant anaesthetists to insert the catheter using traditional landmark techniques. The patient's clinical condition was discussed with spinal surgeons who suggested that a complicated open surgical decompression within ten hours of the symptoms was the only alternative unless a lumbar drain could be urgently placed. The catheter was successfully placed under real time x-ray guidance by a consultant anaesthetist with an interest in chronic pain. CSF was drained and the patient subsequently made a full neurological recovery.



[Fluoroscopy image]

Conclusions: Although fluoroscopy is used by anaesthetists with an interest in pain management, this imaging modality is unfamiliar to most anaesthetists. There is evidence that fluoroscopy can be effectively used to aid the placement of epidural catheters and for epidural blood patches, especially for technically difficult procedures. We believe that the use of fluoroscopy is underutilised and seeking help from colleagues familiar with the technique can improve success rates.

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INTRASPINAL BLOCKADE AFTER STELLATE GANGLION BLOCKADE IN TRAUMA PATIENT

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Background and aims: Stellate ganglion block (SGB) is one of the most often used sympathetic blockade procedure. Despite performed by experienced physicians some complications may occur.

Methods: Fortyfour-years-old female patient who presented with weakness in the right arm, and pain after motor vehicle accident. There was no response to medical treatment. There was loosing of sensation from dis the right elbow joint to fingers on the radial and median nerve tracing. In the electromyography; C5-T1 root avulsion, and MRI; avulsion at right lower brachial plexus was detected. Patient was evaluated as CPRS I (Complex regional pain syndrome) phase 1. In spite of medical treatment, SGB was performed. Respiratory arrest occurred 4-5 minutes after injection. Patient was breated with mechanical ventilator during 2 hours, and discharged 24 hours later with normal vital functions. One year later, the patient admitted the algology polyclinic with strong pain in the same area. Stellate ganglion Radyofrequency (RF)

was planned. The first RF cannula was placed under fluoroscopy. Cerebrospinal fluid was seen in the second cannula, and cannula was withdrawn. Third cannula was placed in another region, and conventional RF was performed through two canals. For anatomical structure defect, we planned cervical MR angiography. In the cervical MR angiography, traumatic pseudomeningocele was observed at the level of C5-T1 on the brachial plexus. Respiratory arrest was thought to develop during blockade of stellate ganglion due to this.

Conclusions: We think the SGB which was performed for the treatment after trauma should be done with imaging methods.

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ULTRASOUND-GUIDED C5 AND C6 NERVE BLOCK AND SUPERFICIAL CERVICAL PLEXUS BLOCK FOR CLAVICULAR SURGERY IN PATIENT WITH SILENT MYOCARDIAL INFARCTION- AN ALTERNATIVE FOR GENERAL ANESTHESIA

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Clavicle surgery has been performed under general anesthesia.

The innervation of the clavicle and the overlying skin varies depending on the source in the literature between C3 and C6. The clavicle itself has been reported to be innervated either by C4, or by C5 and C6. In patient with silent myocardial infarction regional anesthesia may become an alternative for general anesthesia.

We report a case of successful regional anesthesia during clavicular open reduction and internal fixation (ORIF) using a ultrasound-guided C5 and C6 nerve block and superficial cervical plexus block (CPB). A 53-year-old man with silent myocardial infarction undergoing left clavicular ORIF was given preoperatively a superficial CPB according to the classic approach using 10ml of ropivacaine 0.5% and ultrasound-guided C5 and C6 interscalene block using 20ml of ropivacaine 0.5%. The patient did not complain any pain and there were no cardiovascular complications during surgery.

This case demonstrates that a combined cervical plexus and brachial plexus block can provide complete anesthesia during clavicle ORIF.

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ULTRASOUND-GUIDED QUADRI BLOCK FOR OSTEOSYNTHESIS OF SUBTROCHANTERIC FEMORAL FRACTURE

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Background and aims: A 86-year-old patient, 170 cm high, 73 kg weight, fell down in his apartment. He complained of severe pain and in his hip and immobility. Patient had severe aortic stenosis, low left ventricular function (EF 35%), pulmonary hypertension, incipient pneumonia, left-sided fibrothorax, chronic renal insufficiency. Four years ago he underwent cardiac surgery, had four aortocoronary bypasses and simultaneously had carotid revascularization. Two years ago he had spinal cord stroke with consequent left-sided hemiparesis. His laboratory data were: Hgb 111, Htc 0.31, urea 12.4, creatinin 189, PV 0.6, PLT 116. BP was 86/50 mmHg, HR 103/min, SpO2 89%. Because of his status (ASA IV), our goal was to avoid mechanical ventilation, optimize hemodynamic stability and ensure good postoperative analgesia.

Methods: We used ultrasound-guided block of four nerves with high frequency linear probe and in-plane needle guiding technique. With standard approach on femoral nerve we used 15 ml, on sciatic transgluteal approach 18 ml, on lateral femoral cutaneous nerve between sartorius and tensor fasciae lata muscle 7 ml and on proximal block of n. obturatorius 5 ml of local anesthetic.

Results: Surgery started 15 min after performing the block. Total of 45ml local anesthetic mixture (0.5% levobupivacaine with 8mg dexamethasone) was used without additional sedation. Patient was breathing spontaneously and remained hemodynamically stable throughout the surgery.

Conclusions: Motor block lasted for 18 hours and sensory block lasted for 24 hours after the surgery. Patient had excellent postoperative analgesia and did not require additional analgesia during the whole postoperative period.

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THREE LEVEL EPIDURAL BLOOD PATCH TO TREAT LOW PRESSURE HEADACHE

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Background: Epidural blood patch (EBP) has been successfully used to treat both spontaneous and iatrogenic low pressure headache. Spontaneous low pressure headache can be difficult to treat necessitating repeated or multi-level epidural blood patches. Two level (Thoracic-Lumbar) procedures have previously been performed successfully in a few described cases. We describe the first case of a three-level (Cervical-Thoracic-Lumbar) EBP to successfully treat a resistant spontaneous low pressure headache.

Case description: Our patient was an otherwise fit and well fifty seven year old lady who presented with a five-week history of severe sudden-onset headache which was not responding to routine pain killers. She had a past medical history of recurrent sinusitis, mild depression and well-controlled hypertension. The examination showed a typical positional low-pressure headache. MRI investigation of the head and spinal cord showed bilateral hygromas, prominent venous sinuses and diffuse meningeal enhancement and a fluid collection in the soft tissues around C1 (which can be seen in CSF leakage, but doesn't give information about the site of the lesion). The sinuses looked normal.

A lumbar EBP was performed at this stage with no benefit. A week later, an image-guided thoracic EBP resulted in one day of pain relief only.

Then, the decision was made to proceed with a three level EBP which was done by a pain specialist under fluoroscopy.

Result: The three-level EBP led to complete resolution of symptoms immediately which lasted into the follow-up till discharge from the clinic.

Conclusion: Three-level EBP can be used to treat resistant low-pressure headache.

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STATE OF GENERALIZED STATUS EPILEPTICUS IN EMERGENCY FROM GENERAL ANESTHESIA - COMPLICATION OR INCIDENT?

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Background and aims: The occurrence of seizures in emergency from general anesthesia (GA) is a rare event. Some anesthetics may be pro-convulsants¹. We report the occurrence of generalized tonic-clonic (GTC) seizures in emergency from GA.

Case report: 26 year-old male, ASA I, underwent percutaneous nephrolithotomy under GA. Induction with propofol 2 mg/kg, fentanyl 3 mcg / kg, rocuronium 0.6 mg/kg. Maintenance with sevoflurane. Surgery was uneventful. After extubation, develops GTC seizures, recurrent despite therapy: diazepam 10 mg, propofol 50 mg, thiopental 250 mg+125mg, and phenytoin 1 g. The patient was re-intubated and kept on controlled ventilation and sedation with propofol 1.5 mg/kg/h. Initiated sodium valproate - 1g loading dose, infusion 1mg/Kg/h. The exams - ionogram, glycemia, drug abuse, EEG, Head CT, Angio-CT and MRI - were normal. Transferred to Intensive Care Unit, with diagnosis of generalized convulsive status epilepticus. After extubation, EEG and neurological examination were normal. Discharged in third postoperative day, without new episodes, follow-up in Neurology consultation.

Conclusions: Treatment of status epilepticus includes neurological stabilization, airway control, respiratory support, and search for precipitating causes. In this case, exams were negative, pointing to the anesthetic substances as possible triggers. Sevoflurane and propofol both have epileptogenic potential². Possible mechanisms include abrupt changes in the anesthetic agent concentration, hypercapnia and changes in the balance of inhibitory/excitatory neurotransmitters³. Additional studies are needed to understand these mechanisms and prognostic consequences for the patients.

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3. Anesthesia and Analgesia 2008; 107:5;pp.1689-1703

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MEDICATION ERRORS IN ANESTHESIA - CAUSES AND CONSEQUENCES

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Background and aims: Medication errors in anesthesia can have serious consequences and occur despite efforts from providers and institutions. The estimated incidence of these errors in anesthesia is 1 in every 133 cases¹. This communication describes such a case.

Case report: Male, 68 year-old, ASA II, elective repair of Dupuytren's contracture under general anesthesia with LMA. Induction with Propofol 200 mg, fentanyl 100 mcg and maintenance with Sevoflurane. The patient developed bronchospasm and started an IV aminophylline infusion. 3 minutes later develops severe tachycardia and hypertension (HR-180, BP 280/80 mmHg) treated with labetalol 20 mg. An exchange of ampoules (aminophylline by norepinephrine) is recognized, the infusion is stopped, another 10 mg of labetalol are administered. About 5 minutes later occurs cardiac arrest (asystole) with reversal after 3 minutes of ALS. 12-lead ECG and echocardiogram without evidence of ischemia. Initiated dobutamine and norepinephrine infusions, was stabilized, sedated and mechanically ventilated, transferred to PACU. Slight increase of troponin I that subsequently showed a downward trend. No significant clinical events until discharge.

Conclusions: Safety in drug administration is crucial in anesthesia. Proper labeling is essential. Differences among manufacturers and similarities between ampoules containing different drugs contribute to errors². Adoption of standard procedures in preparation, labeling and administration of drugs is a possible measure to reduce these errors³. Their recording and discussion is also important for the development of a safety culture in anaesthesia.

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3. British Journal of Anaesthesia, 2010;105(3):289-296

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CENTRAL NEURAXIAL ANAESTHESIA AND CONTINUOUS EPIDURAL ANALGESIA FOR MAJOR RECONSTRUCTIVE SURGERY AND GIANT THIGH ABSCESS DRAINAGE

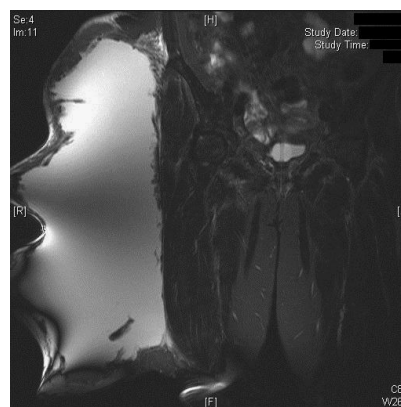
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Case report: We present a case of uncomplicated central neuraxial anaesthesia (CNA) and postoperative continuous epidural analgesia (CEA) for major reconstructive surgery following giant thigh abscess drainage. A 57 year old ASA1 woman developed a persistently swollen thigh following a fall. She developed signs of systemic sepsis and MRI showed an extensive right-sided superficial T11-L3 fluid collection (picture). She was treated with intravenous Meropenem and Vancomycin for four days preoperatively; abscess drainage, extensive debridement and a fasciocutaneous flap were planned. Given the nature of surgery, she was consented for CNA+EA.

Combined spinal-epidural anaesthesia (CSE) was inserted at first attempt. Four litres of pus was drained, necrotic tissues excised and a fasciocutaneous flap completed under uneventful CSE and minimal sedation. CEA provided excellent analgesia for 36 hours, with continuing intravenous antibiotics. Follow-up at 3 months confirmed no complications of CNA/CEA or surgery.

Discussion: Insertion of epidural catheters in patients with sepsis is controversial¹. This case demonstrates that in patients with extensive local infection and recent systemic sepsis, CNA and CEA can be used safely with appropriate antibiotic cover.

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[MRI giant thigh abscess]

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ANESTHETIC MANAGEMENT OF A CESAREAN SECTION IN A PATIENT WITH HYPERTROPHIC CARDIOMYOPATHY: A CASE REPORT

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Hypertrophic cardiomyopathy (HCM) is a genetic cardiac disorder with characteristics of autosomal inheritance and characterised by hypertrophy of the ventricular septum. Eventhough ventricular volume and vascular resistance influence the morbidity of the disease, pregnancy is well tolerated by the patients and vaginal delivery is safely undertaken. However, cesarean section may be performed for cardiac or obstetric indications.

Case report: A 20-yr-old woman, primigravida, in the 34th week of pregnancy with a known diagnosis of HCM, was transferred to our hospital for an elective cesarean section. Because of the diagnosis, epidural anesthesia was planned to perform for her. Before epidural catheterization, electrocardiography, IBP from radial artery, and pulse oximetry were used to determine the hemodynamic status of the patient. Following hydration with Lactated Ringer's solution via a peripheral intravenous catheter, epidural catheter was inserted through an 18-gauge Touhy needle at the L3-L4 interspace, while the patient was in the sitting position. After a 3 ml test dose of Lidocaine, %1, with Epinephrine, total volume of 15 ml Levobupivacaine, %0.5, was given through the catheter over 20 min. A sensory anesthesia upper level of T4 was reached. Intraoperative analgesia was satisfactory, surgery was uneventful. Perioperative maternal hypotension or other complications were not observed.

Conclusion: Epidural anesthesia with invasive monitoring is safely administered in pregnant with non-complicated HCM, who require cesarean section.

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CPNB IN CANCER PAIN. LENGHT OF STAY: TO THE INFINITY... AND BEYOND

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Cancer pain has both nociceptive and neuropathic features, difficult to control. Conventional medical therapies often lead to poor results in terms of quality of life (QoL) and analgesia. In selected cases, the use of regional anesthesia can improve this outcome. Continuous peripheral nerve blocks (CPNB) lend themselves to long-term therapy with few collateral side effects, if properly managed.

A 81 years old patient suffering from axillary lymph node metastases from squamous cell cancer and pain to the left upper limb came to our attention. As palliative, XRay therapy was performed locally; medical therapy with buprenorphine TTS, pregabalin, and ketoprofen was adopted with poor pain control, NRS 8-9. There were presence of lymphedema and inability to perform physical therapy for lymphatic drainage and limb mobilization.

We decided to place a perineural catheter in the left brachial plexus with supraclavicular access, through ultrasound guidance and tunneling. The current treatment was suspended and continuous perineural infusion of levobupivacaine 0.25%, clonidine and dexamethasone was started. With infusion regime, we

registered 0 NRS without the occurrence of side effects, except in certain case of asthenia, xerostomia, and breakthrough pain, treated with ROO opioid and then disappeared.

In 150 days of therapy with CPNB we obtained: improved QoL with optimal control of pain and the ability to move the limb and perform physical therapy, reducing the degree of lymphedema. The catheter requires repositioning after 2 months. No tachyphylaxis, no infection sign. The perineural catheter still continues his work, thus proving to be a good ally in this case control of cancer pain.

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TRANSVERSUS ABDOMINIS PLANE BLOCK (TAP) FOR POST OPERATIVE PAIN RELIEF IN A PATIENT WITH MYOTONIC DYSTROPHY, UNDERGOING LAPAROTOMY

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Background and aims: Myotonic Dystrophy is a chronic multisystem disorder involving skeletal, smooth and cardiac muscles and presents with serious anesthetic problems. We present a 29 years old female with ovarian mass and endometriosis posted for laparotomy.

Methods: On preanaesthetic appraisal she was tall, lean and had cachectic appearance. She had a previous surgery for the correction of scoliosis requiring insertion of a rod in her lumbo-thoracic spine. She had a history of post operative hypoxia and respiratory depression which required artificial ventilation. Her ECG showed AV condition delay. Her ECHO showed trivial tricuspid and mitral regurgitation with preserved left ventricular function. She was too weak to undergo pulmonary function test. She had small mouth and protruding teeth. Her Mallampatti grade was 2. She was given IV induction with Fentanyl and Propofol. Her trachea was intubated with 7.0mm tube after giving Atracurium. 20mg of 0.25% Levobupivacaine was injected bilaterally through a multi hole catheter placed in Transversus abdominis plane inserted through Tuohy needle under ultrasound guidance. Intra operative analgesia included IV Paracetamol 1g, Ketorolac 20mg and Ramifentanyl infusion 3-5ng/ml. Lungs were ventilated with O₂, air and Sevoflurane. Post operatively she was kept in HDU before transfer to the ward after 24 hours. Post operative analgesia included regular IV Paracetamol, PR Diclofenac and TAP block with twice daily top up with Levobupivacaine.

Results: TAP block provided adequate analgesia without the need for opiates.

Conclusions: Continuous TAP block is a safe and effective analgesia in patients with Myotonic Dystrophy undergoing laparotomy.

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SAFETY OF LONG TERM DRUG DELIVERY SYSTEM FOR CONTINUOUS ROPIVACAINE AND MORPHINE EPIDURAL INFUSION FOR CHRONIC CANCER PAIN RELIEF

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Introduction: Chronic cancer pain may remain intractable by standard treatment. Epidural morphine and local anesthetic infusion therapy is adopted for adequate analgesia in patients who have intractable pain.

Case: The authors report a case of a 41-year-old male who was implanted a drug delivery system for continuous epidural infusion (Sitiimplant, Laboratoires Vygon, France); he suffered from chronic pain caused by large rectosigmoid junction adenocarcinoma associated with local invasion and liver metastasis.

Before system implantation a therapeutic response to epidural ropivacaine and morphine was confirmed by temporary epidural catheter. The Sitiimplant was implanted under deep sedation. Due to the presence of a colostomy on the right abdomen, the port was positioned on left upper iliac crest.

After the introduction, the patient was able to be discharged home. It was necessary weekly substitution of percutaneous needle and a drug infusion balloon with PCEA (Ropivacaine 1.65mg/ml; morphine 50ug/ml; perfusion 12ml/h, bolus 2ml) was used. The patient was admitted for control of malignancy symptoms at 6th week post-implantation. He was submitted to palliative radiotherapy at 7th week. The system was effective for 96days until his death from advanced malignancy.

Beside light paresthesia of thighs, no other complications, including infection, happened.

Conclusions: Long-term epidural ropivacaine and morphine infusion provides satisfactory analgesia, few side-effects and a high degree of patient safety, adding mobility, independence and conditions for home discharge.

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EPIDURAL ABSCESS - AN ANESTHETIC NIGHTMARE

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Epidural abscess is a rare but important infection which can expand and compress the central nervous system (CNS), causing severe symptoms, sequelae, or even death.

This case is a description of a post-operative complication that aims to alert to a rare condition with devastating consequences in terms of patient morbidity and mortality.

A 74 year old man with rheumatoid arthritis was admitted for total knee arthroplasty under a regional anaesthesia technique, having no complications during or immediately following the surgery.

At the 5th post-operative day he presents with fever and lumbar pain, near the puncture site, with no other symptoms or neurological deficits associated. After a complete evaluation, the diagnosis of Spinal Epidural Abscess (SEA) was made.

The patient was submitted to medical and surgical treatment, and was discharged six weeks after, fully recovered. Six months after the discharge he continues to have no sequelae.

Although SEA is an uncommon disease, there is some evidence that the incidence may have increased over the last 30 years. Part of this increase may relate to the increase in sensitivity and accuracy of diagnosis by magnetic resonance imaging (MRI) for spinal evaluation and also to the aging of the population.

Thinking of SEA is the key to diagnosis, which must always be considered, especially whenever the patient was submitted to surgery under regional anaesthesia technique. If the appropriate window of opportunity is missed, there can be compromise to the full recovery of the patients and the development of neurological deficits.

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PREGNANCY AFTER EPIDUROSCOPY DUE TO FAILED BACK SURGERY SYNDROME (FBSS): TWO CASES OF SUCCESS!

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Background and aims: Despite advances in surgical technology, FBSS is one of the most common chronic pain syndromes.

Methods: We describe the benefit of epiduroscopy in the handling of two FBSS patients.

Results: - ♀, 33 -years-old, ASA II. Lumbar laminectomy in 2010. Post-operative left sciatic pain,

and

- ♀, 41-years-old, ASA I. Lumbar discectomy in 2008. Post-operative right lumbar sciatic pain.

- Both had lumbar fibrosis on MRIs.

- In both cases, adhesiolysis and injection of a mixture of methylprednisolone + ropivacaine 2mg/ml at L5-S1 level was accomplished under epiduroscopic vigilance.

- The first patient is currently pregnant (1-year post-procedure); the second already delivered her second child (pregnancy at the 7th month follow-up).

Conclusions: Epiduroscopy is a diagnostic and potentially therapeutic procedure that involves looking inside the epidural space. The effect of local steroids and adhesiolysis in reducing nerve inflammation and fibrosis contributes to improved outcomes¹.

Analyzing our patient's cases allows us to state that their post-procedure health improved in parameters such as average pain, mental health and functional status.

During pregnancy, body adaptation to the hormonal milieu impacts the musculoskeletal system. Nonetheless, after epiduroscopy these patients were not only able to stop all the analgesic medication they were prescribed (due to its teratogenicity) but they also didn't present with any new or aggravated pain complaint.

We therefore believe this report highlights epiduroscopy's efficacy in FBSS.

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COMBINED SPINAL/EPIDURAL ANESTHESIA/ANALGESIA FOR ANTERIOR RECTAL RESECTION IN A PATIENT WITH STEINERT DISEASE - CASE REPORT

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Background and aims: Steinert disease is the most common muscular dystrophy of the adult. These patients pose significant challenges to the anesthesiologist, in view of the muscular and extra-muscular involvement and sensitivity to anesthetic drugs, mainly muscle relaxants, hypnotics and opioids, which may result in intraoperative and early postoperative cardiovascular and respiratory complications, and a delayed recovery. Besides, the possibility of developing malignant hyperthermia and myotonic episodes is also present.

Our aim is to emphasize the advantages of locoregional anesthesia/analgesia techniques for abdominal surgery in these patients.

Case-report: We describe the case of a 55 year old female who underwent anterior rectal resection under combined spinal anesthesia /epidural analgesia. The neuroaxial approach was performed at T10-T11. After confirming sensitive/motor blockades, patient was placed on the lithotomy position; a light sedation with propofol was started.

Immediately after surgery beginning, the patient developed respiratory failure and myotonia, making mask ventilation impossible. A laryngeal mask was inserted, and mechanical ventilation under sevoflurane was maintained until end of surgery, which was held uneventfully for 120 minutes; PACU stay was 90 minutes, until full recovery of motor blockade. On first postoperative day, patient experienced respiratory depression, with need of naloxone and sufentanil removal from PCEA bag. She was discharged 6 days after surgery, without further complications.

Conclusions: Despite *Sugammadex*® furor, spinal anesthesia is a safe and less expensive alternative to general anesthesia for abdominal surgery. Opioids should be avoided for postoperative analgesia, even in very low epidural doses.

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AWAKE THORACIC EPIDURAL ANESTHESIA WITH A KYPHOSCOLLIOTIC PATIENT

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Background and aims: Kyphoscoliosis is a disease with vertebral deformities progressive worsening with elderly ages. Difficulties in securing airways restrictive pulmonary diseases, some degradations on cardiopulmonary system and applying regional anaesthesia due to vertebral column deformities, the differences of dissolutions of the local anesthetics, depleted volumes of the cerebrospinal fluid are some of the major problems for the anaesthesiologists. Our aim is to describe the anaesthesia management of a patient with kyphoscoliosis during incisional hernia operation.

Methods: A 67 year-old female patient with severe kyphoscoliosis, having chronic restrictive pulmonary disease and mild cardiac failure. She had Mallampati Score of 4 and limited degree of cervical extension. We applied thoracic epidural anesthesia from the level T5-6, and 50 mg of 0.5% bupivacaine with 50 µg fentanyl was given. A thoracic epidural patient-controlled analgesia infusion of 0.5% bupivacaine (1 mg mL⁻¹) was given 24 hours into the postoperative-period. Arterial blood pressures, heart rate, and peripheral oxygen saturation, pain scores, total analgesic consumption and side effects were also recorded 24 hours-postoperatively.

Results: Enough analgesia was satisfied during the surgery. Bradycardia was occurred at 4th minute of the operation and treated with 0.5 mg of atropine. No other complications were observed. She was discharged on the 5th day, postoperatively.

Conclusions: Awake thoracic epidural anesthesia can be a safe choice providing good quality of anaesthesia and analgesia, and also preventing hemodynamic and respiratory complications for the patients with kyphoscoliosis during intraabdominal surgeries.

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ULTRASOUND-GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN PATIENT WITH FUNCTIONAL UNIVENTRICULAR HEART

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Introduction: Regional Anesthesia in some circumstances can be the best choice. We describe the anesthetic management of a grown-up with functional univentricular heart who underwent fixation of upper extremity fracture.

Case report: 24-yr-old female was scheduled for open reduction internal fixation of left radial head. She had undergone several single-ventricle procedures to achieve Fontan circulation. Since then, she has had a normal activity level. Preoperative assessment showed no signs of pulmonary hypertension or heart failure. Electrocardiogram revealed sinus rhythm and echocardiogram showed normal systolic ventricular function. An ultrasound-guided supraclavicular block was planned and explained to the patient. Prior to surgery, her long-term warfarin therapy was bridged and she received endocarditis prophylaxis. A radial artery was introduced on the right hand. A 22-gauge insulated 70-mm needle attached to a nerve stimulator was introduced using an in-plane technique towards the "corner pocket". In total, 20 ml of local anesthetic was injected to achieve circumferential spread around the brachial plexus. The patient remained stable throughout the procedure and was taken to the recovery room for continued monitoring of her cardiac rhythm. She was discharged home on postoperative day 2.

Discussion: Understanding the unique physiology of Fontan circulation is the key to safe and effective anesthetic management of these patients. The main determinants are systemic venous pressure, pulmonary venous resistance, cardiac rhythm and ventricular function. General anesthesia can disturb any of these factors and, thus, compromise cardiac output. Ultrasound-guided supraclavicular brachial plexus block is an excellent anesthetic choice in patients with such comorbidities.

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POSTOPERATIVE ANALGESIA FOLLOWING LAPAROTOMY AND LARGE INCISIONAL MESH HERNIA REPAIR BY BILATERAL CONTINUOUS SUBCOSTAL TRANSVERSUS ABDOMINIS PLANE BLOCK (TAP) CATHETER INFUSION

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A 43-year-old female, morbidly obese (BMI 57, ASA 3) was scheduled for large incisional mesh hernia repair. She refused epidural analgesia, accepting bilateral transversus abdominis plane (TAP) block with morphine PCA.

Following induction, bilateral subcostal TAP blocks were performed using ultrasonography (low frequency probe - curved array/2-5 MHz) with a blunt needle. 20 mLs Levobupivacaine 0.5% mixed with 75 mcg clonidine was infiltrated on each side.

A laparotomy was required. On finishing, bilateral catheters were inserted into the subcostal TAP, guided by ultrasonography. Continuous dual catheter kit was a Pain Buster (On-Q silver soaker/USA). Infusion rate was 2+2 mLs/hour Levobupivacaine 0.5% via disposable pump (270 ml).

Postoperative pain, measured by VAS, was significantly low from day one to day 4.

No Morphine was required during 2 hour recovery stay, while significantly reduced consumption to day 4 was seen.

Discussion: Postoperative bilateral subcostal continuous TAP block analgesia is a successful alternative to epidural following major open/ laparoscopic abdominal procedures, as a part of a Multimodal Analgesic Technique. It allows early mobilization and rapid recovery, reducing complications. Postoperative morphine consumption is reduced. Thus, respiratory function is improved and hospital stay shorter - an economic benefit. Comparatively, epidurals are technically more difficult in morbidly obese patients, with increased risk of morbidity and mortality.

We highlight the important role of subcostal TAP block catheters for Bariatric surgery. We emphasise the need for ultrasonography to perform blocks and catheter insertion, allowing clear visualization of the abdominal muscle planes, pleura and catheter tip placement.

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CASE REPORT - ANESTHETIC MANAGEMENT FOR CESAREAN SECTION IN A PATIENT WITH AMYOTROPHIC LATERAL SCLEROSIS

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Introduction: Amyotrophic Lateral Sclerosis (ALS) causes progressive degeneration and death of upper and lower motor neurons. Anesthetic management has been controversial and can be challenging. Occurrence in women of reproductive age is exceedingly rare. We describe a case in which epidural anesthesia was successfully performed in an elective cesarean section (CS).

Case report: A 38 year-old parturient with ALS, progressive bulbar palsy and no other relevant medical records was scheduled for a CS at 34 weeks pregnancy. She had dysarthria, dysphagia, fasciculations, muscle weakness, atrophy of upper and lower extremities as well as intercostal and pectoralis muscles. No sensory loss or autonomic dysfunction were detected. Anesthetic management was performed under epidural block with standard monitoring. A total volume of 12ml ropivacaine 0.75% and 5µg sufentanil were administered and a sensitive blockade up to T7 was determined. A healthy female infant was delivered. Procedure lasted 40 minutes and was uneventful except for transient hypotension treated with 10mg ephedrine. Postoperative analgesia: morphine epidural bolus and acetaminophen. Patient was discharged on day 4 post CS without complications.

Conclusions: Respiratory failure represents the main risk of general anesthesia due to abnormal responses to neuromuscular blockers. Although neuraxial anesthesia is not contraindicated, still carries the fear of neurologic exacerbation. However, evidence demonstrates that it seems to be safe. Besides the advantages of neuraxial anesthesia in obstetrics, epidural block in particular was a prudent approach, allowing titration of block height, gradual onset, smaller concentration of local anesthetic in cerebrospinal fluid and good postoperative pain control.

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BURNED UPPER EXTREMITIES (UE) : BILATERAL BRACHIAL PLEXUS OR CERVICAL EPIDURAL BLOCK? CASE REPORT

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Background and aims: Tissues injuries which arise from burns are extremely painful (1). Both anesthesia and postoperative analgesia (POA) must be effective. In burned patients, regional anesthesia is rarely practiced.

Methods: A 38 year-old male had burned his hands and forearms by a high voltage electrical injury which affected muscles, tendons and vascular tissues. At the hospital, he was sent to the operating room for debridement. After an informed consent, under standard monitoring, iatrogenic heavy sedation (50 mg fentanyl plus 8 mg Midazolam) and in the sitting position, he underwent cervical epidural block at C7-T1 level with 15 ml of 1.5% lidocaine, 1:200,000 epinephrine by the Gutierrez's suction drop technique. Under venous and oxygen support, the surgery started and lasted two hours. Haemoglobin saturation decreased from 95% to 89%. After 45 min he aroused and was requested to breathe deeply. It was noticed short weakness of the diaphragm without clinical consequences. Upon arrived at the PACU the patient regained motor functions with predominant paresthesia only at the right UE which lasted up to 40 min.

Results: Although general anesthesia is mostly performed, regional anesthesia offers adequate POA, decreases stress responses and metabolic reactions. However, benefits versus risks with this kind of anesthesia must be evaluated. We opted for cervical epidural because no U.S. apparatus was available. With PNE it would not be possible to obtain precise motor responses.

Conclusions: Regional anesthesia is perfectly feasible when the puncture site allows it.

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CASE REPORT: JUST A SCRATCH? CHRONIC NEUROPATHIC PAIN FOLLOWING PERIPHERAL VENOUS CANNULATION

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We report a case of neuropathic pain in a 42 year old male from routine peripheral venous cannulation for an elective craniotomy and discuss the various mechanisms by which this could occur. The mostly likely trigger in this case study is a combination of phlebitis and local soft tissue infection.

On day 1 of the postoperative period, phlebitis and local cellulitis were diagnosed at the site of insertion of a 20 gauge cannula in the dorsum of the left hand. This cleared with antibiotic therapy, but discomfort remained.

Six months after surgery the patient presented with persistent sudomotor and vasomotor (purplish discoloration, swelling) changes, as well as allodynia to cold temperature and hyperalgesia at the cannula insertion site. Radiological investigations of the hand were normal.

At one year he was referred to the pain management clinic and treated with conventional analgesics, tramadol, gabapentinoids, topical capsaicin, with little benefit.

At four years after the initiating event, pain continued. We then attempted simple superficial radial nerve block using 5 ml of 0.25% levobupivacaine. The patient has now been completely pain free for 3 months.

Neuropathic pain can occur following innocent interventions and deteriorate quality of life. We believe recognition and timely management of acute neuropathic pain may reduce the possibility of developing chronic pain. Our report highlights the need to remain vigilant for this rare complication associated with a very common procedure. It also highlights that occasionally simple interventions can be extremely effective.

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SPINAL ANAESTHESIA IN A PARTURIENT WITH SACRAL NERVE STIMULATOR

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Background and aims: Sacral nerve stimulation is being increasingly used for the treatment of overactive bladder, voiding dysfunction, and urge incontinence and we are starting to encounter women with Spinal cord/sacral nerve stimulators insitu in pregnancy.

Methods: A 32 year old G2P1 parturient who had a full term normal delivery, had to come to theatre for repair of a third degree tear, but medical notes were not available. Past medical history was insignificant except for the sacral nerve stimulator, inserted 18 months ago for voiding dysfunction. The stimulator was switched off during pregnancy. The patient was not fasted and pudendal nerve block was deemed unsuitable as the tear was extending too deep. A transverse scar was noted in the midline at L5/S1 level and in the gluteal region. The X-rays revealed the position of the leads, which were entering at the L5/S1 level, and the impulse generator was positioned in the buttock.

Results: Spinal anaesthesia was administered at L2/L3 level with the patient sitting up and the procedure was completed uneventfully and patient discharged home the next day without any complications.

Conclusions: Spinal anaesthesia is not contraindicated in these patients especially when faced with a parturient with full stomach, but nevertheless precautions need to be taken with regards to reviewing the previous X-rays for the position of the leads, operation notes of insertion of the SCS/SNS. Potential risks include damage to the leads from the spinal or epidural needle or lead migration could have occurred. Ultrasound may be useful, antibiotics are not recommended routinely and monopolar diathermy must be avoided.

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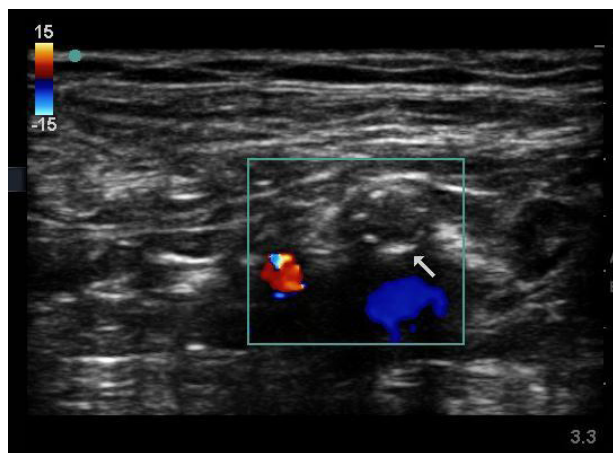
UNUSUAL ULTRASOUND FINDING COMPLICATING PLACEMENT OF A FEMORAL NERVE CATHETER FOR ANALGESIA AFTER KNEE SURGERY

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Introduction: As ultrasound guided regional anesthesia becomes more widely used in clinical practice, we have come to appreciate the extent of anatomic variability, pathology and artifacts that may pose challenges to the clinician with respect to proper image interpretation. We present a case that illustrates these points and led to confusion in properly interpreting the location of the femoral nerve.

Case: A 57-year-old female was scheduled for surgical removal of an infected total knee prosthesis. Her past medical history was complicated by asthma, diabetes, hypertension, and peripheral vascular insufficiency.

In order to provide post-operative analgesia in this patient, an ultrasound-guided continuous femoral nerve catheter placement was planned prior to surgery. During our pre-procedure ultrasound scan of the target area, we were initially unable to visualize the femoral nerve lateral to the patent vascular structures identified via color Doppler flow. Further examination revealed a femoral artery occluded by thrombus, with an unusual sonographic circumferential appearance, which was later determined to be an unknown previously placed metallic stent.



[Image 1]

Discussion: The importance of a pre-procedural scan has been suggested by other authors in the recent literature, as an opportunity to identify unrecognized pathology in the area of the intended peripheral nerve block. In our case, this patient's pathology interfered with our initial attempt to correctly identify the femoral nerve using ultrasound guidance, and highlights the importance of appreciating the anatomic relationship of the femoral nerve to the iliopsoas muscle, rather than focusing primarily on what appears to be the femoral artery.

333 CAUDAL EPIDURAL BLOOD PATCH AFTER ACCIDENTAL DURAL PUNCTURE WITH CAUDAL EPIDURAL

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Introduction: Post dural puncture headache (PDPH) is a very rare complication of caudal epidural. We report two cases which were treated with a caudal epidural blood patch.

Case 1: A 32 year old, morbidly obese primigravida, with a past medical history of L5/S1 posterior interbody fusion. A caudal epidural was performed for labour analgesia as a lumbar epidural was thought to be unsuccessful, with a high risk of PDPH and failure. The epidural space was easily located, but on threading of the catheter, a dural puncture was noted to have occurred. The patient had a normal vaginal delivery but developed a headache on removal of the intrathecal catheter.

A caudal epidural blood patch was performed until back pain was reported. The headache resolved within hours and she made a complete recovery.

Case 2: A 39 year old male underwent a caudal epidural with steroid nerve root injection for treatment of back pain. The procedure was uncomplicated at the time with improvement of his symptoms, however 2 days later, he developed signs of a PDPH. A caudal epidural blood patch was performed with resolution of symptoms within hours and he made a complete recovery.

Conclusion: Caudal epidural blood patch successfully treated both patients with PDPH following a caudal epidural. To our knowledge, there are no other reported cases of successful management of PDPH post caudal epidural with this technique.

334 SPINAL ANALGESIA IN SPINE SURGERY: AN OLD-SCHOOL TECHNIQUE?

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Introduction: Major spine surgery causes severe post-operative pain, hampering recovery. Traditionally, analgesia for this procedures has been performed by endovenous route.

However, spinal analgesia presents intra-operative advantages such as decrease in intraoperative blood loss, consequently improving operating conditions, and decrease in perioperative cardiac ischemic incidents.

Regarding post-operative advantages, it allows reduction of postoperative hypoxic episodes, arterial and venous thrombosis, and provides proper post-operative pain control.

Case report: We report a case of a 74 year-old woman with lumbar degenerative scoliosis submitted to a L4-L5 laminectomy, L5-S1 discectomy and T10-S1 posterior arthrodesis under general anesthesia with a single-tap spinal analgesia with morphine and ropivacaine 0.2%. Post-operative nausea and vomiting prophylaxis was performed. During the procedure the patient maintained a constant hemodynamic stability with reduced blood loss. Post-operatively pain level was reduced (Visual Analogue Scale < 3) as well as analgesic consumption during the first 24 hours. No peri-operatively complications or side effects were registered.

Discussion: According to the literature, use of spinal analgesia diminishes blood loss, maximum blood pressure and heart rate changes, and postoperative analgesic use. In addition, surgeon and patients satisfaction is significantly more with spinal analgesia and anesthesia, when compared with isolated general anesthesia. There is also a low incidence of minor complications associated with the technique.

This case illustrates how the utilization of a simple regional technique allows optimization of surgical conditions and reduction of post-operative pain, without increasing complications, therefore improving post-operative outcome.

335 A CASE OF HARLEQUIN SYNDROME AFTER THORACIC PARAVERTEBRAL BLOCK

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Harlequin Syndrome is a rare syndrome which is occasionally iatrogenic in origin. This case describes the onset of Harlequin Syndrome without Horner's Syndrome following a Thoracic Paravertebral Block in a 40 year old woman administered for pain relief following Laparoscopic Fundoplication. Approximately 60 minutes after the anaesthetic had ended the patient developed a markedly unilateral vasodilation and sweating response on the unblocked side which lasted 6-8 hours in total. The 'Harlequin' appearance is caused by a normal or excessive thermoregulatory and vasodilatory response on the unblocked side with a relative pallor on the normal, unblocked side.

336 LUMBAR PARAVERTEBRAL BLOCK IN CHILDREN... BE AWARE OF URINARY RETENTION

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Background and aims: Paravertebral block (PVB) is considered a reliable and safe approach to achieve analgesia for unilateral surgery. This block is traditionally taught as a blind technique and a single shot or a catheter technique can be used. PVB should avoid some of the major problems associated with epidural anaesthesia, e.g. hypotension, epidural hematoma and urinary retention.

Methods: We report 3 cases of urinary retention in children who underwent unilateral lower extremity orthopaedic surgery under general anaesthesia and lumbar PVB. After induction of general anaesthesia the needle (50 mm 18 G Tuohy) is introduced a patient's fingerbreadth lateral from the lateral margin of the spinous process at the desired level. After bone contact, the needle is walked off the transverse process until a loss of resistance is encountered. After slow injection of 0.3-0.5 ml/kg of local anaesthetic a catheter is introduced and positioned 4 cm beyond the tip of the needle.

Results: Although the block provided good analgesia, postoperatively, a urinary catheter for urinary retention was needed in all of these cases. Placement of this catheter can be a frightening procedure for a child.

Conclusions: This case series illustrates that blind lumbar PVB is associated with urinary retention, plausibly caused by medial epidural spread of local anaesthetic solution through the intervertebral foramina. We advocate the use of ultrasound for better localisation. Also alternative peripheral nerve blocks like lumbar psoas block or fascia iliaca block need to be considered.

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SPONTANEOUS TOTAL HEIGHT RESTORATION OF VERTEBRAL COMPRESSION FRACTURE

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Background and aims: Vertebral compression fractures (VCFs) are primarily caused by osteoporosis. As the population ages, the incidence of VCFs is also likely to increase.[1] The clinical characteristics of VCFs are loss of vertebral height and acute pain. Radiographic images are standardized protocol to diagnose VCFs. The AP and lateral views can reveal changes in vertebral height [2]. However, due to the increased dynamic mobility (DM) of vertebra at the site of fracture, transient spontaneous restoration of vertebral height is also common. Therefore, depending on the posture, acute compression fracture or loss of height may not be visualized on a static image possibly leading to inaccurate diagnosis and treatment. Dynamic mobility of vertebral compression fracture can be measured by comparing standing and supine images. However, there has been limited literature information on the extent and the frequency of this phenomenon. This is a case of acute compression fracture of vertebra with high degree of dynamic mobility and pain treated with kyphoplasty.

Case: Vertebral compression fracture results in vertebral height loss and alters sagittal spinal alignment, which in turn can lead to increased morbidity and mortality. Acute osteoporotic vertebral compression fractures are known to increase mobility and instability of spine. There are limited published data correlating degree of dynamic mobility and efficacy of kyphoplasty on vertebral compression fracture. Here we report a 73-year-old female with severe acute osteoporotic L2 compression fracture who obtained total vertebral height restoration following kyphoplasty with resolution of back pain.

References:

- Shindle MK, Gardner MJ, Koob J, Bukata S, Cabin JA, Lane JM. Vertebral height restoration in osteoporotic compression fractures: kyphoplasty balloon tamp is superior to postural correction alone. *Osteoporos Int* 2006; 17: 1815-9.
- McKiernan F, Jensen R, Faciszewski T. The dynamic mobility of vertebral compression fractures. *J Bone Miner Res* 2003; 18: 24-9.

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EXTENSION OF SPINAL ANAESTHESIA BY EPIDURAL INJECTION OF NORMAL SALINE

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A 35 year old male was given CSE (combined spinal epidural) anaesthesia for reverse sural graft along with skin grafting. Multiple attempts were made for epidural catheterization. During each attempt, 0.9% Normal Saline was used to open up the space, making a total of 18 ml of Normal Saline in the space. Subsequent subarachnoid injection of 2.5 ml bupivacaine (0.5% heavy) lead to the patient's arm going limp and later apnoea for which he required mechanical ventilation with general anaesthesia.

Discussion: The mechanisms postulated to explain this are

- leakage of epidural local anaesthetic into the subarachnoid space,
- the presence of subclinical analgesia as a result of earlier local anaesthetic in the CSF or alternatively,

- it is postulated that the epidural pressure becomes atmospheric due to epidural catheter placement and this results in better spread of local anaesthetic through an effect on circulation and volume of cerebral spinal fluid.

It has also been postulated that prior epidural administration of local anaesthetic may collapse the subarachnoid space below the termination of the cord; hence, a given volume of subarachnoid anaesthetic may spread more extensively. This may be a physical effect independent of the nature of fluid administered.

Conclusion: The administration of a subarachnoid block after prior administration of large volume in epidural space is not safe. This is because the appropriate dose for spinal anaesthesia is not predictable.

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OESOPHAGEAL DOPPLER IN PRONE POSITION

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Introduction: We would like to present a case where Oesophageal Doppler monitoring was used in prone position in a patient with Hypertrophic Obstructive Cardiomyopathy (HOCM) and unprotected cerebral aneurysm with a history of subarachnoid haemorrhage (SAH).

Case: A 43 year old presented with the above history came for a percutaneous nephrolithotomy. We decided to use the Oesophageal Doppler based on NICE guidelines to avoid arrhythmias from central venous lines.¹ Cardiac output monitoring was essential as the blood flow and pressure has to be kept optimal for neuro protection. After the patient was anaesthetised Oesophageal Doppler probe was placed nasally. After prone positioning, the probe was gradually withdrawn until a doppler wave form was obtained.

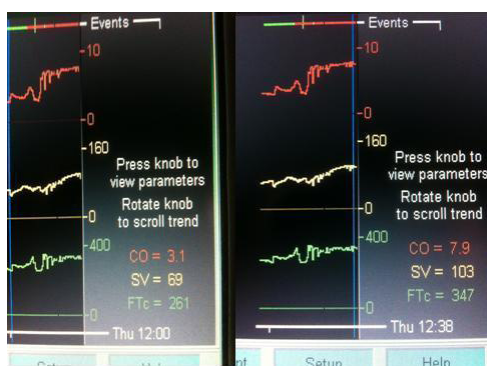


[Prone position]

Fluid boluses were given for optimizing the cardiac output to keep the the mean arterial pressure around 90mm Hg.



[Doppler wave]



[Doppler Graph]

The patient was transferred to high dependency unit (HDU) and discharged from hospital in less than 48 hours.

Discussion: The oesophageal Doppler probe could be used not only in supine but in prone position as well. The usual limitations are interference with diathermy, moving the patient, etc. The benefits of reduced hospital stay and reduced central line related complications outweigh the limitations.

Reference: 1 NICE MTG3 CardioQ-ODM Oesophageal Doppler Monitor: Guidance 11th March 2011

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HYPOTENSIVE ANAESTHESIA AND MONITORING

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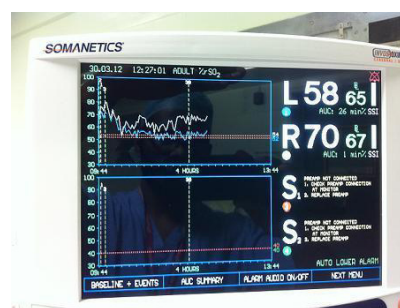
Introduction: Controlled hypotensive anaesthesia is essential to provide a bloodless microscopic surgical field. The common surgeries are middle ear surgery and max fax surgeries. We present a case with use of cerebral oxymetry monitoring.

Case report: A 40 year old female presented for a bimaxillary osteotomy. She is fit and well with no medical problems. Patient consent was obtained. The cerebral oxymetry probes are placed over the forehead when awake.



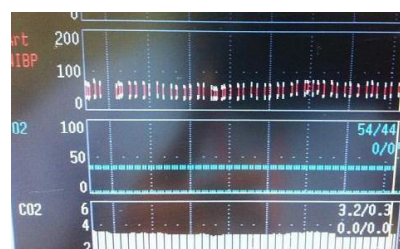
[Cerebral oxymetry probes]

and calibrated for baseline reading for regional oxygen saturation (numerical value between 58 - 82). A fall of less than 20% from baseline or less than 50 is intervention threshold and less than 25% from baseline or less than 40 is critical threshold.



[Cerebral oxymetry monitor]

She had a total intravenous anaesthetic. We aimed her systolic around 70 using pharmacological agents.



[Patient monitor - Arterial blood pressure trend]

If the regional oxygen saturation fell below interventional threshold we intervened to increase regional oxygen saturation by increasing FiO₂, increasing cardiac output and optimising patient position. She made a good post-operative recovery with normal cognitive function.

Discussion: Hypotensive anaesthesia with a morbidity of 3.3% and mortality of 0.2 to 0.6% justifies monitoring.¹ Cerebral oxymetry uses the principle of non-invasive near infrared spectroscopy. Its use is multimodal as a peripheral tissue oxymetry in sepsis, trauma and paediatrics.² Cerebral oxymetry could possibly become a standard monitoring for controlled hypotensive anaesthesia in future.

1. www.rcoa.ac.uk/system/files/CSQ-ARB-section3.pdf
2. <http://www.somanetics.com/clinical-evidence>

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ANAESTHETIC MANAGEMENT OF A PATIENT WITH CEREBELLAR ATAXIA, SCOLIOSIS AND SPINAL SURGERY (HARRINGTON RODS) COMPLICATED BY SEVERE PREECLAMPSIA (HELLP SYNDROME) WITH FETAL GROWTH RETARDATION

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A 36 year old female with cerebellar ataxia and severe lumbothoracic scoliosis presented with uncontrolled hypertension, epistaxis and difficult venous access at 26 week gestation. She had a HELLP syndrome with raised ALT, low platelets count (32) and required stabilization and urgent caesarean section. She had modified RSI with propofol and rocuronium and given a transversus abdominus plane block. She showed significant weakness on emergence, although respiratory function was adequate. The baby weight was 425gm and required further management in SCBU. There was a persistence of raised ALT in postoperative period although platelet count improved to normal levels following surgery.

Discussion:

1. The complex spinal surgery excluded any neuraxial block
2. The presence of Cerebellar ataxia, muscular hypotonia and severe pre-eclampsia lead to a careful choice of anaesthetic and neuromuscular block. In her case, we were able to safely perform RSI without suxamethonium.
3. Attenuation of the hypertensive response to intubation must be achieved in cases of severe pre-eclampsia. The BP control was achieved with MgSO₄, labetalol intravenously and remifentanyl infusion.
4. She also had a difficult venous access. The venous access was gained using ultrasound and then a central line was inserted.
5. The severe thrombocytopenia at her operation raised concerns with increased bleeding tendency. Also performance of TAP block was risky as any concealed bleeding could manifest later on in recovery. She had a normal clotting screen. The surgical team confirmed adequate clotting at her operation and TAP block was performed safely at end of her operation.

342**SYMPTOMATIC HALLUCAL INTERPHALANGEAL SESAMOID BONES TREATED WITH INJECTION UNDER THE ULTRASOUND GUIDANCE: A CASE REPORT**

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Background and aims: Interphalangeal sesamoid bone of the hallux is an uncommon anatomic variant of feet, lying within the tendon of flexor hallucis longus in approximately 27.5% of the population. Even though it often remains asymptomatic, it can cause pain syndromes or degenerative changes in response to undue pressure, overuse and trauma. We report a case of symptomatic hallucal interphalangeal sesamoid bones which are diagnosed and treated after ultrasound-guided injection of local anesthetic and steroid.

Methods: A 29-year-old female patient was referred to our pain clinic with postpartum onset throbbing and crushing pain which started at her both great toes extending to calves. We examined her great toe with ultrasound and found a sesamoid bone at the plantar side of each interphalangeal joint of the hallux under the flexor hallucis longus tendon.

Results: As soon as diagnosed, it was treated by injection of 0.25% chirocaine and triamcinolone 10 mg around the sesamoid bones under the ultrasound guidance. The pain in her great toes and calves was relieved immediately.

Conclusions: If patient suffers from unknown cause of foot pain, through this case we need to consider hallucal interphalangeal sesamoid bones as a possible differential diagnosis. Moreover it can be overlooked on the initial radiographs due to incomplete ossification. Therefore ultrasound -guided injections may be helpful not only for a treatment but also for a diagnosis.

343**REACTIVATED PULMONARY TUBERCULOSIS DETECTED BY ULTRASONOGRAPHY**

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Introduction: The role of ultrasonography in the field of musculoskeletal diseases is increasing. It is easy to apply, noninvasive and is not painful for the patient. We detected reactivated pulmonary tuberculosis with ultrasound in a patient with upper back pain.

Case: A 35 year-old female patient visited our pain clinic with left upper back pain in the 4th and 5th rib area. She complained of discomfort and a mass-like sensation in the upper back with a VAS score of 3-4/10. She was an office worker who had to sit for long hours at the computer. The pain began 10 months ago, and the patient was continuously bothered with a foreign-body sensation that was not affected by position or time of day. Upon physical examination, mild tenderness was observed at the 4,5th rib area, but no visible protrusion was seen. The patient had been diagnosed with pulmonary tuberculosis 2 years ago, which had resolved after taking medication for 6 months. Because a chest x-ray taken 2 months prior to her visit was unremarkable other than old tuberculosis sequela in the left upper lobe our initial impression was myofascial pain syndrome in the rhomboid or trape-

zius. However, upon scanning the upper back area with ultrasonography, a hypoechoic, irregularly shaped, distinct demarcated mass-like lesion was observed, which seemed to be the cause of the patient's foreign-body sensation. We ordered a chest CT scan which revealed reactivated pulmonary tuberculosis. The patient was referred to the department of internal medicine for appropriate management.

Conclusion: Ultrasonography is a good diagnostic tool for musculoskeletal examination, and is also helpful in screening pleural pathologic findings.

344**NEUROLOGICAL DEFICIT IN A PATIENT WITH INTRACTABLE FOOT PAIN AND TETHERED CORD AFTER THE INTRATHECAL PUMP IMPLANTATION. A CASE REPORT**

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Background: Tethered cord syndrome is a developmental abnormality impairing the longitudinal movement of the spinal cord. Surgical treatment may be successful, but failures and significant complications are not uncommon. Patients may choose to refuse the surgery. Some of these patients who are intolerant to oral opiates may be treated with intrathecal therapy.

Method: We report a case of a 53-yr-old female patient with a history of chronic intractable left foot pain and tethered cord syndrome.

She was unable to tolerate oral opiates due to side effects and subsequently underwent a successful intrathecal Hydromorphone trial. During the implantation of the Medtronic intrathecal the patient had a transient right low extremity paresthesia. Post-operatively she developed a progressive right sided L4 radiculopathy. The neurosurgical consultation concluded that her symptoms were related to the spinal catheter worsening the tethered cord syndrome and recommended to explant the pump.

Results: After prolonged deliberations she underwent the untethering of the spinal cord and the removal of the intrathecal pump. Her symptoms improved moderately but the residual neurodeficit persisted.

Conclusion: Based on our experience, interventional pain physicians should be aware of the tethered cord syndrome. The consultation with a neurosurgeon is impertinent since those cases may present a surgical challenge due to the altered anatomy of the spinal cord, which in turn would significantly interfere with the placement of the intrathecal catheter and may potentially cause permanent nerve damage.

345**PARAVERTEBRAL BLOCK FOR DRAINAGE OF AN ABDOMINAL ABSCESS IN A VERY ELDERLY PATIENT**

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Background and aims: A 100 years old woman with a history of hypertension, treated with unknown medication, was presented in sepsis due to a large abscess of the upper lateral abdominal wall. Considering the overall condition of the patient and the duration of surgery a thoracic paravertebral block (T₇-T₁₁) was decided.

Methods: After standard monitoring was applied (NIBP, ECG SPO₂) she was turned to the left lateral position. The spinous processes of T₇ to T₁₁ were identified and the points of needle insertion marked 2.5cm lateral. At this point skin and subcutaneous were infiltrated with 2ml lidocaine 1% in every level. Using a Quinke 22G spinal needle a contact with the transverse process was sought; then the needle was withdrawn and redirected to overpass the transverse process of 1cm. An injection of 5ml ropivacaine 7.5mg/ml was made after careful aspiration. The patient was still feeling pain at the site of incision 20 minutes later, so another 5ml lidocaine 1% was infiltrated and surgery commenced.

Results: She did not complain about any pain or discomfort during the incision, the surgical manipulations of the abscess cavity and irrigation with normal saline (lavage). The overall duration of surgery was 30 minutes and 1gr of paracetamol was given intravenously as well. The first postoperative pain medication was administered 6 hours later.

Conclusions: The paravertebral block is a safe regional anesthesia technique with many indications.

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RADIOLOGIC EVIDENCE OF ACCIDENTAL SUBDURAL INJECTION DURING ATTEMPTED CERVICAL EPIDURAL BLOCK

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Case reports of accidental subdural injection during attempted epidural block have usually described extensive neuraxial blocks with a characteristic radiographic appearance on contrast injection. We experienced a case of cervical subdural injection with unusual clinical findings and radiographic appearance. A 51-year-old female patient with central herniated nucleus pulposus at cervical (C5/6) and lumbar level (L4/5, L5/S1) was referred to the pain clinic. During attempted cervical epidural block at the C6/7 interspace with fluoroscopy, injection of the 4 ml contrast showed posterior spread at cervical level. After cervical epidural steroid injection, the contrast was also confined to the posterior aspect of the spinal canal at lumbar level with fluoroscopy. In order to discriminate subdural space from epidural space, we performed transforaminal epidural injection of the 2 ml contrast at the L5/S1 interspace and we could confirm cervical epidural injection was made into the subdural space. We discuss the clinical characteristics of a subdural injection and the appearance of the cervical and lumbar subduralogram.

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HEADACHE AND UNILATERAL LIMB WEAKNESS AFTER LABOUR EPIDURAL

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Background and aims: Pneumocephalus is a rare but recognised complication of epidural analgesia and has been described extensively in the literature. Its usual presentation is that of severe headache with no focal neurology. We describe a patient presenting with unilateral upper and lower limb weakness secondary to pneumocephalus following an epidural.

Methods: A 28-year-old primigravida was anaesthetised for category two caesarean section. Three unsuccessful attempts at a combined spinal/epidural (CSE) technique were made using a loss-of-resistance to air technique. Thus, caesarean section proceeded under general anaesthesia.

Nine hours later, the patient developed a severe occipital headache with positional features but no focal neurology. A diagnosis of post dural puncture headache was made and an epidural blood patch performed at 36 hours postpartum using a loss-of-resistance to saline technique. The headache improved markedly.

Three days postpartum, the patient developed left upper and lower limb weakness (Medical Research Council grade 4+/5) with associated paraesthesia in a patchy distribution. This was associated with a severe headache, now frontal in nature and non-positional.

Magnetic resonance imaging revealed a small volume of intraventricular air in the frontal horns of the lateral ventricles. The neurosurgeons advised conservative management but the patient's symptoms persisted for several weeks, causing significant distress.

Conclusions: Pneumocephalus should be considered as a differential diagnosis in patients presenting with headache and focal neurology following epidural analgesia. In this patient, performance of an epidural blood patch, the multiple attempts at epidural and use of a loss-of-resistance to air technique are likely contributory factors.

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COMBINED ULTRASOUND NERVE BLOCKS IN CHRONIC PAIN TREATMENT

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Background and aims: Nerve blocks are widely used alone or combined with general anesthesia to decrease postoperative pain. Currently, they are also used in chronic pain management. We describe a clinical report with

simultaneous use of two ecogued blocks (stellate ganglion and paravertebral) for treatment of chronic neuropathic pain.

Methods: Female patient, 38 years, right cervical/brachial/dorsal severe pain (VAS-9) limiting shoulder active/passive mobility and hyperalgesia at C5-C7 and T3-T8 dermatomes, caused by an intense physical effort. Trigger point on the right paravertebral region with cephalic and caudal pain spread. Thoracic-lumbar CT and MRI were normal. EMG showed suprascapular nerve lesion. After 18 months of conventional analgesia, paravertebral block (T8-T9, 5ml 1%lidocaine, clonidine 50µg and dexamethasone 2mg) and stellate ganglion blockade (3ml 1%lidocaine, clonidine 25µg and dexamethasone 2mg) were performed with ultrasound guidance.

Results: Stellate ganglion blockade is indicated for treatment of several conditions including post-traumatic pain. There are several possible approaches. We performed an oblique sub-fascial injection. Paravertebral blockade is effective in benign and malignant neuralgia treatment involving the thoracic and abdominal dermatomes.

Ultrasound presents several advantages over fluoroscopy such as less local anesthetic, greater security with visualization of adjacent structures and needle, and lower incidence of hematoma.

To our knowledge there aren't publish cases using combined paravertebral and stellate ganglion blockade. We used both techniques for diagnosis and pain relieve. Immediate benefit was achieved (VAS-2). No benefits were found at 3weeks follow-up.

Conclusions: Cases of chronic pain unresolved with conventional analgesia, the combination of nerve blocks can be important in multidisciplinary approach.

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HIGH VOLUME SPINAL ANESTHESIA IN A PATIENT WITH RESPIRATORY AND CARDIOLOGICAL DISORDERS FOR EMERGENCY ABDOMINAL SURGERY

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Background and aims: A 78 years old patient with coronary artery disease, pacemaker, severe obstructive and restrictive respiratory disease (FVC and FEV₁, 42% and 43% of the predicted values respectively) and pneumonia, was presented for emergency abdominal surgery (bowel obstruction).

Methods: Due to his co morbidities and the unavailability of an Intensive Care Unit bed, we decided to perform a combined spinal - epidural anesthesia instead of general anesthesia. After standard monitoring (NIBP, ECG SPO₂) was applied and an arterial line was inserted, he was turned to the left lateral position and a combined spinal - epidural (27G and 18G respectively) at the L₄-L₅ space was performed, with 4.2 cc bupivacaine 0.2% plus 25γ fentanyl administered intrathecally. An epidural catheter was inserted as well. The dose of local anesthetic was calculated taking in consideration the patients' height and the required level of spinal block.

Results: Surgery commenced 12 minutes later without pain. The patient was haemodynamically stable. The duration of surgery was 1 hour and it was uneventful. In the post anesthetic care unit the patient was monitored for another hour and then transferred to the department of surgery.

Conclusions: High spinal anesthesia is a valuable alternative for abdominal surgery in high risk patients.

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MIGRATION OF EPIDURAL CATHETER

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Misplacement of epidural catheters carries potentially risk for patients such as analgesic failure, inadvertent spinal block or local anesthetic toxicity.

The aim of an epidural test dose is to avoid the consequences of injecting a local anesthetic either intravascularly, subdurally or intrathecally.

We report the case of a 69 year-old female, presented for anterior resection for rectal cancer which had undergone combined anesthesia.

Epidural catheter was placed atraumatically in the awake patient. A test dose of 3 mL of lidocaine 2% with 1:200000 epinephrine was administered without any change in heart rate or arterial blood pressure and no clinical

signs of subarachnoid injection. After anesthetic induction an epidural bolus of 12 mL ropivacaine 0.75% and sufentanil 5 µg was administered. In a few minutes there was a marked and sustained decrease in blood pressure that did not respond to the usual measures, and a noradrenaline perfusion was administered to maintain blood pressure in acceptable levels. The surgery was not associated with any hemorrhagic event. After anesthetic emergency, the examination revealed a sensory block level T4/5 and a motor block in the lower extremities.

Injecting an epidural test dose and then observing the patient for detection of epidural catheter misplacement was thoroughly described. The efficacy of the classic test dose in achieving this goal remains undetermined.

In the present case, the final position of catheter was never determined with certainty but migration of the catheter to the subarachnoid space is the most likely hypothesis.

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REGIONAL ANAESTHESIA IN PATIENTS WITH IMPLANTED DEEP BRAIN STIMULATORS

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Background and aims: Deep brain stimulators (DBS) are invasive devices used to control the symptoms of Parkinson's disease and other movement disorders, chronic pain and some psychiatric conditions. Poor peri-operative management may lead to significant morbidity in this patient group, however little has been written about regional anaesthetic techniques in patients with a DBS device in-situ.

Methods: A case report describing the management of a patient with advanced Parkinson's Disease and a DBS for elective orthopaedic surgery. This is followed by a literature review and focused discussion on DBS devices and the potential hazards they present to the anaesthetist.

Results: N/A.

Conclusions: DBS devices shall be encountered more frequently in anaesthetic practice as both the clinical indications for their use, and number of centres inserting them worldwide, increase. This review brings together current evidence in an effort to aid in the safe management of this complex group of patients. Large case series describing the management of patients with these devices are not yet available and should be a focus for the future.

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CUTANEOUS CEREBROSPINAL FLUID LEAK ASSOCIATED WITH EPIDURAL TECHNIQUE. WHAT CONCERNS?

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Background: The occurrence of neurocutaneous fistula after epidural anesthesia is extremely rare. It may be responsible for persistent and incapacitating headache and meningitis. The authors describe a case of lumbar cutaneous cerebrospinal fluid leak after the placement of an epidural catheter.

Case report: Parturient, 32 year-old, BMI-27Kg/m², ASA II, admitted for labor analgesia. Epidural catheter inserted in sitting position, with 18G Tuohy needle at L3-L4. Analgesia with ropivacaine 0.2% and 10µg of sufentanil and maintained by continuous infusion at 5ml/h of ropivacaine 0.15% with 0.5 mg/ml of sufentanil. Due to stationary labor, it was decided to perform a cesarean. Epidural anesthesia with ropivacaine 0.75%. Surgery was performed without complications.

Two days after epidural catheter removal, the anesthesiologist was called because the patient noticed a constantly wet region in the lumbar area. On examination it was found drainage of droplets of clear, colorless, odorless liquid through the hole where the skin had been perforated for epidural. Patient had no headache or other neurological complaints.

Considering that it could be a CSF leak, appropriate precautions were taken and appropriate tests were ordered for diagnosis.

Conclusion: In this case, the anesthetist did not suspect that perforation of dura mater had occurred during epidural technique. Doses of local anesthetics and opioids used for analgesia during labor, anesthesia and postoperative analgesia were those recommended for epidural administration and were uneventful. This supports the hypothesis that there would be no previous

perforation of dura mater and it probably occurred during the removal of the epidural catheter.

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ULTRASOUND GUIDED SUPRA-POPLITEAL SCIATIC NERVE CATHETER PLACEMENT AND BLOCKADE IN A PATIENT WITH PERIPHERAL ARTERY DISEASE

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Background and aims: Continuous peripheral nerve blockade can be used as an alternative to intravenous and neuroaxial analgesia in ischemic pain, due to its potential benefits and low complication rate.

Methods: We present the case of a 47 y/o male with peripheral artery disease and ischemic rest pain with a non-healing plantar ulcer of the right lower limb. The patient complained of 7-8/10 subjective pain despite medical treatment, and a previous epidural analgesia with out relief. The patient underwent supra-popliteal sciatic nerve catheter placement and blockade. A previous subarachnoid blockade was performed in order to allow the extension of the right lower limb, using a 25 gauge pencil-tip needle and injecting 1ml of 0.5 Bupivacaine HB, allowing for a sensitive blockade. The patient was placed in the prone position, and the popliteal nerve was identified using ultrasound. A 20ml bolus of 0.375% Levobupivacaine was administered, and subsequently a catheter was introduced and advanced 6cm from the skin, infusing 0.25% Levobupivacaine at a rate of 8ml/hr.

Results: The patient experienced full remission of his pain 4 hrs after the procedure, and during the following 6 days with a subjective pain score of 0-1 at rest and 2-3 with movement. The patient did not experience any side-effects.

Conclusions: The use of ultrasound for the placement of catheters and peripheral nerve blockade provides a better analgesic result by aiding in nerve localization, real-time visualization of the needle-tip, catheter placement and diffusion of the administered local anesthetic.

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UNEXPECTED INTRAOPERATIVE SACRAL POSITIONAL INJURY DURING A 13H40MIN ORTHOPLASTIC SURGERY UNDER EPIDURAL ANAESTHESIA WITH SEDATION, WITH SUBSEQUENT CHANGE IN CLINICAL PRACTICE

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Background: The Nuffield Orthopaedic Centre in Oxford is a tertiary national and international referral centre for major limb reconstructive surgery. Our experience of prolonged orthoplastic cases (up to 14h15min) under central neuraxial anaesthesia with sedation (CNA+Sed) amounts to some 40 procedures in the recent five years including those with free muscle transfer, without serious complications of positional injuries. We now present a 13h40min free flap procedure under CNA+Sed which was unexpectedly complicated by a sacral pressure sore and initiated change in clinical practice.

Case report: A 57-year-old non-obese lady with coeliac disease and hypothyroidism and low risk for pressure sores (Waterlow score 2) underwent excision of tibial osteomyelitis and free gracilis flap reconstruction under epidural anaesthesia and sedation with propofol/ketamine/fentanyl/midazolam. Throughout the 13h40min procedure haemodynamic stability, core temperature and perfusion were well-maintained. Nevertheless, at the end of the operation a small grade 2 sacral pressure sore was noted. It healed with conservative treatment. Despite the complication, the patient was well-satisfied with the hospital care and preferred CNA+Sed to general anaesthesia. Subsequently, we introduced intraoperative pressure-relieving exercise for lower body in addition to previously established "in-flight" exercises for upper body, after 4 hours of procedure in supine positions.

Conclusion: While CNA+Sed offers an added value of protecting patients from upper body positional injuries through preserved communication with the patient, meticulous care to prevent positional injuries below the level of the block is still required. We recommend regular "in-flight" exercises for all patients undergoing prolonged operations, even with low preoperative Waterlow score.

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LESSONS FROM PRE-PROCEDURE ULTRASOUND SCANNING PRIOR TO EPIDURAL INSERTION IN A PATIENT WITH UNANTICIPATED SCOLIOSIS UNDERGOING FREE FLAP SURGERY UNDER EPIDURAL ANAESTHESIA WITH SEDATION

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Background: The Nuffield Orthopaedic Centre in Oxford is a national and international referral centre for major orthoplastic limb surgery. For prolonged (frequently over 10hrs) cases involving free muscle transfer, successful continuous epidural anaesthesia is crucial for optimal perioperative care. When combined with sedation (EA+Sed), this anaesthetic technique particularly relies on successful epidural EA. We present a case where our practice of routine pre-procedure lumbar spine ultrasound scanning proved invaluable.

Case report: A 55 year-old non-obese man was scheduled for excision of tibial osteomyelitis and free gracilis flap reconstruction under EA+Sed, following trauma some 30 yrs ago. Ultrasound examination in sitting position revealed unanticipated significant scoliosis. The trainee anaesthetist, though with limited experience of lumbar spine scanning, was able to identify midline, part of ligamentum flavum/dura complex and estimate needle angulation (approximately 20 degrees to perpendicular due to spine rotation). The first attempt at insertion guided by palpation alone was unsuccessful and caused paraesthesia. The second attempt using the estimated angle of insertion and interspace estimated by ultrasound examination, which differed to that guided by palpation, was successful at the first attempt. The patient underwent successful 7hrs surgery, was comfortable throughout and remarked on the usefulness of the pre-procedure ultrasound scan.

Conclusion: This case demonstrated crucial role of ultrasound scanning prior epidural insertion in a patient with unanticipated spine scoliosis: estimation of needle angulation, depth and best insertion level, as well as reduced insertion attempts and avoidance of paraesthesia. We recommend ultrasound scanning in patients with scoliosis to facilitate uncomplicated EA.

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BONE CEMENT IMPLANTATION SYNDROME DURING TOTAL ELBOW ARTHROPLASTY WITH A PATENT FORAMEN OVALE

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Background: Bone cement implantation syndrome has been reported frequently after total hip arthroplasty with a patent foramen ovale. We report a case of BCIS after total elbow arthroplasty. A 47 y/o obese female with hypertension, rheumatoid arthritis, asthma and undiagnosed patent foramen ovale presented to the OR for left total elbow arthroplasty. She received a supraclavicular block pre-operatively, was taken to the OR and underwent induction of general anesthesia uneventfully. During the cementing process, the patient suddenly developed bradycardia and a precipitous drop in end tidal CO₂. The patient underwent ACLS resuscitation, a TEE was performed, an intra-aortic balloon pump was placed, and the patient was taken to the cardiac catheterization lab. The patient was noted to have multiple peripheral pulmonary emboli and poor cardiac function.

Methods: We examine the effects of methyl methacrylate on patients undergoing total elbow arthroplasty, and highlight the potential physiologic response after cementing. It has been documented on numerous occasions that methyl methacrylate can cause microemboli and cause severe hypotension resulting in fatal myocardial depression. In a patient with a patent foramen ovale, the results can be devastating.

Conclusion: Methyl methacrylate used intraoperatively during total elbow arthroplasty as a routine procedure, but can have fatal results in patients with cardiac defects. It is important to be aware of the immediate and potentially fatal consequences during the cementing. If patients experience cardiovascular collapse, it is imperative that the anesthesiologist understand the physiology of methyl methacrylate, immediately initiate ACLS, and utilize the appropriate hospital resources to treat the BCIS.

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FOREHEAD REGIONAL ANAESTHESIA FOR TUMORECTOMY IN PLASTIC SURGERY

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Background and aims: To describe a case report of a 94 y/o patient which was operated due to a basal cell carcinoma 5x4x2cm and needed resection of the forehead skin from the helix of the one ear to the another and then up 10 cm upper the eyebrows.

Methods: After sedation with 50ug fentanyl she desaturated to 83%. As we saw she was extremely sensitive to opioids due to her elderly, we proposed regional anesthesia for the procedure. The surgeons marked the skin that had to be removed and covered with a skin graft and we took into account its sensitive nerve innervation. Consequently bilateral nerve block of supraorbital, supratrochlear and auriculotemporal nerves had to be performed. With a 28 gauge needle and a 10ml syringe we injected 2ml of a solution of Lidocaine 1% and Levobupivacaine 0.25% in the supraorbital foramen and 2 ml of subcutaneous injection in direction to the root of the nose; in order to block the supraorbital and supratrochlear nerves. With a 25 gauge quinke needle 4ml were injected subcutaneous from the lateral part of the eyebrow to the helix, so sensitive branches of the auriculotemporal nerve were blocked. The regional anesthesia was performed bilaterally and 16ml were used.

Results: The procedure was carried out without incidences in expontaneous ventilation and no necessity of supplementary analgesia.

Conclusions: Regional blocks of the nerves that innervate the head are very important and can help us to avoid general anesthesia in elderly patients who are at high risk if receiving general anesthesia

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BILATERAL TAP BLOCK PRESERVES THE SIGNS OF PERITONEAL IRRITATION

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We report a case of a patient with hemoperitoneum after a laparoscopic cholecystectomy, he had received a bilateral TAP block. He did not complain of pain until 1 hour when he referred abdominal pain and he had signs of

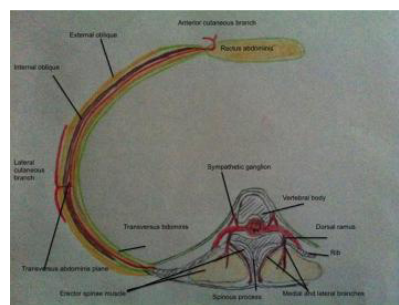


FIG. 1. The abdominal wall muscles and the neural p

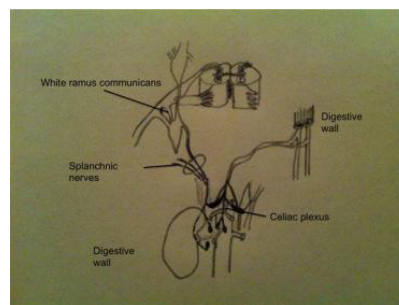


FIG. 2. Sympatyc nervous system or visceral pathway

peritoneal irritation, haemodynamic instability and a falling hemoglobin. An emergency laparotomy was performed finding a hemoperitoneum of 4000cc, loss of the cystic artery clamp.

The abdominal pain is transmitted by two different ways to the central nervous system, cerebrospinal or somatic nerve fibers. (from receptors in the skin and parietal peritoneum), and visceral peritoneum to the dorsal root ganglia, and their central axons project into the spinal cord (figures 1,2).

Materials and methods: We evaluate the chart of a patient who underwent the laparoscopic cholecystectomy on outpatient.

Discussion: Due to the pain pathways in the abdominal cavity the TAP block do not block the sings of peritoneal irritation giving a practical tool for pain management.

Conclusion: The TAP block is used like a part of a scheme for handling POP multimodal analgesia after endoscopic surgery not only reduces pain POP, but increases the quality of the recovery of surgery patients.

Although the majority of trials reviewed suggest superior early pain control, they were unable to definitively identify the surgical procedures, dosing, techniques, and timing that provide optimal analgesia following TAP block. This review suggests that our understanding of the TAP block and its role in contemporary practice remains limited, and the TAP block preserves the signs of complications.

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HIP PAIN SECONDARY TO ACETABULAR LABRUM TEAR FOLLOWING PREGNANCY - A CASE SERIES

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Background and aims: Acetabular labral hip tears are classically reported in sportsmen. There is, however, very little in the literature about this condition occurring following pregnancy. We present seven cases of hip pain secondary to acetabular labral tear after childbirth.

Methods: Seven patients presented to the Pain Service with hip and groin pain at various times following delivery. On clinical suspicion, these patients subsequently underwent magnetic resonance hip arthrograms, leading to diagnoses of acetabular labral tear.

Results: Clear diagnosis and medical treatment of long-standing pain thought to be arising from labral tears is difficult. Conservative treatment is preferable, but this condition can occasionally be corrected by surgery. Two patients have since undergone successful arthroscopic repair of the lesion, with non-surgical treatment instituted for the others. Routine MRI of the hip may not detect subtle tears for which MR arthrography is the most sensitive investigation. Dysplasia and osteoarthritis are known predisposing features, neither of these were present here. It is proposed that increased ligamentous laxity and reduced cartilage collagen during pregnancy besides hyperabduction of hips during lithotomy position for gynaecological examination and vaginal delivery may predispose such patients to this condition. Epidural anaesthesia may further inhibit protection from movement beyond the normal range. This theory needs further investigation.

Conclusions: Acetabular labral tears following pregnancy may cause significant hip pain. This condition is possibly underdiagnosed and is potentially curable. A high index of suspicion ensures early diagnosis and appropriate management. Predisposing risk factors during pregnancy still need further evaluation.

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USE OF 'FAST TRACK' ARTHROPLASTY IN MINIMISING HOSPITAL STAY IN A MORBIDLY OBESE PATIENT (BMI 56.2) REQUIRING MULTIPLE SURGERIES

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Background: A 'fast track' protocol for hip and knee arthroplasty is in use at Wansbeck Hospital, UK. This protocol aims to reduce hospital stay, post-operative complications and recovery time. This approach differs from traditional surgery by establishing multidisciplinary collaboration and patient involvement. It aims for only 1-2 days of hospital stay.

Methods: Protocol is divided in pre, intra and post-op management.

Preoperative: Assessment by nurse, explanation of protocol to the patient with patient involvement, premedication with Gabapentin, Paracetamol +/- Oxycontin.

Intra-operative: Prophylactic antiemetic, tranexamic acid, low dose spinal without intrathecal opioids and Propofol TCI. LA is administered by surgeon locally along with joint catheter attached to infusion pump. Low dose spinal encourages early regression of motor block which enables early mobilisation. No urinary catheters are used routinely.

Post-op: Close monitoring and mobilisation is aimed at 3-5 hours after the surgery.

Results/Case: A 68 year old obese (BMI-56.2, Weight-180.2 Kg) male patient was assessed for hip and knee arthroplasty. With multidisciplinary approach, patient involvement and using fast track protocol, this gentleman had four joints replaced (both hips and both knees) at Wansbeck Hospital, UK.

All four joints were replaced during Aug 2008 to Sept 2009 with hospital stay of one day for each arthroplasty, total hospital stay being only four days.

Conclusions: Benefits of fast track protocol for hip and knee arthroplasty include enhanced recovery, fewer complications, short hospital stay and thus reduction in the costs. It also improves the patient satisfaction and reduces death rates.

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TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK FOR SURGICAL ANAESTHESIA- CASE REPORT

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Background and aims: Ultrasound (US) guided transversus abdominis plane (TAP) block has been used for analgesia but not for surgical anaesthesia. TAP block showed sensory block from L1-T7 in volunteers (1) but not used for surgery. We report its use for inguinal hernia and epigastric hernia repair.

Methods: A 78 year old man presented for left inguinal hernia and epigastric hernia repair. Apart from mild aortic stenosis his examination was unremarkable. The patient was given the options of new innovative regional anaesthetic technique (TAP anaesthesia) or GA. He agreed to regional. A written informed consent was obtained. To cover sensory block at both hernia sites; left side TAP block at iliac crest and bilateral subcostal block was necessary. The backup plan was to supplement with LA and if that failed to give a GA.

An arterial line was inserted in addition to standard monitoring. Under aseptic precautions US guided leftsided inguinal TAP block and bilateral subcostal block were performed and 20ml of 1% Ropivacaine and 2 % Lignocaine injected respectively. Sensory block attained after 30 min. Discomfort noticed on pulling the hernial sac, required 6ml of 0.5% bupivacaine infiltration, otherwise surgery was uneventful. The patient was monitored for impending LA toxicity overnight. His ECG was normal and stay was uneventful. Single study reported that TAP block reached toxicity levels without any neurotoxic symptoms. (2)

Conclusion: TAP anaesthesia block has a role in surgical anaesthesia but toxicity is concern. Hence more studies are necessary.

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I AM TELLING THE TRUTH, THE WHOLE TRUTH AND NOTHING BUT THE TRUTH: AN UNFORESEEN CASE OF DEEP VEIN THROMBOSIS

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Introduction: Venous Thromboembolism is a well publicised health topic, yet despite current risk recognition and prevention strategies, we will infrequently encounter an unexpected and unavoidable case.

Case description: A 58-year-old fit and healthy gentleman of normal BMI was seen in an orthopaedic outpatient clinic regarding a long-standing history

of bilateral knee pain. A clinical diagnosis of right patellofemoral osteoarthritis was made and a knee arthroscopy was subsequently scheduled. During the preoperative assessment, he stated that he previously had two similar uneventful procedures under general anaesthetic. Nonetheless, under the individual's request, this operation was performed under local anaesthetic; a tourniquet was not used during the procedure and he was discharged the same day. On the forth postoperative day, he attended clinic with a tender, swollen and warm right calf, which was later confirmed as deep vein thrombus. A root cause analysis found that despite not having any medical or surgical risk factors for a VTE, he confessed to being on a short-haul flight and multiple coach journeys only hours prior to the operation. He decided not to disclose this important information to members of staff either on the day of pre-assessment and on the day of surgery.

Discussion: This case illustrates that prevention of VTEs should not be limited solely towards their known risk factors. Furthermore, it reiterates the fact that patients with recent air travel should be considered under threat from getting blood clots. Nurses at present do not ask the leading question on travel before or after surgery.

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TOTAL SPINAL ANAESTHESIA AFTER LUMBAR PLEXUS BLOCK. CASE REPORT

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Case: 68 years old female, 72 kg, 162 cm, ASA III, with essential hypertension and ischaemic heart disease (myocardial infarction two years earlier; coronary stent). Scheduled for right cemented total hip arthroplasty. Requested general anaesthesia and additional regional blockade in form of posterior lumbar plexus block. After intravenous induction with midazolam, fentanyl and propofol airway was supported with laryngeal mask and anaesthesia maintained with isoflurane in oxygen & air mixture. Spontaneous respiration was established. Psoas compartment block was performed using 100 mm insulated needle with direct current nerve stimulation. The quadriceps femoris muscle contractions were elicited with the current reduced to 0.2 mA. 30 ml of 0.5% levobupivacaine was injected. There was a loss of twitch during injection but motor response returned upon aspiration every 5 ml injected. As soon as injection was completed patient became apnoeic, developed bilateral mydriasis and hypotension, which was treated with the 0.5 mg aliquots of metaraminol (4 mg in total). Spontaneous respiration returned before the surgery was completed, 2 hours after the block had been performed. The patient was alert and fully aware in recovery. Sensory block level was at the 3rd thoracic dermatome, motor block remained profound, Bromage 3.

Conclusions: Total spinal anaesthesia following lumbar plexus block is a recognized and probably under-reported complication. Motor response at 0.2 mA during nerve stimulation may be indicative of the needle being inside the spinal nerve sheath. The return of muscle contractions during injection of local anaesthetic suggests maldistribution of the drug.

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USE OF SUBARACHNOID OPIOIDS MIXTURE AS ANALGESIA OPTION IN VERY EARLY STAGES OF LABOR. A CASE REPORT

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A 42 yo 1G after IVF, scheduled at 41wks + 5 days for induction. At admission BISHOP of 0 with prostaglandin gel 1, with irregular uterine contractions the patient requests analgesia. 62 kg, 163 cm height, very

anxious, complaining of pain in the perineal region. We initiate analgesia with subarachnoid opioids, CSE analgesia with 25 mg of 3% hyperbaric meperidine 5 ml, fentanyl 25 mcg and morphine 70 mcg, leaving the epidural catheter for posterior analgesic management, achieving VAS 1/10. Dexamethasone 4 mg and ondansetron 8 mg IV where placed. Pass 5 hours she had nausea and vomiting, treated with metoclopramide 10 mg IV. Labor continues with VAS 3/10 for already 8 hours when is decided C Section for dystocia. Epidural plain 1.8 % lidocaine total volume 20 ml, reaching sensory level of D4, Bromage of II. The Surgery is performed without eventualities. A healthy female newborn of 3030 g, Apgar 9/10/10, cord blood gases pH 7.18, EB: -3. She didn't required analgesia until 140 minutes of PACU discharge.

The morphine doses differ between populations. The controversy is with the dose to be administered by the incidence of side effects[1]^[2], it appears that 100 mcg or less produce the same analgesia as 500 mcg with lower incidence of adverse effects[3]. Meperidine has been used successfully for labor analgesia dose from 10 mg[4].

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ANAESTHETIC MANAGEMENT OF A PATIENT WITH OPITZ SYNDROME PRESENTING WITH CHRONIC RENAL FAILURE AND SUBGLOTTIC STENOSIS

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A 22 year male patient diagnosed with Opitz Fria syndrome since childhood presented for continuous Ambulatory peritoneal catheter insertion (CAPD), omentectomy and arteriovenous graft on the left upper limb (previously failed arteriovenous fistula). The patient was diagnosed to have chronic renal failure for which he was on continuous venovenous haemofiltration. The Patient's other clinical problems were renal agenesis, dysmorphic features, polydactyl, empty sella on growth hormone and testosterone replacement. Previously, the patient had undergone airway evaluation and was diagnosed with bifid epiglottis and subglottic stenosis. The CT scan imaging confirmed the subglottic tracheal diameter of 4.5 mm. One week prior to admission for surgery, the patient was admitted to the ICU with lower lobe pneumonia for which he was on noninvasive ventilation.

As we had anticipated problems with airway management, the patient was prepared for an alternative anaesthetic technique. The surgeons decided to perform both the procedures in the same setting. The patient was dialysed on the previous day and premedication was administered on the morning of surgery. An ultrasound guided transverse abdominal plane (TAP) block was performed using 30 ml of 0.2% ropivacaine for the CAPD catheter insertion and omentectomy. For the arteriovenous graft we administered ultrasound guided supraclavicular block with 20 ml of 0.2% ropivacaine. The surgery lasted for 175 minutes, and the patient was comfortable throughout the procedure. We sent questionnaires to Anesthesiologists, both nationally and internationally seeking their views on managing this case in which we came across interesting comments and suggestions.

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ANAESTHETIC MANAGEMENT FOR CAESAREAN SECTION IN PATIENT WITH CORONARY ARTERY DISSECTION

S. Solaidhanasekaran, P. Balaji *Anaesthetics, Hull Royal Infirmary, Hull, UK.*

Background and aims: The incidence of myocardial infarction is rare during pregnancy which is 7.5 in 100000 deliveries. But the mortality rate is very high(37%). It is a great challenge to anaesthetise the women with ongoing ischemic heart disease for Caesarean section.

Methods: 26 year old fit and well female who developed sudden angina associated with 'T wave' inversion in lead 2,3 and aVF in ECG and raised troponin level. Her angiogram showed dissection of marginal coronary artery (OM3) which was not amenable to PCI. She was started on Aspirin, Clopidogril, Bisoprolol and ACEinhibitor. In spite of medical management, She had intermittent angina. Elective caesarean section planned for breech

presentation. We performed Combined Spinal Epidural (CSE) (needle-through-needle technique) using 18G tuohy needle at L3/L4 space. We gave 1.5mls of 0.5% isobaric bupivacaine and 300 micrograms of diamorphine in spinal. Phenylephrine infusion titrated to maintain the blood pressure. The block was T10 for Pain. We topped-up the epidural using 0.5% bupivacaine titrated with the level of block. We achieved the block level of T4 for pain with 4mls of 0.5% bupivacaine.

Results: Patient was haemodynamically stable and felt comfortable throughout the surgical procedure.

Conclusions: Rapid reduction of blood pressure and SVR which are associated with spinal anaesthetic is detrimental to maintain myocardial perfusion especially in a pregnant women with ischemic heart disease. We avoided these detrimental effects by giving lower dose in spinal and increased the level of block via epidural catheter in a controlled manner, along with the infusion of Phenylephrine.

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CASE REPORT: A SELECTIVE SENSORY ULTRASOUND-GUIDED BLOCK OF THE ULNAR NERVE

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Background/aims: A female patient in her sixties sustained a left 5th CMCJ (Carpo metacarpal joint) fracture dislocation. Despite a closed reduction and K-wiring, a marked rotation deformity persisted, causing functional impairment, including preventing the patient from playing the violin. A de-rotation osteotomy of the metacarpal at the mid-shaft was proposed. To accurately assess the rotation of the finger intra-operatively, it is best if the patient can flex her fingers herself. A sensory block of the dorsal/ulnar skin is required, with the motor supply to the long flexors intact.

Method: In order to achieve anaesthesia that allowed flexion, a block of the ulnar nerve prior to the division of the dorsal branch was required. This ensured that the motor supply to the medial portion of Flexor Digitorum Profundus was not blocked, as this arises from the ulna nerve around the elbow.

A Sonosite S-Nerve ultrasound with a 13-6 MHz probe was used to identify the division of the dorsal branch of the ulnar nerve in the forearm. An in-plane technique was then used to infiltrate 7mls 0.25% L. Bupivacaine around the Ulnar nerve, 1cm proximal to this division.

Results: The surgery was performed without the need for supplemental anaesthesia and the patient was able to flex her fingers during the procedure to ensure adequate correction of the rotational deformity.

Conclusions: This case illustrates selective sensory blockade of the ulnar nerve using ultrasound. It allowed assessment of hand function intra-operatively which would not have been possible with other anaesthetic techniques.

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ACUTE PSYCHOSIS FOLLOWING THE INJECTION OF A PARTICULATE STEROID FOR LUMBAR FACET INJECTION

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Background: We describe a case of acute psychosis following injection of 120mg Depomedrone. Acute mental disorders including psychotic behaviour are a recognised side effect of systemic steroids. However, particulate steroids have not been previously described to cause such side effects.

Case description: Our patient, a 41 year old lady presented to the outpatient department with chronic back pain. She was referred by orthopaedic surgeons and suffered from right sided facet joint arthropathy evident on MRI. Her past medical history was unremarkable otherwise. She underwent a diagnostic median branch block to the lumbar facet joints with local anaesthetic and 120mg Depomedrone.

Three days later, she was admitted to the hospital with an acute psychotic episode and suicidal thoughts. Primary investigation including a brain CT-Scan and routine bloods were unremarkable. She was treated with Olanzapine and discharged home three days later with psychiatric follow up. She made full recovery after two months.

Conclusion: Particulate steroids can still show behavioural side effects of systemic steroids.

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AMPUTATION OF LOWER LIMB IN CRITICALLY ILL PATIENT USING VERY LOW DOSE ROPIVACAINE

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Background: Anaesthesia induction in patients suffering from severe cardiovascular and pulmonary failure remains challenging, due to their extreme haemodynamic instability that complicates general anaesthesia.

Case report: A 75 years old patient was referred to our hospital, following gangrene of right lower extremity, in order to undergo lower to the knee amputation. His medical history included smoking of 120pack/years with accompanying severe chronic obstructive pulmonary disease, while severe angiopathy due to diabetes mellitus had been previously recorded. He had also undergone His spirometry measurements were: FVC= 1,83 lit (58% predicted), FEV1= 530 ml (25% predicted) and FEV1/FVC= 290 ml (40% predicted), confirming severe COPD. Transthoracic ultrasound showed severely impaired left ventricle function with ejection fraction of 25%, moderate mitral regurgitation and hypokinesis of anterior heart wall probably due to prior ischemic attack.

Following placement of two 16 and 18 gauge peripheral lines respectively, spinal anaesthesia using 4mg of ropivacaine in the center of spinal cord was administered in hypobaric solution (solution volume 4ml), while patient remained in sitting position for 3 minutes. Amputation of 40 min duration was performed in half sited position, while total analgesia (sensory block) was achieved in absence of motor block.

Results: All throughout the operation blood pressure monitoring through an arterial line showed no disturbances (145/95mmHg to 125/70mmHg) without any need of vasoconstrictive agents, except for hourly fluid replacement.

Discussion: The administration of very low dose spinal anaesthesia in critically ill patients seems to be ideal in patients with severe cardiovascular failure due to the minimal effect on hemodynamic stability.

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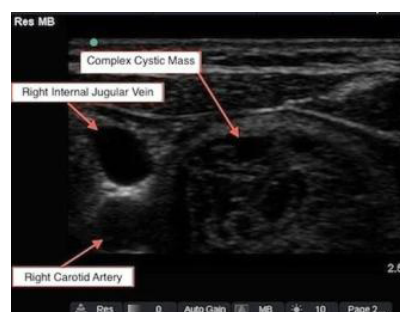
INCIDENTAL DETECTION OF THYROID MASS DURING ULTRASOUND GUIDED CENTRAL VENOUS CATHETER INSERTION

A. Vaughton, M. Hough Anaesthetics, Dorset County Hospital, Dorchester, UK.

Background: Two-dimensional ultrasound imaging is the preferred method for guiding the insertion of a central venous catheter into the internal jugular vein¹. Ultrasound for central venous cannulation allows visualization of normal and abnormal anatomy reducing catheter placement complications.

Methods: We describe the care of a 47 year old lady who presented as an emergency for surgical management of a ruptured bladder. After induction of anaesthesia, a right internal jugular CVC was inserted under ultrasound guidance to assist perioperative fluid management. An incidental complex solid cystic mass was noted during the ultrasound assessment of her internal jugular vein prior to CVC insertion. On questioning post surgery the patient was unaware of the mass and was found to be clinically and biochemically euthyroid. Following the patients recovery from her laparotomy she underwent further investigations for her thyroid mass, resulting in a right thyroid lobectomy consistent with a follicular adenoma. She made an uneventful recovery from both surgeries.

Results:



[Ultrasound Image]

Conclusions: With the increasing use of ultrasound for ever more procedures it is important that clinicians are aware of abnormal anatomy and potential pathology in the regions they are imaging. In this case, the recognition of variant thyroid anatomy coincidentally facilitated earlier and effective treatment of a previously unrecognised thyroid mass.

References:

1. National Institute for Clinical Excellence. Guidance on the use of ultrasound locating devices for placing central venous catheters. Technology Appraisal Guidance No. 49 2002 September.

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TRANSITORY PARAPLEGIA CAUSED BY AIR IN THE EPIDURAL SPACE: A RARE COMPLICATION OF EPIDURAL CATHETER PLACEMENT

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Background and aims: Neurological complications following central neural blockades are extremely rare (< 4:10000). We report a case of transitory paraplegia following combined spinal anesthesia.

Case report: 44-yr-old man, ASA II, scheduled for sigmoidectomy. Monitored according to ASA standards. After 3 failed attempts, an epidural catheter was successfully placed at L3-L4 space with a 18G Tuohy needle, using the loss of resistance to air technique. Bupivacaine 12.5mg and sufentanil 3 µg were administered via subarachnoid through a 27G Quincke needle in L4-L5 intervertebral space. Two hours later, due to abdominal discomfort complaints, ropivacaine 0.75% 10 ml and sufentanil 5 µg were administered through the epidural catheter. Five hours after the epidural bolus the patient complained of abdominal pain but presented paraplegia. The epidural catheter was then removed and a CT scan performed, revealing gas accumulation in the extradural space and intervertebral spaces from T11 to L4, with the largest diameter at L4. After evaluation by neurosurgery the patient remained monitored and intravenous methylprednisolone 2g was administered. Reversion of motor block and decrease of the air volume on the CT was documented 10 hours later.

Discussion and conclusions: Our interpretation of this transitory neurologic deficit lies on compromised blood flow and function of lumbar nerve roots, secondary to increased pressure in the epidural space caused by the air collection. Although rare, an early diagnosis of this complication should be sought to avoid irreversible neurologic damage, using imaging study, followed by adequate therapy.

References:

- Anesth Analg 2007; 104:965-74.
J Neurosurg Spine. 2006; 5:359-61.

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EPIDURAL ANALGESIA FOR PREGNANT WITH ANKYLOSING SPONDYLITIS: CASE REPORT

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Background and aims: Ankylosing spondylitis is a form of arthritis that usually begins in the sacroiliac joints and slowly progresses to spinal fusion. This disease presents a high risk of difficult airway and difficult 'back'.

Case report: A 30 years old female patient with a 7 year history of ankylosing spondylitis. Therapy (Adalimumab) was stopped at the beginning of gestation due to risk of complications in the newborn. She had severe spinal involvement with general thoracic and lumbar spondylosis, sacroilitis and cervical spine involvement. In pregnancy she gained 14 kg. In coordination with the patient we decided for vaginal delivery. She was 81 kg in weight, 166 cm in height, with a body mass index of 29.4. Back examination revealed a classic 'bamboo spine' appearance with a reduced interspinous spaces. She was considered for epidural analgesia during her vaginal delivery with possible conversion to epidural anaesthesia for caesarian section. A central approach was taken. On the fifth attempt the epidural space was identified using

loss of resistance to saline. There was no difficulty with threading the epidural catheter with prior injection of saline through the epidural needle. After administration of 10 ml of 0.125% Marcaine VAS score changed from 10 to 1. Postoperative anaesthetic review revealed no neurological complications related to the regional technique.

Conclusions: In pregnant with AS neuraxial anaesthesia can be considered and a central approach can be used. A normal dose of epidural local anaesthetic can achieve an adequate level of block.

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EFFECT OF ADDING MAGNESIUM TO BUPIVACAINE AND FENTANYL FOR SPINAL ANESTHESIA IN LOWER LIMB ORTHOPAEDIC SURGERIES

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Background and aims: In recent years spinal anesthesia using a local anesthetic in combination with an opioid has gained popularity for lower limb operations due to the high success rate and patient satisfaction, intrathecal administration of magnesium sulphate significantly potentiated antinociception during spinal anesthesia. This study aimed at evaluating the effect of adding MgSO₄ to bupivacaine and fentanyl for spinal anesthesia in lower limb orthopaedic surgeries.

Methods: In this double-blind randomized clinical trial, 100 candidates of spinal anesthesia for lower limb orthopaedic surgeries (ASA class I-II) were recruited in Hazrat Rasoul Akram Medical Complex in a 10-month period. They randomized for receiving 1.0 ml of preservative-free 0.9% sodium chloride (group S) or 50 mg of MgSO₄ 5% (1.0 ml) (group M) following 12.5 mg of bupivacaine 0.5% plus 25 µg of fentanyl intrathecally. Data were collected regarding the time to reach the highest level of sensory blockade, time to L2 regression.

Results: Median time to reach the highest level of sensory blockade was significantly higher in the S group (16 vs. 14.5 min; p=0.02). Median times to reach the highest level of motor blockade and its full regression were comparable between the two groups.

Conclusions: Normal 0 false false EN-US X-NONE AR-SA /* Style Definitions */ table.MsoNormalTable {mso-style-name:"Table Normal"; mso-tstyle-rowband-size:0; mso-tstyle-colband-size:0; mso-style-noshadow:yes; mso-style-priority:99; mso-style-qformat:yes; mso-style-parent:""; mso-padding-alt:0in 5.4pt 0in 5.4pt; mso-para-margin:0in; mso-para-margin-bottom:0.0001pt; mso-pagination:widow-orphan; font-size:11.0pt; font-family:"Calibri", "sans-serif"; mso-ascii-font-family:Calibri; mso-ascii-theme-font:minor-latin; mso-fareast-font-family:"Times New Roman"; mso-fareast-theme-font:minor-fareast; mso-hansi-font-family:Calibri; mso-hansi-theme-font:minor-latin; mso-bidi-font-family:Arial; mso-bidi-theme-font:minor-bidi;} Intrathecal MgSO₄ along with the spinal anesthesia with bupivacaine and fentanyl in lower limb orthopaedic surgeries hasten the sensory blockade and prolongs the period of anesthesia without additional side effects or influence on the motor blockade.

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TREATMENT OF MYOFACIAL PAIN SYNDROME IN PATIENT WITH LUMBAR SCIATICA

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Background: The association of Lumbar sciatica and lumbar myofascial pain is relevant in many cases complaining of lumbago. Infiltrating the epidural space only didn't provide satisfactory result in this group of patients. In this study we report treatment of both lumbar pain and myofascial pain syndrome (MPS)

Methods and materials: Between year 2010 and 2011, five hundred eighteen patients were treated for lumbar radiculopathy. Epidural infiltration was performed on L3-L4; L4-L5; L5-S1 based on the location of the radiculopathy.

In addition to their lumbar sciatica, sixty seven patients out of the five hundred eighteen were found complaining of MPS with painful myofascial trigger points (TrPs).

A first group of thirty patients out of the sixty with positive lumbar myofascial syndrome were treated with epidural infiltration and infiltration of their myofascial TrPs.

A second group of thirty seven patients with lumbar sciatica and MPS was treated with epidural infiltration only.

Results: The first group treated for both lumbar radiculopathy and MPS was pain free at the first, second and third month after the procedure.

As for the second group with MPS, treated with epidural infiltration only, twenty five patients revisited for persisted back pain. The pain was referred to their lumbar TrPs. We performed infiltration at the lumbar myofascial TrPs for this second group. A dramatic improvement was noted.

Conclusion: We conclude that treatment of patients with lumbar sciatica associated with Myofascial pain syndrome should be based on treating both etiology by infiltrating the epidural space and the myofascia TrPs.

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ABSTRACT: TREATMENT OF CERVICAL RADICULOPATHY

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Background: Cervical radiculopathy, frequently encountered in the general population, is an enduring source of disability and suffering. Conservative medical treatment reduces neck pain and disability in 90% of cases. The epidural steroid injections are an option in the treatment regimen, relieving cases resistant to medications and conservative treatment.

Study design: A prospective study.

Setting: An interventional pain management center in a university hospital.

Objectives: To evaluate the effectiveness of cervical interlaminar epidural injections of steroids with a local anesthetic in the management of compressive cervical radiculopathy due to disc herniation and/or spondylosis.

Methods: 31 patients with cervical radiculopathy resistant to at least 4 weeks of medical treatment are referred by their physician to the interventional pain management center for cervical interlaminar epidural injections.

Outcomes assessment: Multiple outcome measures were utilized including the Numeric Pain Rating Scale (NPRS), the Neck Disability Index (NDI) at baseline and 6 months post-treatment.

Significant pain relief was defined as a 50% or more reduction of the NPRS score.

Significant functional status improvement was defined as 40% or more reduction of the NDI score.

Results: Significant pain relief ($\geq 50\%$) was demonstrated in 68% of patients and functional status improvement ($\geq 40\%$) in 55% of patients.

Conclusion: Cervical interlaminar epidural injections with steroids and local anesthetic may be effective in patients with acute/chronic function-limiting cervical radiculopathy.

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RETROSPECTIVE ANALYSIS OF ANESTHESIA DURING LUMBAR DISCECTOMY

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Background and aims: In our study, we aimed to evaluate the anesthesia techniques performed in lumbar discectomy cases, retrospectively.

Methods: In this study, 150 lumbar discectomy cases that were operated between January 2010 and December 2011, were evaluated retrospectively. Patients were divided into 2 groups as spinal anesthesia (SA; n=12) and general anesthesia (GA; n=138). Demographic characteristics, smoking habits, known additional diseases, preoperative respiratory values of patients known to be chronic obstructive pulmonary disease (COPD), the type of anesthesia, anesthetic drugs used, the need for additional analgesic, hemodynamic measurements as first values in the operation room and the lowest and highest recorded measurements during surgery, presence of hypotension and bradycardia during surgery, the use of ephedrine-atropine, operation time, bleeding amount and the total amount of fluid given to the patient during surgery were studied.

Results: 5 of 12 patients at Spinal Anesthesia group had hypotension, and this difference was statistically significant ($p < 0.001$). The use of ephedrine

in this group was significantly higher ($p < 0.001$). Bradycardia was not seen in the Spinal Anesthesia group, while was seen in 6 of 138 patients in General Anesthesia group, this was not statistically significant. All patients in Spinal Anesthesia group (n=12) had a diagnosis of COPD. Bupivacaine was used as a local anesthetic agent in Spinal Anesthesia group.

Sevoflurane (n=121), isoflurane (n=3), desflurane (n=14) were used as inhalation agent; tracrrium (n=80), esmeron (n=49), norcuron (n=9) were used as muscle relaxants in General Anesthesia group.

Conclusions: Spinal anesthesia should be kept in mind, as a safe anesthesia technique in low thoracic and lumbar surgery in prone position, for patients with COPD, which have high risk for general anesthesia.

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ULTRASOUND ASSESSMENT OF LUMBAR SPINE, CAN WE IMPROVE THE LEARNING PROCESS?

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Background and aims: The use of ultrasonography for difficult neuroaxial anesthesia has been recently suggested. However there are very few practitioners of spinal ultrasound (US). This study evaluates the transfer of competence in spinal ultrasound.

Methods: 26 anesthesiologists were given a teaching including 40 min lecture on ultrasound assessment of lumbar spine, and 15 min individual hands on workshop using a 2-5Mhz curved array probe on a live model. Age and experience in ultrasound guided peripheral nerve blocks were noted: group A n=14 : 12 months or less of experience; group B n=12: more than 12 months. The participants were asked to perform in 5 min four tasks: determination of 3 intervertebral spaces (S1-L5, L5-L4, L4-L3), optimal insertion point of needle, ligamentum flavum dura mater complex (LF-DM complex) and its depth. Number of attempts was recorded. The results were compared to a standard upon agreement of two experts. Data were assessed with Microsoft Xlstat software (SPSS, Chicago).

Results: Results were better in group B, and summarized in table.

TABLE 1. Success rate (attempts), $p < 0.05^*$

Participants	Group A: n=14	Group B: n=12
Experience in peripheral US-guided nerve blocks (months)	≤ 12	> 12
Age (yr old)	49.5	48.5
Determination of 3 vertebral interspaces	1(1.3)	1(1)
Determination of a optimal point of puncture	0.36(3)	0.5*(2.5)
Identification of LF-DM complex	0.36(3)	0.5*(2.5)
Determination of LF-DM depth	0.36(1)	0.5*(1)
Participants with 4 tasks successfully	4	5

Conclusions: This study suggests that the teaching process usually applied in matter of spinal ultrasound needs probably to be improved for a better transfer of competence.

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ULTRASONOGRAPHY-GUIDED STELLATE GANGLION BLOCK: A SAFE AND EFFECTIVE METHOD FOR CHRONIC PAIN RELIEF

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Background and aims: Effective block of the stellate ganglion is an appropriate treatment to relief chronic pain syndromes in upper extremities, head, neck and chest. The anatomical location of the stellate ganglion increases the potential risk of injury to the vital elements such as carotid arteries, etc. Recently, ultrasonography-guided block increasingly is utilized for several nerve block procedures. The main purpose of current study was to

investigate the outcomes and complications of the block using ultrasonography in a series of patients which, to our knowledge, is not reported before.

Methods: There were 26 patients referred with facial pain, CRPS I, CRPS II, post-mastectomy pain or post-herpetic neuralgia. Stellate ganglion was blocked at the level of transverse process of the C6 using lidocaine 1% (0.5 cc) and bupivacaine 0.25% (5 cc) with the patient in supine and the thyroid, carotid arteries, trachea and needle path observed under the ultrasonography probe. Two to 7 days post-injection, the patients revisited and the procedure repeated if the pain was >3 based on the visual analogue scale.

Results: In total, 101 procedures were done until the patients reported pain <3 . The complications included one case with brachial plexus somatic block, hoarseness, and 3 cases with coughing. There was no life-threatening complication such as vascular puncture or neuroaxial injection.

Conclusions: Ultrasonography-guided stellate ganglion block is safe and effective procedure for pain relief in patients with chronic pain of upper extremities, head, neck and chest.

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CEREBRAL OXIGENATION AND SPINAL ANAESTHESIA IN ELDERLY PATIENTS WITH HIP FRACTURE

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Background and aims: To observe how the haemodynamic changes induced by spinal blockade affect cerebral oxygenation.

Methods: This prospective pilot study included 22 patients aged >75 yr presenting for surgical repair of hip fracture. Institutional Hospital approval and individual consents were obtained. Intrathecal anaesthesia was performed with bupivacaine or levobupivacaine plus fentanyl 15 µg. Local anaesthetic dose: 7 mg if height ≤ 160 cm and 9 mg if >160 cm. All patients received supplemental oxygenation (36%). Hypotension was defined as a systolic blood pressure (SBP) <100 mmHg or a decrease of more than 25% from the baseline mean arterial pressure (MAP). Cerebral tissue oxygen saturation (LcT O₂Sat) was measured by INVOS 5100 cerebral oximeter.

Results: Expressed as (X $\pm$ SD). Age(yr) 83 $\pm$ 6.4. Preoperative haemoglobin (g/L) 11.8 $\pm$ 1.9. Pre/postoperative Pfeiffer test: median (range): 1 (0-6) / 0 (0-6).

TABLE 1.

Haemodynamic parameters	Baseline	10 min after block	20 min after block	30 min after block	during surgery
MAP(mmHg)	97.2 $\pm$ 14.7	69.2 $\pm$ 20.7	63.3 $\pm$ 16.9	64.2 $\pm$ 19.9	69.5 $\pm$ 16
LcT O ₂ Sat (%)	59.3 $\pm$ 9.6	59.5 $\pm$ 9.2	58.9 $\pm$ 9.5	57.1 $\pm$ 9.8	58.6 $\pm$ 9.3

Conclusions: Hypotension observed after spinal block and treated with vasoconstrictors does not decrease LcT O₂Sat.

Reference: Meng L. et al. BJA 2011; 107(2):209-17.

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7,000 REPORTS DOWN MEMORY LANE. A BIBLIOGRAPHIC STUDY ON EPIDURAL ANATOMY AND PATHOPHYSIOLOGY 2001-2012

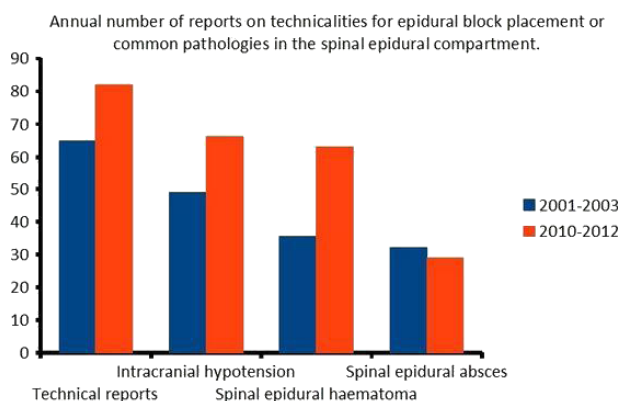
K. Jensen, J. Borghlum *Anaesthesia and Intensive Care, University Hospital of Copenhagen: Bispebjerg, Copenhagen, Denmark.*

Background and aims: Scientific interest in the epidural compartment has been considerable for many years. It is estimated that as many as 13,000 reports have been published on epidural blocks, and 7,000 reports on technique, anatomy and physiology. Given this overwhelming amount of information, we were curious if the cumulative scientific evidence on common, well-documented issues relating to epidural pathophysiology had in fact exhausted the need for new reports.

Methods: We conducted a comprehensive Medline search on human studies on epidural or caudal nerve block for two periods, 2001-2003 and 2010-2012. We excluded all studies relating to veterinary use, sacral stimulation or neur-

axial tumours. Titles and abstracts were classified according to subject matter: 1) technical information; 2) intracranial hypotension or postdural puncture headache; 3) spinal epidural haematoma; and 4) spinal epidural infection.

Results: A total of 950 reports were included. Figure 1 displays our main findings.



[Figure 1.]

Conclusions: We did not confirm our hypothesis of a reduced need for pathophysiological reports. On the contrary, report numbers seem to be increasing. While some of the conditions during conduction of the study occur spontaneously and unrelated to epidural blocks, it is evident that they also signal a clinical impasse - an ongoing need to improve block efficacy, prevent headaches, and counteract the risk of haematoma with the increasing use of anticoagulant therapy.

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THE USE OF ULTRASOUND IN PLACEMENT OF EPIDURALS AMONGST ANAESTHETIC TRAINEES

L. Adams, W. Jones *Department of Anaesthesia, Leeds General Infirmary, Leeds, UK.*

Background and aims: The use of ultrasound to assist in placement of epidurals is a recommendation of NICE. Although evidence is limited, trials suggest the use of ultrasound either in real-time or as a pre-placement scan improves efficacy and safety and may be helpful in achieving correct placement of an epidural. We wished to study the use of ultrasound to assist in placement of epidurals amongst a group of trainee anaesthetists.

Methods: A questionnaire survey was designed to determine awareness and uptake of the NICE guidance. This was disseminated to all trainees working in Leeds Teaching Hospitals NHS Trust during October 2010.

Results: 68 anaesthetic trainees responded, of which 97% completed the survey. 91% of trainees do not use ultrasound to assist in placement of epidurals. Anaesthetists cited varied reasons for this including (percentage of reasons given): lack of training (83%), lack of equipment (39%), lack of conviction that ultrasound would facilitate placement of the epidural (37%) or unaware of the guidance (34%). 87% trainees would be keen to receive training in the use of ultrasound to facilitate placement of an epidural.

Conclusions: There is poor uptake of the use of ultrasound in epidural placement amongst anaesthetic trainees. Lack of training and unawareness of the guidance are key reasons why anaesthetic trainees are not using ultrasound. These factors can be improved and a large proportion of trainees are interested in receiving training. Our intention is to introduce a course available to all anaesthetists to improve awareness and obtain these skills.

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SHORT TERM OUTCOME OF BRACHIAL PLEXUS BLOCK IN VASCULAR ACCESS SURGERY

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Background and aims: To present our data on short term outcome of brachial plexus block for upper limb vascular access procedures done for renal dialysis.

Methods: This is a retrospective review of all cases that had a brachial plexus block for an upper limb renal dialysis vascular access procedure at the vascular surgery unit in KHM, Jordan, between January 2009 and September 2011. Two hundred eighty eight patients had the block. All blocks were guided by a nerve stimulator. sedation were used at the time of the block.. pubivacaine 0.375%(20-35 ml) was used.

Results: All patients had an adequate block. A successful block was achieved in 232 (80.6%) patients while a partially successful block was achieved in 56 (19.4%). The mean duration of the block was 5.6 (2.2-48.0) hours. Prolonged blocks beyond 24 hours occurred in 5 patients. Injection related complications included discomfort during injection local hematomas in 8 (2.8%) patients). Transient nerve paralysis complicated 82 (28.5%) cases (phrenic nerve in 57 (19.8%) patients, sympathetic chain resulting in Horner's syndrome in 20 (6.9%) patients and Vagus nerve resulting in hoarseness of voice in 5 (1.7%) patients). The type of access was changed following the block in 18 (6.3%) patients who were originally planned for prosthetic loop graft and ended in native access (13 (4.5%) brachiocephalic arteriovenous fistulas and 5 (1.7%) basilic vein transposition).

Conclusions: Brachial plexus block is an effective and safe mode of anesthesia for upper limb renal dialysis vascular access procedures.

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PREDICTING DIFFICULTY SCORE FOR SPINAL ANESTHESIA OF PATIENTS WITH TUL SURGERY

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Background and aims: Determining difficulty spinal score before surgery leads to choice of appropriate methods and reduce the complications. This study has been done to assess the predictive value of patient variables that are effective on difficult spinal anesthesia(DSA).

Methods: 101 patient undergone Trans Ureteral Lithotripsy (TUL) surgery. All patient's demographic information along with BMI, lumbar spinous process status, deformity of the spine, radiological signs of lumbar vertebrae were recorded. Then the patient undergoing spinal anesthesia by the anesthesiologist executive. Information about the the numbers of puncture with or without displacement in the same space were recorded. Results were analyzed by using the software SPSS v16 and Chi square test.

Results: 50 patients (49.5%) undergoing spinal anesthesia on the first attempts of the first space. 36 patients (35.6%) had interstitial score and 15 patients (6.9%) had a difficult spinal score. In our study there is no significant relationship between DSA and gender, age, height, weight, history of spine surgery, history of difficult spinal anesthesia. But there is a significant relationship between difficulty spinal score and lumbar spinous process status ($p = 0/0001$), radiological profile of the lumbar spine ($p = 0/0001$), lumbar deformity ($p = 0/007$) and BMI ($p = 0/006$). Then by using the Roc curve and table of distribution of sensitivity and specificity values, cut point was determined the 8/5 for anticipated difficult spinal with a sensitivity equal to 86/7% and specificity was 86%.

Conclusions: It seems that Considering the clinical examination of patients before spinal anesthesia with focus on lumbar spinous process status, Present of lumbar deformity and Calculation of BMI can be helpful in predicting Difficulty of spinal anesthesia. Also lumbar spine X-ray can be helpful in predicting the difficulty of spinal stiffness.

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QUALITY AND SAFETY OF PERFORMANCE AND PATIENT EXPERIENCE WITH ULTRASOUND GUIDED CENTRAL NEURAXIAL BLOCK DURING CAESAREAN SECTION

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Background and aims: Recent survey reported low incidence of major complications (0.0074%), but parturients are at a higher risk of procedure-related complications due to physiological changes¹. De Filho et al² concluded the incidence of successful neuraxial puncture in the first attempt may be lower than reported. Our aim is to determine success at first attempt, safety and patient reported experience following ultrasound-guided (U/S) neuraxial block in obstetric anaesthesia.

Methods: Local Audit committee approved. Patients consented. Prospective re-audit over six months, 23 patients included. Two anaesthetists, one scanned the patient's back in sitting position using low frequency probe with Sonosite M-Turbo machine, to assess the appropriate space, mid-line and depth from skin to ligamentum flavum (determine the size of the needle) and other performed the procedure. Procedure was timed from skin infiltration to the emergence of CSF, drug administration to bilateral dense sensory and motor block and co-relation between ultrasound measured and real-time depth with needle. Standardized dose of 2.5 mls of Bupivacaine 0.5% (heavy) and 300 micrograms of diamorphine administered in all patients.

Results: 91% elective and 9% emergency. Majority were overweight 43% with a significant proportion morbidly obese 13%. Only 2 patients had two attempts due to anatomical deformities. The length from skin to ligamentum flavum measured with U/S co-related well with needle increasing patient safety (78% having < 8 cm and 22% >8cm). We had 100% success with neuraxial block with 95% patient satisfaction.

Conclusions: Ultrasound guidance improved the safety and efficacy of neuraxial block in parturient, despite anatomical abnormalities with excellent patient satisfaction.

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A RANDOMISED CONTROL TRIAL ON ULTRASOUND-ASSISTED SPINAL ANAESTHESIA

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Background and aims: Studies have suggested that pre-procedural scanning with ultrasound facilitates spinal anaesthesia in patients with difficult anatomical landmarks by identifying an appropriate site for needle insertion and improves first-attempt success rate. We aim to study if pre-procedural scanning with ultrasound improves first-attempt success rate and decreases time taken for the procedure in the general population.

Methods: After receiving approval from ethics committee, 170 patients, aged between 21 and 80 years, ASA I to III, were recruited. Informed consent was taken. Patients were randomized into 2 groups, ultrasound guided identification of landmarks (Group U) and manual palpation of landmarks (Group M). Primary outcome was first-attempt success rate and secondary outcomes were time taken to perform procedure, success of spinal, complications and patient satisfaction.

Results: The first-attempt success rate in Group U was 63.5%, in Group M was 51.8% ($p=0.121$). Average time taken for procedure was 2.9 min in Group U and 3.9 min in Group M. 51.8% of procedures were performed within 1 minute in Group U and 30.6% in Group M ($p=0.005$). 2 patients in Group M required conversion to general anaesthesia. There were no differences in complications. Patient satisfaction was higher in group U.

Conclusions: There is a trend towards improvement in first-attempt success rate of spinal anaesthesia with pre-procedural ultrasound scanning. There is a higher rate of procedures performed within one minute and greater patient satisfaction in the ultrasound-assisted group. There is a potential role of pre-procedural ultrasound scan in the general population.

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RECURRENCE AND METASTASIS FOLLOWING REGIONAL ANAESTHESIA AND ANALGESIA FOR SURGERY IN BREAST CANCER PATIENTS

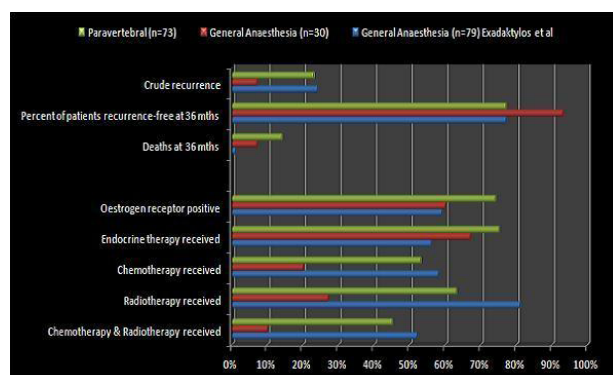
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Background and aims: The stress response to surgery may modulate the risk of recurrence and metastasis in patients undergoing surgery for primary breast cancer. Regional anaesthesia attenuates the surgical stress response, reduces general anaesthetic requirement, and spares perioperative opioid use. Paravertebral anaesthesia has been shown to reduce tumour recurrence and metastases following breast cancer surgery [1]. We sought to identify a similar observation within our local population.

Methods: We retrospectively examined the medical records of 111 patients undergoing mastectomy +/- axillary clearance between July 2003 and December 2007. Ethical approval was waived by the local Research Governance Committee. We obtained: demographic data, tumour size and grade,

node status, oestrogen receptor status, tumour margins, and whether adjuvant chemotherapy, radiotherapy and endocrine therapy were used. We also analysed pain scores in recovery and the use of perioperative morphine. Furthermore, we documented disease recurrence within a 36-month follow-up period.

Results: 73 patients received general anaesthesia combined with paravertebral analgesia. 30 patients had general anaesthesia combined with perioperative morphine administration. Given the small numbers in the general anaesthesia group, we compared our results with those of Exadaktylos et al [1].



[Tumour characteristics and recurrence]

Conclusions: In our population, paravertebral analgesia for mastectomy does not appear to reduce the incidence of recurrence and metastases in breast cancer patients.

Reference: 1. Exadaktylos et al. Can anesthetic technique for primary breast cancer surgery affect recurrence or metastasis? *Anesthesiology* 2006; 105: 660-4.

387 ENHANCED RECOVERY AUDIT - PRILOCAINE VS BUPIVACAINE FOR SPINAL ANAESTHESIA IN LOWER LIMB ARTHROPLASTY

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Background and aims: Orthopaedic Enhanced Recovery was adopted in Our Trust in 2011 with an aim to improve quality and reduce the length of stay. Prilocaine is a spinal anaesthetic with rapid recovery of motor blockade¹. The main aim of this audit was to see whether prilocaine improved day 0 mobilisation and reduced the length of hospital stay.

Methods: The patients who had lower limb arthroplasty under spinal with bupivacaine and prilocaine were included. Data were collected regarding patient demographics, ASA grade, time of surgery, intraoperative and postoperative medications, pain scores at 0, 4, 8, 12 and 24 Hrs, day of mobilisation and discharge for each group.

Results: Twenty patients were studied in each group. There were no difference in the patient demographics, ASA status and time of surgery. Pre-medication, intraoperative and postoperative medications were all standard in both groups. The pain scores were similar in both the groups. About half of the patients in prilocaine group were mobilised the same day while 9 out of 20 patients were mobilised on day 0 in bupivacaine group. The day of discharge remained similar in both prilocaine and bupivacaine groups averaging 2.4 and 2.36 days respectively.

Conclusions: Prilocaine produced similar results compared with bupivacaine in terms of day of mobilisation and discharge, hence offered no advantage in patients undergoing enhanced recovery arthroplasty.

References: 1. Arthroscopic Surgery of the Knee: A Comparison of Low-dose Prilocaine and Fentanyl with Bupivacaine and Fentanyl, A S Black, G N Newcombe et al. *Br J Anaesth* 2011; 106(2).

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EFFECTIVENESS OF COMBINED SPINAL-EPIDURAL ANESTHESIA IN TOTAL COX AND KNEE ARTHROPLASTY

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Background and aims: In recent years radical operations for bone tumors in children have been more widely performed. The aim of the investigation is to present results of combined spinal-epidural anesthesia (CSEA) in total cox and knee arthroplasty (TCKA).

Methods: The study consisted of 105 patients undergoing TCKA under CSEA ranging in age from 12 to 17, with osteosarcoma (n=55) and Ewing's sarcoma (n=50). Operative time was 200-240 minutes. CSEA was established by "one-segment" method at L3-L4. After locating epidural space, 29G needle is passed through epidural needle into spinal fluid to inject 0.5% Marcain Spinal, aged dose - 3.0-4.0 ml into spinal fluid. When surgical procedure lasts more than two hours, mixer (naropine 0.2% 2 mcg/ml, fentanyl 2 mcg/ml, adrenalin 2 mcg/ml) is administered, average rate 0.2 ml/kg. Sedation was provided by continuous infusion of propofol, rate of 7-4 mg/kg/h or inhalation of sevoflurane 2-3 volume% by means of Laryngeal Mask Pro Seal with artificial lung ventilation. Postoperative analgesia was established with epidural pump, gradually injecting medications into epidural space for 3-5 days.

Results: Pain control was significant in 100% of the patients and no major complications occurred due to technique applied. CSEA provided a constant pain free state, sufficient myoplegia with hemodynamic stability, and also provided an ideal postoperative analgesia.

Conclusions: CSEA technique allows to use achievement and progress along with up to date methods of sedation in patients undergoing TCKA.

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COMPARISON OF POSTOPERATIVE PAIN SCORES IN PATIENTS RECEIVING SPINAL VERSUS GENERAL ANAESTHESIA FOR PRIMARY KNEE AND HIP REPLACEMENT

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Background and aims: In lower extremity joint replacement, the choice of anaesthetic technique to optimise postoperative pain relief is controversial and challenging. We compared the use of spinal anaesthesia (SA) with intrathecal diamorphine and general anaesthesia (GA) in total knee replacement (TKR) and total hip replacement (THR). Primary outcome measures included postoperative pain scores, time to mobilisation and time to discharge.

Methods: The audit included 24 patients, aged 23-82 years, scheduled for TKR and THR. Group A1 = TKR+SA, group A2 = TKR+GA, group B1 = THR+SA, group B2 = THR+GA.

3ml 0.5 % bupivacaine with 300µm of diamorphine intrathecally was used for SA and sedation with propofol administered by target control infusion. All procedures were performed by the same surgeon. Local wound infiltration (LWI) with levobupivacaine, morphine and ketorolac was given to all patients. Postoperatively, patients received paracetamol and codeine 6 hourly and morphine orally as required. Pain was assessed by visual analogue score (VAS).

Results:

	Group A1 (n=5)	Group A2 (n=3)	Group B1 (n=11)	Group B2 (n=5)
Median VAS (1-10):				
1st postoperative day	2	2	2	2
2nd postoperative day	3	2	2	2
3rd postoperative day	1	2	1	1
Mobilisation within (day)	1	1	1	1
Discharge in (day)	4	5	4	4

Conclusions: When LWI is used, SA with intrathecal diamorphine and GA are comparable anaesthetic techniques, resulting in satisfactory postoperative pain scores and enabling early mobilisation and discharge.

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RARE COMPLICATIONS ALSO HAPPEN: EPIDURAL HEMATOMA AFTER SPINAL ANESTHESIA

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Background and aims: Epidural hematoma (EH) is a rare and potentially catastrophic complication of neuroaxial blockage¹. We reported a case of an EH in a pregnant woman after spinal anaesthesia (SA).

Methods: 37-year-old pregnant, 70 Kg, ASA 1, underwent a SA for cesarean section. She had already been submitted to 2 SA for cesarean sections, both with no complications. The preoperative study was normal and she takes no medication. A trained anaesthesiologist performed an uneventful SA at level L3-4 with a 27G Quincke needle.

Results: Six days after she goes to the ER complaining of severe lumbar pain and in the right buttock that radiated to the external right thigh (VAS 10/10). She also had decreased muscle strength, walking limitation and paresthesias. The patient was medicated for sciatic pain and discharged. In day 13 post-cesarean, the pain persisted, and she returned to the hospital. A spine MRI was performed and showed a sub-acute epidural hematoma at level L3 to S2-3, without compression of the spinal cord. After evaluation by neurosurgery and anaesthesiology, was decided conservative treatment with analgesia, methylprednisolone and pregabalin. After 16 days of treatment she had no paresthesias, the pain decreased (VAS of 3/10), the muscular strength increased, but still has some walking limitation.

Conclusions: The option for a conservative treatment seems to have been an appropriate and wise choice. We wait and hope for symptoms resolution in a short time. The patient didn't had any apparent risk factors, like hemorrhagic puncture, coagulation disorders and inhibitors of haemostasis medication, but an EH developed nevertheless.

Reference: ¹Reg Anesth Pain med 2010;35:64-101.

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DIFFERENCE BETWEEN PENCIL-POINT SPINAL NEEDLE SIZE, AND MANUFACTURING COMPANY AFFECT THE BACKFLOW SPEED OF CSF AND THE STATE OF THE PUNCTURE

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Background and aims: Smaller diameter pencil-point spinal needles are known to be lower incidence of postdural puncture headache (PDPH). Pencil-point spinal needles using the introducer need longer length than cutting spinal needles. Therefore it takes more time to detect CSF through the needle and fill the hub of the needle with CSF. The purpose of this study was observation of the time to start seeing CSF through the needle and dropping CSF from the hub of the needle on different size and manufacturing company, and the state of the puncture and the state of the puncture.

Methods: Five different manufactures' 25-gauge and 27-gauge pencil-point needles were prepared (Table 1).

(I) observation of artificial CSF backflow speed

(II) measurement of needle size using a microscope

(III) measurement of needle hub volume (IV) observation of the state of puncture to artificial dura.

Results:

(I) observation of artificial CSF backflow speed (Table 2)

(II) measurement of needle size

(III) measurement of needle hub volume (Table 3)

	25G (No.)	27G (No.)
UNISIS Pencil-point needle (U-needle)	10	10
B/BRAUN Pencan needle (BB-needle)	10	10
BD Whitacre needle (BD-needle)	10	10
PAJUNK Splott canula needle (P-needle)	10	10
PAJUNK Splott canula needle (P-needle)	10	10

[Materials]

	25G (n=10)	25G (n=10)	27G (n=10)	27G (n=10)
	Time to see CSF (sec)	Time to drip CSF (sec)	Time to see CSF (sec)	Time to drip CSF (sec)
U-needle	0	49.3±4.0	0	5.7±0.5
BB-needle	2.6±0.3	49.7±3.9	5.7±0.5	107.3±4.7
BD-needle	0	58.8±1.0	0	102.1±1.8
P-needle	0	70.6±3.3	0	129.8±2.5
D-needle	0	56.6±1.0	0	127.7±13.5

[Artificial CSF backflow speed]

	25G (ml)	27G (ml)
U-needle	0.176	0.176
BB-needle	0.165	0.168
BD-needle	0.124	0.122
P-needle	0.151	0.147
D-needle	0.170	0.172

[Needle hub volume]

Conclusions: Pencil-point spinal needle diameter more affects the backflow speed of CSF than difference between manufacturing companies. The state of puncture was different between the spinal needle manufacturing companies.

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COMPARING THE EFFECT OF HEARING LOSS AFTER SPINAL ANAESTHESIA WITH 25G QUINCKE AND 26G ATRAUCAN NEEDLES; A RANDOMIZED PROSPECTIVE STUDY

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Background and aims: Studies with hearing loss have been reported more frequently especially in last two decades. This study is comparing the effect of 25g quincke and 26g atraucan needles on hearing after spinal anaesthesia and determine the degree and reversibility of hearing loss (HL) with transient-evoked otoacoustic emissions (TEOAE) and pure tone audiometry (PTA).

Methods: The study protocol was approved by the Medical Ethical Review Committee (No;23 march.23.2011) and 42 patients who were undergoing surgery under spinal anaesthesia were included in this study. The patients were randomly divided into two groups. Group Q (n:22) patients received spinal anaesthesia through a 25-gauge (G) Quincke spinal needle and group A (n:20) patients received the same through a 26-G atraucan spinal needle. TEOAE and PTA were applied before the operation and postoperative first and seventh days.

Results: TEOAE measurements as indicating the cochlear function of Quincke needle group were showed decreased response in the postoperative first evaluation ($p < 0.05$). There was no significant difference between the two groups measured on the postoperative seventh day. PTA results of postoperative first day, indicated decreased hearing thresholds at low frequencies in both groups. Recovery of hearing loss was detected on seventh day measurements in both groups.

Conclusions: Present study showed that spinal anaesthesia can lead hearing loss on first postoperative day, especially at low frequencies and reversible. Emissions of cochlea in the group Q were significantly more decreased than

group A on first postoperative day. It suggested that quincke needle can be more traumatic according to atraucan needle.

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POSITIONING FOR LUMBAR PUNCTURE, MEASURED BY ULTRASONOGRAPHY

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The purpose of this study was to identify the patient position for lumbar puncture associated with the widest interspinous distance utilizing ultrasound introduction. There is no Standard, recommended, optimal position for patients who are undergoing the procedure (1). The physician may choose the L3, L4 or L5 interspace, usually based on which space appears to be widest by palpation of the spinous processes. The clinician may encounter difficulties such a calcified supraspinal ligament or spinal anomalies, resulting suboptimal needle placement. The objective of this study was to identify the patient position associated with the widest interspinous distance by measuring the interspinous space (between the spinous processes) using ultrasonography. We compared the two positions frequently used for lumbar puncture and a third position used in our department for the placement of spinal-epidural anesthesia.

Methods: 31 healthy adult volunteers (14 men and 17 women, age range 17- 44 years, mean 27.3 years) were placed in different three positions. Positions of the patients were Lateral recumbent fetal position in position A, Sitting position with feet unsupported in position B, sitting position by extending the legs straight without hip and knees flexion in position C. Using a portable ultrasound device, the L3-L4 or L4- L5 interspinous space was measured in volunteers. Measurements were compared between the three positions.

Results: The result showed that the interspinous distance was significantly great in the “ C- sitting position by extending the legs straight without hip and knees flexion” position than in the other two positions frequently used for lumbar puncture ($P < 0.001$). Therefore we recommend this position for lumbar punctures especially in situations in which implementing of other two position fails.

1. Kooiker JC (1998) Spinal puncture and cerebrospinal fluid examination. In emergency medicine . Saunders, Philadelphia, pp 1054-1077.

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EFFECTS OF ADDING INTRATHECAL NEOSTIGMINE OR MAGNESIUM SULPHATE TO BUPIVACAINE IN PATIENTS UNDER LOWER EXTREMITIES SURGERIES

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Background and aims: Regional anesthesia is widely used to perform different surgical procedures including those performed on the extremities. In this study, the effects of adjuvant therapies with neostigmine or magnesium sulphate were assessed and compared with those of bupivacaine alone in patients under lower extremities surgeries with spinal anesthesia.

Methods: In this double-blind randomized clinical trial, 90 patients, candidate for lower extremities surgeries in a training hospital, were recruited. The patients with ASA class I and II aging from 20 to 65 years between 2009 and 2010 were evaluated. The selected patients were randomly assigned to receive either bupivacaine alone (Group A, n=30), or bupivacaine plus magnesium sulphate 50% (Group B, n=30), or bupivacaine plus neostigmine (Group C, n=30). The sensory block onset, top level of sensory block, motor block onset, and the completion of motor block and recovery were recorded.

Results: The sensory block onset time and knee flexion time were not significantly different among the three groups ($P > 0.05$), whereas the time to complete motor block and motor recovery time were significantly different between groups.

Conclusions: According to the obtained results, it may be concluded that magnesium sulphate is a safe and effective adjuvant for increasing the onset time of motor block.

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DAY-CASE AMBULATORY ORTHOPAEDIC SURGERY UNDER SPINAL ANAESTHESIA - A SURVEY OF CURRENT OPINION AMONG ANAESTHETISTS PRACTICING REGIONAL ANAESTHESIA IN THE UNITED KINGDOM

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Background and aims: Day-case surgery is increasingly performed with short duration spinal anaesthesia (SA). Some units run SA only lists¹. SA has several benefits above general anaesthesia (GA), eg. avoidance of sore throat, reduced emesis, immediate resumption of oral intake, and avoidance of GA complications. However, SA also has several specific risks, including failure, headache, urinary retention, TNS, neurological injury, hearing loss, visual impairment and cardiovascular collapse².

We question the appropriateness of SA only lists in context of fully informed consent and therefore performed a UK-wide survey of current opinion regarding SA for day-case knee arthroscopy in a 40 year old ASA I patient.

Methods: 602 ESRA registered AAGBI (Association of Anaesthetists of Great Britain & Ireland) members were sent a questionnaire. 208 responded.

Results:

- 90.3% respondents prefer performing GA to SA.
- 1.9% performed SA preferentially, 2.4% used SA in about 50% of procedures, 45.6% used it selectively, 25.7% rarely, and 24.8% never perform SA.
- Anaesthetists stated that 96.6% of patients would prefer GA if the risks and benefits were properly explained.
- 58.4% respondents thought there were no financial advantages in using short duration SA routinely.

Conclusions: The great majority of anaesthetists prefer GA and believe that very few properly informed patients would choose SA. Though there are clear benefits in selected patients, SA has to be carefully considered on balance of risks and benefits compared to the alternatives.

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1. www.daysurgeryuk.net/bads/joomla/files/Handbooks/SpinalAnaesthesia.pdf.
2. Pollard JB. Cardiac Arrest during Spinal Anesthesia: Common mechanisms and strategies for prevention. *Anesth. Analg.* 2001; **92**: 252-256.

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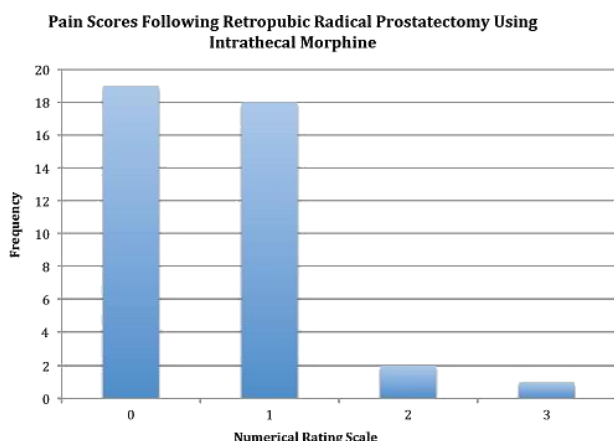
THE EFFICACY OF INTRATHECAL MORPHINE ANALGESIA FOLLOWING RADICAL RETROPUBIC PROSTATECTOMY

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Background and aims: Prostate cancer is the most common cancer of men in the UK¹. Radical retropubic prostatectomy (RRP) is offered to men with high grade disease and low risk for surgery. Severe pain is common following RRP. Effective analgesia reduces morbidity and length of hospital stay. American Pain Society Guidelines would consider moderate-severe post-operative pain unacceptable². A variety of analgesic techniques have been used at our centre. Our aim was to evaluate the quality of analgesia for patients undergoing RRP who received intrathecal morphine for post-operative pain relief. We also evaluated the frequency of opioid related side effects.

Methods: Acute pain charts were collected retrospectively, from May 2011 onwards, for patients undergoing RRP who had received intrathecal morphine for post-operative pain relief. The maximum pain score on a 0-3 numerical rating scale (NRS) and the frequency of nausea, vomiting and respiratory depression were recorded.

Results: Pain scores were collected for 40 patients undergoing RRP at our centre. All received intrathecal morphine 200mcg. 37 (93%) of patients reported no pain or mild pain only (NRS 0-1) (figure 1). No nausea, vomiting or respiratory depression was reported.



[Figure 1]

Conclusions: Intrathecal morphine has offered good-excellent analgesia in 93% of patients undergoing RRP at our centre with no documented nausea, vomiting or respiratory depression. We would recommend the use of this technique.

References:

1. <http://info.cancerresearchuk.org/cancerstats/types/prostate/incidence/uk-prostate-cancer-incidence-statistics>.
2. American Pain Society. Quality improvement guidelines for the treatment of acute pain. JAMA 1995;274:1874-1880.

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COMBINATIONS OF LOW-DOSE ANTIDEPRESSANTS AND LOW-DOSE GABAPENTIN AS USEFUL ADJUVANT TO OPIOIDS FOR INTRACTABLE, PAINFUL BONE METASTASES

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Background and aims: Systemic analgesics would not provide good enough pain relief for some kind of cancer pains. Metastatic bone pain is characteristic of cancer pain and one of the refractory cancer pains, since the pain includes not only nociceptive but also neuropathic pain. Low-dose gabapentin-antidepressants combination with opioids is effective in the management of neuropathic cancer pain. The aim of the present study was to see whether low-dose mirtazapine-gabapentin is effective in the treatment of painful bone metastases.

Methods: Twenty five cancer patients confirmed to have bone metastases were allocated into two groups: G-I group took gabapentin 200 mg and imipramine 5 mg every 12 hours orally; G-M group took gabapentin 200 mg and mirtazapine 7.5 mg every 12 hours orally. Pain assessments were performed at the first visit and 1 to 7 days and 10 and 14 days after the start of the medication.

Results: Not only low-dose gabapentin-imipramine but also low-dose gabapentin-mirtazapine soon decreased the total pain score and paroxysmal pain episodes, and the decreases were statistically significant one day after the medications. Also, the medications maintained the significant decreases for about two weeks. Several patients developed mild drowsiness in the two groups.

Conclusions: Low-dose gabapentin-antidepressant combinations with opioids were effective in the management of painful bone metastases without severe adverse effects.

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THE COMBINATION OF PATCH CAPSAICIN 8% WITH PREGABALIN MAY PROTECT FROM THE DEVELOPMENT OF HYPERALGESIA

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Aim of the study is to examine if the combination of patch capsaicin 8% with pregabalin may protect from the development of hyperalgesia.

Methods: Eleven patients with postherpetic neuralgia were divided into two groups. Patients in Group A (N=6) received patch capsaicin 8% and tab Zaldiar (for ten days). Patients in Group B (N=5) received patch capsaicin 8%, tab Zaldiar (for ten days) and tab pregabalin (150 mg/d). We followed up the patients for 3-4 months.

Results:

- 1) Two patients from the Group A were excluded from the study because they continued to feel pain (VAS>6) and we added pregabalin.
- 2) One patient from the Group B was excluded from the study because he continued to feel pain (VAS>6) and we increased the dose of pregabalin (300mg/d).
- 3) Patients in Group A, 3-4 months afterwards, seems to feel more pain than they were feeling at the beginning, before treatment (8,2 vs 7). On the other hand patients in Group B, 3-4 months afterwards, seems to feel the same pain as they were feeling at the beginning, before treatment (6,9 vs 6,8). The number of patients is small and we can not do statistical analysis.

Conclusion: Although we can not come to definite results, we may conclude that the combination of patch capsaicin 8% with small doses of pregabalin might protect from the development of hyperalgesia.

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THE USE OF 8% CAPSAICIN PATCH FOR TREATMENT OF CHRONIC LUMBAR RADICULAR NEUROPATHIC PAIN

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Background and aims: The sciatica is the most common form of chronic neuropathic pain. The aim of the study is to establish the effectiveness of 8% capsaicin patch in localised chronic lumbar radicular neuropathic pain.

Methods: Prospective, observational study of 50 patients (men-women) aged 50-75 years with sciatica during the period 11/3/11-15/1/12. Pain intensity using NRS, DN4 questionnaire, side effects and the level of patient satisfaction were registered.

Results: Baseline values: NRS: 6, 8±1, 7 DN4: 6, 8±1, 4. At the follow up: NRS: 3, 1±1, 6. 88% of patients present reduction of pain ≥3 points 8% of patients present reduction ≤3 points 4% were lost to follow up.

The most common side effects were erythema and local application side burning lasting up to 24 hours after application. As far as patient satisfaction 44 patients were totally satisfied, 4 patients were satisfied and 2 patients were lost to follow up. 15 patients were retreated.

Conclusions: 8% Capsaicin patch was useful in the treatment of chronic lumbar radicular neuropathic pain observing a reduction in pain intensity, no severe side effects and a high degree of satisfaction to the patients.

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EPIDURAL ABSCESS FOLLOWING SURGICAL PLACEMENT OF SPINAL CORD STIMULATOR AND LEADS

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Introduction: Epidural abscess is a rare, but known risk factor after any invasive procedure involving the epidural space. We present such a case that occurred after a surgically implanted spinal cord stimulator.

Case: A 60-year-old female with post-lumbar laminectomy pain syndrome underwent surgery for a spinal cord stimulator. She was taken to the operating room and a sterile surgical prep and drape were performed. A skin incision was made and under fluoroscopic guidance, leads were placed via paramedian approaches with entry points into the epidural space at L1/L2, and advanced to the T9-10 level. An internal pulse generator was placed in a subcutaneous pocket over the buttock, and the wounds were irrigated with bacitracin and closed in multiple layers with vicryl sutures and skin staples.

28 days later, she presented to the emergency room with a purulent discharge from her surgical incision. An MRI was obtained and revealed an epidural abscess from T8-L1, with mild spinal cord compression. She was taken to the operating room for removal of her stimulator and epidural leads,

and started on intravenous antibiotic therapy for 8 weeks and made a full recovery.

Discussion: Implanting a spinal cord stimulator is not without serious risk. Although a literature review suggest that infections are the third most common complication, and occur at a rate of 3-5%, most of these infections occur in the subcutaneous pocket surrounding the pulse generator and connection to the leads, and do not extend into the epidural space, making this case unique.

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TREATMENT OF CHRONIC LOW BACK PAIN WITH PERIRADICULAR INJECTION OF MELOXICAM: LONG-LASTING BENEFICIAL EFFECTS

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Background and aims: Chronic low back pain radicular (LBP) involving one or more dermatomal levels can occur without obvious structural causes. A pilot study was designed to assess the effect of periradicular injection of meloxicam on chronic LBP.

Methods: 56 patients (27males,29females) with chronic LBP (median duration 3years range 0.5-39). Mean period of follow up of 33 months after periradicular infiltration of meloxicam 10 mg in 10 ml of saline at each involved dermatomal levels. The patients were assessed using a standard Verbal Rating Scale (VRS) with 0=no pain to 10=severe pain, before the initial injection (baseline) and at 1,5,10,30,60 min, and 1,5,15,30 and 90 d after meloxicam. Repeat injections of meloxicam were administered only if VRS $\geq$ 3.

Results: The mean baseline pain score was 9 ± 0.9 despite use of multimodal analgesic regimes, with 91% of the patients receiving NSAIDs, glucocorticosteroids and paracetamol. In addition, 55% of the study patients were also taking oral opioid analgesics, 25% used gabapentanoid compounds, 9% received epidural steroid and/or local anesthetics injections, 9% received peri-facet injections, 12% underwent laser treatment and physical therapy. At 1 minute after the initial injection of meloxicam, the mean radicular pain score was decreased. 37% patients required no further injections, 43% required a second injection after 7 days, and 20% 3 injections. After the meloxicam treatments, all patients were able to increase their level of physical activity, only 18% required occasionally "rescue" analgesia with oral NSAIDs.

Conclusions: Periradicular injection of meloxicam may be an effective therapeutic option for patients with LBP due to nerve root irritation.

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KYPHOPLASTY FOR VERTEBRAL COMPRESSION FRACTURES TREATMENT: MULTIDISCIPLINARY PAIN APPROACH

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Background and aims: Vertebral compression fractures (VCF) are a major cause of morbimortality. Kyphoplasty (KP) is a minimally invasive percutaneous technique used to treat pain and improve function in patients with VCF due to osteoporosis and other osseous lesions (metastases, multiple myeloma and hemangiomas)[1]. Our aim is to describe the role of a multidisciplinary Chronic Pain Unit (CPU) in the management of these patients with VCF using KP.

Methods: We describe our current practice to treat patients with VCFs who underwent KP.

Results: KP was performed in 18 patients between January 2009 and April 2012 in our CPU as day case procedures. Pre, intra and postoperative assessment was done by a multidisciplinary team. Patient selection is based on clinical and radiological criteria: painful VCF, MRI images with a hyperintense signal in the fractured vertebrae and type A with intact posterior cortex. The anesthetic technique employed was local anesthesia and sedation (benzodiazepines and short-acting opiates). The procedures were performed by a chronic pain anesthesiologist and an orthopedic surgeon with no complica-

tions recorded. Follow-up was conducted on all patients using Short-Form 36 and Oswestry Disability Questionnaire. All patients reported pain relief and 8 patients were discharged, from the CPU, until 1 year after surgery.

Conclusions: From our experience, when KP is performed in selected patients, by a multidisciplinary team, it seems to persistently improve pain without surgical or anesthetic complications. However, long term follow-up is necessary.

References: [1] M.Wiles, R.Nowicki, S.Hancock, et al. Anaesthesia for vertebroplasty and Kyphoplasty. *Current Anaesthesia & Critical Care* 20(2009)38-41.

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PAMIDRONATE DISODIUM VERSUS CALCITONIN: A COMPARATIVE STUDY IN THE MANAGEMENT OF BONE METASTASES IN PATIENTS WITH BREAST CANCER

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Background and aims: The presence of bone metastases has been found to be the most common cause of cancer-related pain. Bisphosphonates are used in the treatment of bone disease. Calcitonin, as a hypocalcemic drug, may be useful as adjuvant analgesic.

Methods: Ethical approval was granted from National Cancer Institute. This prospective study was conducted on 60 female patients, they were complaining of painful bone metastases from breast cancer. The patients were randomly allocated to one of three groups according to the drug received, pamidronate group received 60 mg / 2 weeks for three months, calcitonin group received 100 IU S.C. / day daily for 14 days and then day after day for the rest of the study, and combination group received combination of the two regimens. Patients were evaluated for vital signs, bone pain scoring, Visual Analogue Scale V.A.S., narcotic score, and biochemical parameters: serum calcium, serum bone alkaline phosphates, urinary calcium, urinary creatinine and urinary hydroxyproline.

Results: Significant decrease in bone pain scoring was found in pamidronate and combination groups. Calcitonin was found to be more hypocalcaemic with rapid action.

Conclusions: Combining the two drugs make benefit from the rapid onset of calcitonin and the delayed but long acting action of pamidronate in dealing with hypercalcaemia of malignancy.

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ULTRASOUND GUIDED NERVE BLOCKS IN CHRONIC PAIN MANAGEMENT 2 YEARS PERSONAL EXPERIENCE

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Background: Traditionally, intervention techniques in chronic pain management are performed under fluoroscopic or CT guidance. Recently, there was growing concern with ultrasound (US) as it gives a real-time image for needle and surrounding anatomy so it improves patient safety. It is portable, relatively easy to learn, moderately priced, and does not pose any radiation risk.

Aim: To clarify the techniques of ultrasound guidance in chronic pain management.

Methods: After gaining some experience in US guidance in anaesthetic practice at St. JOSEPH's Hospital London Ontario Canada, US guided nerve block was used in diagnosis and management of chronic pain at Medical Research Institute Hospital, Alexandria University. All patients gave their consents before undergoing nerve blocks.

US scanning for stellate ganglion block (SGB): For diagnosis and management of complex regional pain syndrome (CRPS) and phantom upper limb.

US scanning for suprascapular nerve block: For shoulder pain management.

US scanning for paravertebral block: To reduce chronic pain after breast therapy for cancer.

US scanning for thoracic, lumbar and caudal epidural block: For epidural catheter implantation, corticosteroid and local anaesthetic injection for radicular pain symptoms, phantom limb and CRPS.

US scanning for transversus abdominis plane block, US scanning for ilioinguinal and iliohypogastric nerve block and US scanning for

lateral femoral cutaneous nerve block were used for management of persistent neuralgia following radiotherapy or surgery.

In conclusion, ultrasound guided regional block is a novel technique in chronic pain management. Focusing a spotlight on its scanning technique is recommended to encourage its use.

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CAREFUL USE OF QUTENZA (CAPSAICIN 8%) PATCH TO TREAT FACIAL POST HERPETIC NEURALGIA

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Background: Ten to 15% of these patients with herpes zoster will develop long lasting neuropathic pain and of those over 60 years old, nearly half will experience symptoms of PHN¹. Qutenza (capsaicin 8%) patch has been used successfully to treat post herpetic neuralgia (PHN) and is associated with a low complication rate². The manufacturer warns about its use near the eyes or mucus membranes.

Methods: Three case reports of patients with post herpetic neuralgia affecting the face that had failed treatment with oral analgesics and adjuvants. They then had a Qutenza (capsaicin 8%) patch carefully applied to the painful area of the face.



[Qutenza to the face]

Results: All three had good initial response with significant reduction of the pain, but unfortunately this lasted only three weeks at most. After the application the skin was erythematous and the patients noted some local discomfort, but had no eye nor mucosal irritation after the application.

Conclusions: Qutenza can be used to treat facial PHN, its application has to be very careful to avoid any eye and mucosal irritation. The eye on the affected side should be protected with gauze and taped shut. More experience is needed.

References:

- 1) Herne, K., R. Cirelli, et al. (1996). "Antiviral therapy of acute herpes zoster in older patients." *Drugs Aging* 8(2): 97-112.
- 2) Jones, V. M., K. A. Moore, et al. (2011). "Capsaicin 8% topical patch (Qutenza)—a review of the evidence." *J Pain Palliat Care Pharmacother* 25(1): 32-41.

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PULSED RADIOFREQUENCY OF LUMBAR DORSAL ROOT GANGLION FOR CHRONIC POSTAMPUTATION PHANTOM PAIN

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Background and aims: Chronic pain following lower-limb amputation usually presents as a combination of phantom and stump pain. Controlling these types of neuropathic pain is always complicated and challenging. If pharmacotherapy does not control the patient's pain, interventional procedures have to be taken. The aim of this study was to evaluate the efficacy of using pulsed radiofrequency (PRF) on the dorsal root ganglia (DRG) at the L4 and L5 nerve roots to improve phantom pain.

Methods: Two patients with phantom pain were selected for the study. After a positive response to segmental nerve blockade at the L4 and L5 nerve roots, pulsed radiofrequency was performed on the L4 and L5 dorsal root ganglia.

Results: Global clinical improvement was good in one patient, with a 40% decrease in pain on the visual analogue scale (VAS) in 6 months, and moderate in the second patient, with a 30% decrease in pain scores in 4 months.

Conclusions: PRF of the dorsal root ganglia at the L4 and L5 nerve roots may be an effective therapeutic option for patients with refractory phantom pain.

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IMPACT OF EXTRACORPOREAL SHOCK WAVE THERAPY IN THE TREATMENT OF CHRONIC LATERAL EPICONDYLITIS

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Background and aims: Radial shock wave therapy (RSWT) is a relatively new way to treat chronic tendinopathies, such as lateral epicondylitis. However, very few studies have been realized on this subject, and the results are very divergent. We aimed to observe the impact of this technique on chronic lateral elbow pain.

Methods: Fifteen subjects who had a lateral epicondylitis for at least 3 months were included in the study. Two groups were formed: experimental (10 subjects) who received 6 sessions of physiotherapy and RSWT, and the control group (5 subjects) who received exclusively physiotherapy. Physiotherapy sessions were composed of massage, stretching, diacutaneous fibrolysis, and a muscular eccentric program of the wrist extensor muscles. We evaluated the subjects before the first session, and after 6 weeks of treatment with a pain visual analog scale (VAS), the painless wrist flexion amplitude, and the "Patient-Rated Tennis Elbow Evaluation" (PRTEE) questionnaire.

Results: The difference between initial and final evaluations was significant (regarding to the wilcoxon test) for all of the parameters studied (p=0,028 for the VAS, p=0,005 for the wrist flexion amplitude, and p=0,005 for the PRTEE) in the experimental group. It was not significant in the control group (VAS p=0,14, wrist flexion amplitude p=0,08, and PRTEE p=0,07). The comparison between the two groups was not significant, neither in the beginning, nor in the end of the treatment (regarding to the Umann and Whitney test).

Conclusions: RSWT associated to physiotherapy is a more effective treatment for lateral epicondylitis than physiotherapy alone.

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NALOXONE REVERSAL OF URINARY RETENTION ASSOCIATED WITH SPINAL OPIOIDS

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Background and aims: Spinal administration of opioids can improve the quality of life in end stage cancer, and this has been suggested as an additional step for the WHO ladder for patients continuing to experience refractory pain despite systemic medications. However, spinal opioids may lead to adverse effects¹ including urinary retention. This case study tested one treatment modality described in the literature.

Method and results: A tunnelled intrathecal catheter was inserted to relieve intractable severe pain resulting from pelvic recurrence of rectal adenocarcinoma in a 41 year old female. 200mls 0.125% L-bupivacaine plus 20mg diamorphine was infused at 0.8ml/hr. Commencement of treatment was associated with urinary retention despite normal motor function requiring urinary catheterisation and two trials without catheter were unsuccessful.

A literature review suggested potential benefit for the unlicensed use of naloxone. Two subcutaneous doses of 100 mg naloxone were administered with immediate resolution of urinary retention and no recurrence. After one month the spinal catheter was removed and re-inserted after 36 hours, again with persistent urinary retention. This responded rapidly to one further dose of naloxone. There was no adverse effect on analgesia. The patient was discharged home fully mobile and survived a further four months with good urinary function.

Conclusions: Spinal administration of opioids may be associated with urinary retention².

An opioid antagonist given in small doses can reverse this side effect without adverse effects on analgesia.

References:

- ¹ *Clinical Journal of Pain*, 2008; 24: S8-S13.
- ² *Clinical Pharmacology and Therapeutics*, 2007; 82/1(48-53).

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MULTIMODAL APPROACH IN THE TREATMENT OF BACK PAIN AND RADICULAR PAIN - CASE REPORT

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Background and aims: Despite analgesic therapy and minimally invasive procedures of pain-treatment, the result is often unsatisfactory. The aim of this paper is to show that besides the physician; also the patient has a very important role in a long-term reduction of pain.

Methods: This is the case report of a patient with pain in the thoracic and lumbar spine, with the pain spreading bilaterally in the lower extremities. The patient's magnetic resonance image showed pathology of thoracic and upper lumbar spine. The patient was advised to take pregabalin, diclofenac and Zaldiar tablets as needed and reduce his weight (132 kg). We performed an epidural steroid injection, using the interlaminar approach at the level of L1 / LII with 80 mg Depo Medrol and 10 ml of 0.25% levobupivacaine.

Results: Arriving to our clinic the patient had experienced pain for the last three months (VAS 10). After the epidural steroid injection, the condition was significantly improved, and the intensity of pain was 5 (VAS). At the follow-up visit the intensity of pain was decreased (0-5 by VAS). After five months the patient's analgesic therapy was cancelled with a pain intensity 0-3 (VAS) without pharmacotherapy. The patient successfully continued the weight-loss with physical exercise (swimming) and a changed lifestyle. After fifteen months the patient had lost 50 kg in weight (82 kg).

Conclusions: Analgesic therapy with epidural steroid administration, life-style changes and weight loss has proven successful in reducing back and radicular pain with this patient.

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INFILTRATION OF THE LATERAL FEMOROCUTANEUS NERVE OF THE THIGH WITH MIXTURE OF LEVOBUPIVACINE 0.5% AND TRIAMCINOLONE FOR TREATMENT OF MERALGIA PARESTHETICA

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Background and aims: A 37 years old patient referred strong pain in the thigh after a knee arthroscopy, with disesthesia and allodynia, worse at night and had difficult to sleep because of pain. EVA 6. He was in treatment with pregabalin 75MGs/12 hoURS, tapentadol 50mgs/12 hours and lidocaine patch /24 hours.

Methods: We realized a block of the lateral femorocutaneous nerve of the thigh with the administration of a mixture of levobupivacaine 0.5% and triamcinolone acetoneide (40mgs) with a Pajunk Stimuplex needle guided with ultrasounds. Patient was revised two weeks later.

Results: The patient pain improved (EVA 3). Allodynia and disesthesia disappeared.

Conclusions: Infiltration of the lateral femorocutaneous nerve of the thigh with mixture of levobupivacaine and triamcinolone acetoneide can be a good treatment for meralgia paresthetica.

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INFRACLAVICULAR CATHETER AS A TREATMENT OF COMPLEX REGIONAL PAIN SYNDROME TYPE I

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Background and aims: To adopt a new approach to the treatment of the complex regional pain syndrome with levobupivacaine 0.125 % continuous infusion through infraclavicular catheter.

Methods: We reported a 20-year-old patient, after Colles fracture and immobilization, presented an arm complex regional pain syndrome. The pain, six months long, were localized on right arm, more intense in forearm and hand. It was a stabbing pain, with paresthesias and an intense allodynia, making difficult to get to sleep. VAS 6-8 rated. It was found in clinical examination an intense right-hand oedema, raised in temperature, and a deep pain in passive mobilization. She was previously undergone with Pregabalin 75 mgs and Tramadol 100 mgs every 12 hours.

In that situation, it was inserted a Pajunk Stimuplex catheter and levobupivacaine 0.125 % continuous infusion (5 ml/h) was prescribed. The patient was evaluated weekly for two months.

Results: The patient underwent a pain fall (VAS 2-5 rated), decreasing edema and allodynia. Previous treatment was left.

Conclusions: Infra-clavicular block with levobupivacaine 0.125 % continuous infusion appears as a good treatment approach in complex regional pain syndrome.

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PHARMACOLOGICAL AND SURGICAL TREATMENTS OF PAIN IN CHRONIC PANCREATITIS

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Background and aims: Abdominal pain is a major clinical syndrome in chronic pancreatitis. The aim of the study was to explore the possibilities of pharmacological and surgical treatment of pain in chronic pancreatitis.

Methods: Pain in the dynamics was studied among 170 patients with chronic pancreatitis. All were performed reconstructive surgery on the pancreas. Severity of pain was studied among patients in 3-month's period during 15 years using a visual analogue scale (VAS). Pharmacological therapy of pain included diet, non-steroidal anti-inflammatory drugs (NSAIDs), narcotic analgesics, long-term epidural analgesia. Surgical treatment of recurrence of pain is to perform thoracoscopic sympathectomy.

Results: The intensity of pain in before-operating period was $4,8 \pm 0,5$ VAS. Continuous epidural analgesia (0.2% ropivokain + fentanyl) was the most effective treatment of pain in before-operating period with the intensity of pain does not exceed $1,7 \pm 0,8$ points VAS. The intensity of pain was $3,9 \pm 1,2$ point VAS when (NSAIDs) and narcotic analgesics. The intensity of pain the late postoperative period (36 ± 8 months) depended on the type of surgery and ranged from $0,7 \pm 0,9$ to $2,7 \pm 0,9$ points VAS. For the treatment of pain in 25% of patients after resection of interventions in terms of 1.5 to 7 years performed thoracoscopic sympathectomy. Pain was completely eliminated in 50% of cases.

Conclusions: Pharmacological treatment of pain allows the well to arrest the pain syndrome in the before operating period. In the postoperative recurrence of the segregated pain in 50% of cases can be eliminated by thoracoscopic sympathectomy.

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A CASE SERIES STUDY USING PATCH OF CAPSAICIN 8% ON THE TREATMENT OF NEUROPATHIC PAIN - OUR EXPERIENCE

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Background and aims: Neuropathic pain affects 8-9% of patients with chronic pain. It's a complex pain with different etiology and may be presented with a variety of symptoms and individual answers and with an unpredictable result. It has a great impact in Quality of Life and increases health care related costs. Patch of Capsaicin 8% is indicated in adults with peripheral neuropathic pain. The aims of this cases series study, were to investigate, examine and report the effectiveness of the patch and the interference into daily life.

Methods: 37 patients were included in this study, (M:10; W:27), between 23 and 85 years-old and we've applied capsaicin 8% patches (according to SmPC's application procedure). They had a diagnosis of neuropathic pain or pain with a main neuropathic component. These patients were evaluated with the Visual Analogue Pain Scale before (VAS₁) and after (VAS₂) treatment. During the study they were contacted telephonically in order to get a qualitative evaluation and were followed every two months.

Results: 13 patients presented a great improvement (VAS₁: 8.9; VAS₂:2.3); 9 patients presented improvement (VAS₁: 8.9; VAS₂:4.5). The first 13 patients applied the patch 3 times, and 3 of them discontinued oral medication. 15 patients didn't show any VAS improvement.

Conclusions: This cases series study suggests that capsaicin 8% patch shows a good result into the relief of symptomatology and may benefit patient's quality of life. However, further investigations with randomized controlled trials may be warranted.

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LUMBAR HYGROMAS MANAGEMENT DURING INTRATHECAL DRUG DELIVERY

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Background and aims: Intrathecal drug delivery potential complications include spinal headache, epidural, subdural and subcutaneous hygroma, cerebro spinal fluid leakage around the catheter insertion site and pump pocket seroma. An adequate protocol of complications treatment is mandatory. We are presenting two cases of lumbar hygroma treatment occurring in our Pain Center.

Methods: A 47 yr women developed after 8 days from implant a lumbar hygroma and Post-Dural Puncture Headache. A selective lumbar epidural blood patch has been performed with 20 ml under direct control of fluoroscopy after one unique percutaneous diagnostic aspiration of hygroma. Conservative measures of keeping the patient at bed and using a compressive dressing were continued for 7 days. A 19 yr male developed after 4 days a progressive and limited lumbar hygroma without PDPH. Only conservative measures and one percutaneous aspiration were adopted. Hygroma was small and self-limiting and disappeared on its own.

Results: In the first case headache persisted for 3 weeks, orally steroid therapy was initiated at beginning. Two magnetic resonance with gadolinium injections did not observed a fistula or a pseudomeningocele after 10 and 25 days. A reduced swelling has persisted for sometime also after discharge at home. In second case without PDPH, local swelling disappeared completely after two weeks.

Conclusions: PDPH can influence the choice between conservatives measures and not during complications of intrathecal implants. A preventive protocol is mandatory as 1 to 2 days of patient lying flat at bed and abdominal binder with pressure dressing at the spinal site.

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POST HERPETICAL NEUROPATHIC PAIN TREATED BY EPIDURAL INJECTION

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Background and aims: Treatment of post herpetic neuropathy are not still defined. Among the different possible therapeutic approaches, there is the technique of epidural injection of drugs, whose efficacy we intended to verify.

Methods: Our study has been performed in 9 months in 15 patients, range 46-75years, affected by chronic neuropathic post herpetic pain. All these patients had previously undergone unsuccessful conservative therapy. Our therapeutic strategy combined invasive procedure with drugs already in therapy (NSAIDs 82%, strong opioids 15%, tramadol about 61.6%, tricyclic antidepressants 85%, anticonvulsants 74.5%). The patients received Bupivacaine and Methylprednisolone as a day procedure. Using a standard technique, with 18 G Tuohy needle the puncture was performed medially in the corresponding lumbar or thoracic interspace. Pain score (VQS) were used to assess patients before and after epidural injections.

Results: There were no complications. In the whole group of patients we performed maximally 3 epidural injections. We had two no-responder patients. Just after 14 days, 78% patients were satisfied and their VQS were improved significantly. After 3 months only 25% of patients has still necessity to continue some conservative therapy.

Conclusions: Our therapy obtained very good pain relief. It seems to be good approach to post herpetic pain in outpatient's treatment. This is pro-

totype of patient with chronic neuropathic pain who needs a multidisciplinary and multimodal approach.

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SURGEONS ADMINISTERING LOCAL ANAESTHETIC: A SURVEY OF KNOWLEDGE OF DOSES, TOXICITY AND INTRALIPID

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Background and aims: The incidence of local anaesthetic toxicity (LAT) is quoted as 0.01%. Overdoses can result in rare yet life threatening complications including cardiorespiratory arrest. Peripheral nerve blocks are associated with the highest incidence of systemic toxicity and may be performed by surgeons. Our aim was to assess surgeons' knowledge of local anaesthetic doses; their ability to recognise LAT; and their knowledge of intralipid.

Methods: Questionnaires were completed by surgeons from foundation year to consultant grades. We assessed their knowledge of various LA agents, including safe doses, toxicity features and treatment. All responses were anonymous.

Results: Results were collected from fifty three surgeons in nine different surgical specialities.

Consultant	Staff Grade	ST 3-7	ST1-2/ F 1-2
3/19 (16%)	1/3 (33%)	3/21 (14%)	3/10 (33%)
[Grades correctly stating safe maximum dose of LA]			

	Numbers correctly stating maximum safe dose	Numbers stating doses within a safe range for a 70 kg patient	Numbers stating unsafe doses for a 70 kg patient
Lignocaine (3mg/kg)	10 (19%)	18 (34%)	9 (17%)
Lignocaine with adrenaline (7mg/kg)	10 (19%)	19 (36%)	0 (0%)
Bupivacaine (2mg/kg)	7 (13%)	11 (21%)	5 (9%)
Bupivacaine with adrenaline (2mg/kg)	1 (2%)	6 (11%)	11 (21%)

[Knowledge of local anaesthetic doses]

45/53 (75%) identified at least one side effect of LAT, but only 4/53 (7.5%) mentioned intralipid for treating LAT.

Conclusions: It is essential that professionals administering local anaesthetic understand safe doses, effects of toxicity and recommended treatment. This survey demonstrates significant lack of knowledge at all grades and highlights inadequacies of teaching safe practices for local anaesthetic use by all surgical specialities.

We suggest formal training for all levels.

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A DOUBLE-BLIND PLACEBO CONTROLLED TRIAL COMPARING ALIZAPRIDE AND ONDANSETRON IN THE PREVENTION OF POSTOPERATIVE NAUSEA AND VOMITING (PONV) IN PATIENTS UNDERGOING GYNAECOLOGICAL LAPAROSCOPY

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Background and aims: PONV occurs after surgery with an incidence up to 80%. Guidelines, suggest to use antiemetic prophylaxis only in moderate to high PONV risk patients. The choice of antiemetic depends on safety, effectiveness and economics. This trial compared alizapride(A), a cheap antiemetic, with ondansetron(O) for the prevention of PONV, to demonstrate non-inferiority of A to O.

Methods: A 100mg was compared to O 4mg and placebo(P) in a double-blind, randomized, placebo controlled ethical approved study in 520 ASA

I/II patients undergoing gynaecological laparoscopy. Study drugs were given 30min before end of surgery. VAS score for nausea and number of emetic episodes were recorded during 24 hours. Treatment of PONV was with dexamethasone and droperidol. Statistical analysis was performed by our biostatistical department to test for non-inferiority. If a relative risk ratio of more than 1.125 was found, we considered A to be less effective than O.

Results: The incidence of patients ever experiencing PONV during PACU stay was 32.1% in the A-group compared to 28.6% in the O-group and 34.2% in the P-group. The incidence of PONV during 24 hours was 36.8% in the A-group versus 31.5% in the O-group and 39.25% in the P-group. A subgroup analysis revealed that in patients with only 2 risk factors, the risk for PONV during 24 hours in the A-group was 12.1% and 25.6% in the O-group.

Conclusions: In high-risk patients, A is less effective than O. In patients with only 2 risk factors, A is non-inferior compared to O and might be a cost-effective alternative.

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POST-OPERATIVE PAIN IN DAY CASE SURGERY: ARE WE GIVING THE RIGHT ANALGESICS AFTER DISCHARGE?

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Background and aims: The control of postoperative pain (POP) in day case surgery contributes to the satisfaction and quality of health care in Ambulatory setting.

In our country, after day case surgery, the patient must be given appropriate analgesics to take home and this can contribute to better control of POP.

Our aim is the evaluation of POP by a phone contact 24 hours after surgery and verification of yielded analgesia's adequacy.

Methods: Revision of the 24 h postoperative contact of patients older than 18 years old who was operated in the Ambulatory Unit during 2011. We evaluated the POP's intensity and when it was moderate or severe we evaluated the analgesic protocol that was given to the patient to take home.

Results: Reviewed 1893 patients which 65.3% was female, 58 patients had moderate pain and one severe pain. Considering only the surgical procedure, 41.4% would have previsible severe pain and 18.9% moderate pain. In 55.2% analgesic medication yielded after discharge was adequate to previsible pain.

Conclusion: We verify a good control of POP.

The analgesic's choose considered not only the surgical procedure but also other factors related to the patient and his behavior before discharge. This study, contributed to our practice analysis and the verification that the pluridisciplinary work is vital in the control of POP.

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THE ROLE OF NITRIC OXIDE IN ACUTE LUNG INJURY: A HISTOLOGICAL AND BIOCHEMICAL STUDY

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Background and aims: Respiratory complications are major factors contributing to death in acute toxemia. They are characterized by complex interactions among cytokines, chemokines, adhesion molecules and leucocytes. Pro-inflammatory cytokines have been implicated in the up regulation of the inducible form of nitric oxide synthase (i-NOS) which produces large amounts of nitric oxide (NO). This study was conducted to investigate the effects of nitric oxide on the course of acute lung injury.

Methods: Study was conducted under guidelines of animal care in Kasr al Aini medical school. Thirty two adult male albino rats were equally divided into four groups: Group (I) served as control. Acute lung injury was induced in the other three groups by subcutaneous injections of caerulein. Group (II) was left untreated. Group (III) L-arginine (NO precursor) was co-administered with caerulein, while group (IV) was treated simultaneously with L-NNA (NOS inhibitor).

Results: The histological picture of lung injury was associated with hypoxemia. These changes worsened with the co-administration of L-arginine. Treatment with L-NNA greatly improved the condition, as manifested by the microscopic examination of lung sections and through analysis of blood gases. Immunohistochemical study of inducible nitric oxide synthase revealed that pneumocytes type (II) and some inflammatory cells (polymorphs) may be the possible source of endogenous NO production in acute lung injury.

Conclusions: It is suggested that i-NO inhibitors may have a potential role in treatment of adult respiratory distress syndrome.

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COMPARISON OF INJECTION PAIN OF PROPOFOL IN DIFFERENT AGE AND GENDER GROUPS: PROPOFOL LCT VS PROPOFOL MCT/LCT

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Background-aims: Propofol is a widely used agent with pain during injection. Most of the studies reports pain was due to high concentration of free propofol and the long-chain triglycerides (LCT). Propofol medium-chain triglyceride/long-chain triglyceride (MCT/LCT) emulsion was formulated to decrease pain on injection. Our aim is to determine whether there is a relationship between age and gender groups in terms of pain frequency and severity around injection site with propofol-LCT and propofol-MCT/LCT.

Methods: After getting ethical committee approval 607 ASA-II patients were included to the study. Patients were randomized into two groups (group LCT and Group MCT). Each groups were divided into 3 subgroups according to their ages: group Y (18-40 years old), group M (41-65 years old), group E (over 65 years old). Group LCT and MCT were also divided into two groups according to gender. In group LCT (n=303), 25% of the calculated propofol-LCT dose (2 mg/kg), in group MCT 25% of the calculated propofol-MCT/LCT was given with 0.5 ml/sec rate. Following the injection, patients' VAS were evaluated.

Results: VAS values are significantly higher in LCT when compared with group MCT (p<0.001). When compared the VAS values are higher both in subgroups Y and M of group LCT than subgroups Y and M of group MCT (p<0.05). In intergroup comparison VAS values were higher in MCTf and LCTf groups compared to MCTm and LCTm.

Conclusions: We report that Propofol-MCT/LCT causes significantly lower injection pain than propofol-LCT and the pain is higher in young and middle aged group and in women.

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PREVENTION OF PAIN DUE TO INJECTION OF PROPOFOL WITH ADMINISTRATION OF LIDOCAINE & METOCLOPRAMIDE

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Background and aims: Propofol is a rapidly acting anesthetic agent and is widely used to induce of general anesthesia. However pain on injection is a common and adverse problem which is sometimes distressing to patients. Lidocaine has been found efficacious in reducing pain on injection of propofol; but, this type of pain may not be completely eliminated with lidocaine. Metoclopramide is a dopaminergic receptor blocker with antiemetic action. Metoclopramide has a peripheral analgesic effect; because metoclopramide has structural and physicochemical properties similar the procaine and procaineamide. It was demonstrated that its effect in reducing propofol pain injection comparable with lidocaine. The aim of this study was to examine the analgesic effect of combination lidocaine/metoclopramide administered and compared with lidocaine alone for reducing pain on injection of propofol.

Methods: In this prospective, randomized and double blind study 200 male and female patient conducted for elective and short duration surgery and received either lidocaine 20mg plus metoclopramide 10 mg iv or lidocaine 20 mg iv alone with venous occlusion method, and then 1mg/kg of propofol was administered in dorsal hand vein. Pain intensity was assessed through four point scale.

Results: The incidence of propofol injection pain in the lidocaine/metoclopramide group (n=5) was significantly lower than lidocaine group (n=13) (p=0/04). Severity of pain in two groups was only mild (score=1). In the other hand, within first 24 hours after propofol injection, only in one patient in lidocaine group was demonstrated complication (skin wheal) (n=1) (p=0/316s).

Conclusion: This study demonstrated That lidocaine metoclopramide combination is more effective than lidocaine alone for reducing pain on injection of propofol.

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SURVEY OF NATIONAL PRACTICE FOR THE CLEANING OF ULTRASOUND EQUIPMENT IN HOSPITALS IN ENGLAND

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Background and aims: Ultrasound equipment has been shown to be a vector for infection transmission and, although rare, there are reports of serious and even fatal complications. Manufacturers recommend a variety of products for cleaning with no national or institutional guidelines regarding for which is most effective.

The aim of this study was to establish the current practice in the cleaning of ultrasound equipment in acute hospitals in England.

Methods: Written confirmation was received from the West Anglia Research Ethics Committee that formal ethical approval was not required for surveys of National Health Service staff. An anonymized questionnaire was sent to the lead Operating Department Practitioner in all acute NHS hospital trusts in England. Repeat questionnaires were again mailed to trusts which did not respond to the first mailing and then non-responders were asked to complete the questionnaire as a telephone based survey.

Results: The response rate from the survey was 56% (92 out of 164 hospitals). 61% of the surveyed hospitals use Sonosite™ machines. 75% of hospitals use proprietary wipes. In order of frequency these are as follows: Clinell™, PDI-Sani Cloth™, Tuffie Wipes™ and Tristel™. 23% of hospitals use soap and water alone.

Conclusions: Our results show a wide variation in national practice for cleaning ultrasound equipment nationally with a significant minority using soap and water alone. We recommend Sani-cloth CHG 2% as a separate study by our group has shown superiority in cleaning to soap and water and a residual effect which persists for at least six hours.

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LENGTH OF HOSPITAL STAY FOLLOWING PRIMARY TOTAL HIP AND KNEE REPLACEMENT: GA VS REGIONAL

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Background: Leeds Teaching Hospitals has a dedicated unit for joint arthroplasty. Well defined patient pathways are in place to optimise peri-operative care enabling fast-track THR and TKR. Anaesthesia influences outcome including Length of Stay (LOS) by affecting analgesia, PONV and time of mobilisation. Our aim was to review LOS following primary lower limb arthroplasty with different types of anaesthesia.

Methods: Data were collected retrospectively through electronic records over a 6 month period from March to August 2011. Hip and knee replacements were each categorised into 2 groups: Group 1 - GA (GA, GA +Block and GA+Spinal); Group 2 - Regional (Spinal, Spinal +Block, Spinal +LA). LOS data were statistically analysed using Mean, Median, Mode and t-test to look at the relationship between LOS in the two groups of primary hip and knee arthroplasty.

Spinal +LA was compared to Spinal+ Nerve Block, which was the default regional technique for THR.

Results: Data was analyzed for 161 THR and 131 TKR over a 6 month period.

	Mean	Median	Mode
(TKR) GA Regional	3.68 3.76	4 4	4 4
(THR) GA Regional	3.5 3.7	4 4	4 3
[LOS]			

Conclusions: There was no significant difference in the LOS in patients receiving GA or Regional for Hip or Knee replacement. Spinal+LA does not seem to influence LOS in TKR. LOS in our hospital is well within national

standards. We propose to analyse a bigger sample to get conclusive evidence whether LOS and Anaesthetic is related.

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SONOANATOMIC VARIATIONS OF PES ANSERINE BURSA

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Background and objectives: The pes anserine bursa lies beneath the pes anserine tendon, is prone to inflammation due to overuse, misuse, or direct trauma. The pes anserine bursitis is a cause of chronic knee pain and weakness. Accurate diagnosis of position of bursae is critical for diagnostic and therapeutic goals. The aim of this study is to evaluate sonoanatomic variations of pes anserine bursa in medial knee.

Patients and methods: We enrolled 170 patients admitted to pain interventional ward and general operation room. Ultrasound imaging (transverse approach, 7-13 MHz linear array probe) identified the medial knee and the variations in sonoanatomic position of pes anserine bursae according to Pes anserine tendons. Additionally we evaluated the sonoanatomic variation of saphenous nerve.

Results: Demographic data were not difference. The position of pes anserine bursa was 21.2% (in males) and 18.8% (in females) between medial collateral ligament and pes anserine tendons; 67.1% (in males) and 64.7% (in females) between pes anserine tendons and tibia; and 8.2% (in males) and 12.9% (in females) intra pes anserine tendons. The saphenous nerve, 77.6% (in males) and 74.1% (in females) had intratendons position and 18.8% (in males) and 15.3% (in females) had extratendons position of pes anserine tendons (P = 0.18). Visibility of sonoanatomic structures was well 20% (in males) and 21.2% (in females); moderate 63.5% (in males) and 64.5% (in females) and poor 16.5% (in males) and 14.1% (in females).

Conclusion: Ultrasound provides very accurate information about variation the pes anserine bursae and saphenous nerve. Recognition of such variations is important in the diagnostic and therapeutic goals such as injection of medications into the swollen bursa. This suggests that our proposed ultrasound method, can be a reliable guide to facilitate medial knee approaches for diagnostic and therapeutic objects.

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SURVEY OF ASEPTIC TECHNIQUE WHILE ADMINISTERING PERIPHERAL NERVE BLOCK WITH ULTRASOUND

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Background and aims: The use of ultrasound for peripheral nerve blocks has increased over years but there are no clear guideline available regarding sterility and US. •AAGBI 2007: use gloves, drape and chlorhexidine while doing a PNB.

We decided to do a survey of sterile practice among anaesthetists.

Methods: We surveyed 75 anaesthetists who attended the 11th Ultrasound guided regional anaesthesia course at East Surrey hospital, UK. A questionnaire was distributed among the 60 delegates and 15 faculty members and received 71 responses.

Questionnaire:

- Does your hospital have a guideline
- Precautions for single shot block and catheter technique individually without US:
 - full aseptic technique Y/N
 - If no which of the following do you use?
 - hat/mask/gown/glove
 - chlorhexidine 0.5%/alcohol 70%
 - chlorhexidine 2%/alcohol 70% iodine
 - Non touch technique
- Ultrasound use:
 - Do you use US routinely Y/N
 - Do you use sterile sheath Y/N
 - Do you use sterile ultrasound gel Y/N
 - Do you use sterile tegaderm to cover probe Y/N

Results:

- 1) 12 responders knew of a hospital policy.
- 2) 18 responders use full asepsis for single shot technique. Only 53 used catheter and all used full aseptic technique.
- 3) 49 responders used US routinely, 37- probe covers, 59 sterile gel, 48 tegaderm.

Conclusions: There is no set standard practice seen between anaesthetists while doing PNB with or without ultrasound. There is yet any study to be done on infection rates and ultrasound guided PNB. We recommend the use of sterile probe sheaths for catheters and sterile tegaderm for single shot block, with sterile US gel as a routine.

426**SURVEY OF CHANGING EXPERIENCE IN REGIONAL ANAESTHESIA**

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Background: Recent advances in regional anaesthesia have significantly changed the way in which regional anaesthetic procedures are performed. Notable developments are ultrasound guided regional anaesthesia (UGRA), continuous perineural catheter techniques, introduction of various nerve block needles and the release of current National Patient Safety Agency (NPSA) guidelines in UK. We conducted a survey to identify the current practice of regional anaesthesia (RA) among the residents in South East region of London about their individual preferences and experience whilst performing central neuraxial blocks (CNB) and peripheral nerve blocks (PNB) especially while using the newer techniques.

Methods: An email questionnaire was sent to all the anaesthesiology residents working across the fourteen hospital trusts in the South East London. Questions explored on their clinical practice whilst performing CNB~PNB techniques, preferred anaesthetic solution, equipment and adjuvants, training experience and knowledge of NPSA guidelines.

Results: The survey response rate was 71%. 45% had attended cadaver workshop compared to 77% who attended UGRA training courses. 90% practised UGRA for PNB while 12% used it for CNB. 93% were aware of the RA related NPSA guidelines. Only 22% were familiar with continuous catheter techniques. Levobupivacaine was a popular choice in epidural (82%) and PNB (75%). Majority of respondents were aware of certifications in RA (EDRA) and 48% felt it appropriate to train in RA fellowship.

Conclusions: Anaesthesiologists varied in their background knowledge and the increasing awareness of latest developments in regional anaesthesia is reflected in their changing clinical practice.

Reference: Survey of regional anaesthesia practice among trainee anaesthetists in the UK. *Anaesthesia* 2002;57(11):pg 1146-1147.

427**ASSESSING SURGEONS' KNOWLEDGE OF THE PRINCIPLES AND SAFE PRACTICE OF LOCAL ANAESTHESIA**

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Background and aims: Local anaesthetic agents are potentially toxic; high doses or imprecise administration may cause seizures, coma or even cardiac arrest and death. As frequent users of these agents one would expect surgeons to possess detailed knowledge of dosage and toxicity. We therefore produced a questionnaire to assess this knowledge amongst surgeons at our institution.

Methods: We investigated a group of surgeons, with various levels of experience, on their knowledge of factors such as safe doses of common agents, drug concentrations, timing of repeat doses and signs of local anaesthetic toxicity. Following the questionnaire, a teaching session was delivered to improve knowledge. The same questionnaire was re-issued 4 weeks later to ensure education had been successful.

Results: 14 surgeons completed the questionnaire. Only 35.7% (n=5) knew the recommended safe dose for Bupivacaine (2mg/kg) and 50% (n=7) knew the safe dose for Lidocaine (3mg/kg). 50% (n=7) recognised that there are 10mgs in 1ml of a 1% solution, whilst just 21.4% (n=3) were able to name 3 signs of local anaesthetic toxicity. Education and re-questioning led to an improvement in knowledge in each of these areas.

Conclusions: Surgeons' knowledge of local anaesthetic agents was generally poor, considering that these agents are used so commonly, and carry a risk of morbidity and mortality. Simple education can improve understanding of even experienced practitioners and consequently can have a beneficial effect on patient safety.

428**DRAIN TUBE LMA: ANAESTHESIOLOGISTS SATISFACTION?**

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Aims: Through this study, we determined the degree of satisfaction among anesthesiologists of three reference hospitals in Seville about three types of laryngeal masks with drain tube.

Methods: A satisfaction survey of 110 anesthesiologists physicians about the management of I-gel LMA, Proseal and Supreme laryngeal masks. We evaluated the following variables: drain tube management, need of changing for another device, placement easiness and sealing quality. We used a Likert scale of 1-5 (not, low, normal, quite and very satisfied). SPSS v16.0 statistical analysis, hypothesis testing using Chi-square, descriptive study (ANOVA) and multiple comparisons (Bonferroni).

Results: The average experience using this devices was two years (49.1% of anaesthesiologists) with I-gel, three years (30.9%) with Proseal and one year (50.9%) with Supreme. The average satisfaction score obtained about drain tube management was: Supreme (3.95), Proseal (3.70) and I-gel (2.35). About the need to change for another device: Supreme (4.15), Proseal (3.74), and I-gel (2.92). In the ease of placement: Supreme (4.28), I-gel (4.08) and Proseal (3.52). Satisfaction score about sealing quality: Supreme (4.15), Proseal (3.96), and I-gel (3.34), showing statistical significance at this four variables.

Conclusions: The more satisfactory laryngeal mask to most anesthesiologists surveyed appears to be the Supreme, followed by Proseal, and finally, the I-gel. However, Proseal did not satisfied so much at placement easiness. The devices available in market should be evaluated and rated by the professionals who make use of them.

429**A SURVEY OF REGIONAL ANAESTHETIC BLOCK ROOM USE IN ENGLAND**

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Background and aims: Regional Anaesthetic Block Room use is widespread in North America and Europe. It has proposed benefits of speeding up theatre turnaround times and also provides excellent teaching opportunities in Regional Anaesthesia¹. We were aware of the adoption of these practices in some NHS Trusts in England and wanted to find out how widespread the use of Regional Anaesthetic Block Room is.

Methods: A list of all Acute NHS Trusts in England was sourced from the NHS website. A telephonic survey of the Anaesthetic Departments of all the Acute Trusts was undertaken in April and May 2012. A simple series of questions were used to improve response rates.

Results: We surveyed 158 Acute Trusts and obtained responses from 146 Trusts, a response rate of 92%. 7 Trusts use Regional Block Rooms with a further 2 Trusts looking to start using them in the near future or start pilot schemes.

Conclusions: Regional Anaesthetic Block Rooms in England are used in a small minority of trusts (0.04%). Possible reasons for this surprisingly low incidence include, difficulty in changing infrastructure and working practices to accommodate a new system, barriers to obtaining funds for new equipment and the need for regular (usually daily) use to produce cost and time savings. These obstacles may hinder the establishment of Regional Anaesthetic Block Rooms especially in smaller Trusts.

Reference:

1. Wijayatilake DS, Prasad GA. The 'block room'. A new model of delivering regional anaesthesia. *RCoA Bulletin* 2007;45: 2283-2286.

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ROUTINE SPINAL ANESTHESIA AS AN ACCEPTABLE ETHICALLY SITUATION FOR THE STUDY OF THE NORMAL CONTENT OF SOME METABOLITES IN THE CEREBROSPINAL FLUID IN HEALTHY INDIVIDUALS

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Background and aims: Standards for levels of purine metabolites in the cerebrospinal fluid in different sources of literature are very different from each other (because of different methods. Therefore, to develop content standards of purine metabolites, we studied 70 cerebrospinal fluid of healthy adults of both sexes, who underwent routine operative interventions under spinal anesthesia.

Methods: Sampling of 0.1 ml of cerebrospinal fluid in the performance of spinal anesthesia for orthopedic intervention to remove temporarily implanted intraosseous metal and plastic gynecologic intervention. Contents of purine bases was determined direct spectrophotometry in aqueous extract of serum termocoagulant of cerebrospinal fluid in each of the purine metabolite wavelengths. At the same time assumed that the content of purines in the aqueous extract termocoagulant of cerebrospinal fluid is directly proportional to their true concentrations in whole cerebrospinal fluid, as recommended by J. Marimont, M. London (1964).

Results: Thus we have determined the average values and the limits of normal content of adenine, guanine, hypoxanthine, xanthine, uric acid in the cerebrospinal fluid of the residents of our region.

Conclusions: We believe that the spinal anesthesia in some categories of healthy patients is not only an excellent method of pain relief, but also a way to determine the normal limits for the content of any physiological metabolites.

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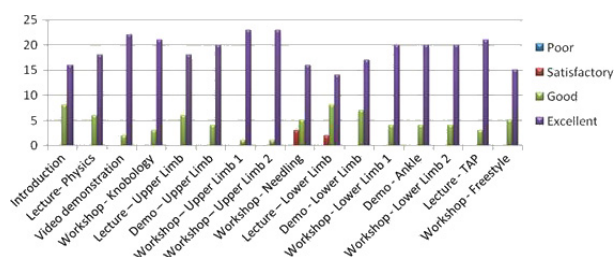
CROSS-BORDER COLLABORATION IN ULTRASOUND GUIDED REGIONAL ANAESTHESIA

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Background and aims: In 2004 the largest single expansion of the European Union (EU) took place. In 2007, 74031 foreign doctors (30.94% of total pool) were registered to practise in the UK. Of these, 28% came from EU member states other than the UK. Many of these doctors repatriated after a fixed period, maintained contacts within the UK and fostered strong links with UK institutions. In 2010 such links led to the organisation of an ultrasound guided regional anaesthesia (UGRA) course in Piekary, Poland.

Methods: A team from the North-East of England ran an UGRA course in Piekary in February 2011 and, following excellent delegate feedback, the course was repeated in October 2011. Royal College of Anaesthetists accreditation was obtained. Faculty included both Polish and UK doctors.

Results: Combined feedback from the two courses was excellent. Hosting the course led to a 20% increase in the use of regional anaesthetic techniques in Piekary and an increase in the variety of blocks performed.



[Poland Feedback]

Conclusion: We hope to develop larger scale collaborations including common conferences and research. Such partnerships between countries, and

selected hospitals, aids the spread of knowledge in the field of regional anaesthesia.

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DOES PARAVERTEBRAL ANAESTHESIA IMPROVE QUALITY OF LIFE IN CONSERVATIVE SURGERY IN BREAST CANCER?

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Background and aims: Ambulatory Surgery is an important health care alternative that allows the results to match those of conventional surgery, improving the efficiency of utilization of health resources and increasing the quality of both science and technology, as perceived by patients and professionals. We pretended to improve patients quality of life in breast surgery.

Methods: We studied 81 patients undergoing breast-conserving surgery, 40 (group A) under general anesthesia and 41 (group B) under local anesthesia, either local or paravertebral. Once admitted to the outpatient program, we collected data on quality of life (SF-36) and preoperative pain (VAS). In all the cases were operated by the same surgical team and the duration was similar. He returned to collect data for quality of life and pain in post-operative (before discharge home) and a month later. Then, we compared data in both groups.

Results: Ambulatory surgery improved quality of life in breast surgery. The quality of life and the results of the VAS in the immediate postoperative period are significantly better in the regional anesthesia group.

Conclusions: Ambulatory surgery improved quality of life in conservative surgery in breast cancer. Paravertebral and local thoracic blocks local anesthesia and thoracic paravertebral show good alternative to general outpatient surgery in this sample.

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ASSESSMENT OF RELIABILITY AND VALIDITY IN USER SATISFACTION WITH ULTRASOUND IMAGES

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Background: Elastography, a new modality, is a non-invasive qualitative method of demonstrating tissue strain. Clinical application, until now, has concentrated on tumour diagnosis. Our group has shown discrete colour strain patterns as a surrogate of local anaesthetic spread in both Thiel embalmed human cadavers and patients. We aimed to determine how well trainees are able to interpret sono-elastography (combined B-mode & Elastography) compared to B-mode and also assess its validity and reliability.

Methods: Initially, we interviewed four experts to determine what features of a new ultrasound modality they would consider essential and a questionnaire drafted around their answers. It was constructed using a 5-part Likert scale from unable to assess to completely satisfactory and applied to 18 trainees of varying experience after viewing videos of an inter-scalene and sciatric block using B-Mode and sono-elastography. A subset of six participants repeated the study one week later as part of our reliability assessment.

Results: Face validity conferred by expert opinion on characteristics of useful new modality. The internal reliability of both B-Mode and sono-elastography questions was good (Cronbach's alpha 0.71 and 0.82 respectively). Differences between B-Mode and sono-elastography existed with regard to anatomy recognition, colour and needle visibility (Wilcoxon Signed-Rank Test). Factor analysis identified anatomy & needle tip identification as the two most prominent items using B-Mode and anatomy & spread as the two most prominent items using the sono-elastography.

Conclusion: We have developed a reliable and valid questionnaire & identified key features when assessing the introduction of elastography to practice.

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REGIONAL SURVEY OF TRAINING AND PRACTICE IN INTERSCALENE BRACHIAL PLEXUS BLOCKS

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Background and aims: NICE guidelines state use of US for peripheral nerve blockade. RCOA has mentioned regional anaesthesia as 'essential' area

of learning. The Joint Committee of ASRA and ESRA, have recommended, two distinct pathways for obtaining US guided regional anaesthesia training.

These are practice pathway and residency-based pathway. Objectives were:

1. Training and experience related to brachial plexus blocks.
 2. Awareness of NICE guidelines.
- How to improve our learning and training in regional blocks.

Methods:

1. Two local surveys were conducted, one year apart, in department.
2. This showed poor experience and training.
3. Following which an internet based survey was conducted, regionally.
4. Two results were compared and analysed.

Results: 80 % were happy with verbal consent, while rest wanted written consent. 62% of anaesthetists do their blocks awake. 50% use sterile drapes and further 19% also use sterile gown. 87% use nerve stimulator for localization technique. Bupivacaine 0.25- 0.375% is the most common local anaesthetic used. 8% had no supervised training for the blocks and over 75% would like to have more supervised training. 13% do not keep any record of their blocks. 21% were not aware of the NICE guidelines.

Conclusions: The Joint Committee propose education should include workshops with hands-on experience. Also on daily basis spending time with experienced individuals. There should be more courses and dedicated supervised lists or fellowships available for trainees. The adoption of 'UGRA coordinator' within each department. Recommendations for log book maintenance, aseptic precautions and consent standards to be published.

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PREOPERATIVE SMALL-DOSE GABAPENTIN PREVENTS TOURNIQUET-INDUCED ARTERIAL PRESSURE INCREASE IN ORTHOPEDIC PATIENTS UNDER GENERAL ANESTHESIA

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Background and aims: Rise in blood pressure is a common outcome during anesthesia procedures, which is estimated to variable extents. Furthermore, the prevalence of blood pressure rise is more frequent in lower limb surgeries than upper limb. Prolonged utilization of tourniquet during orthopedic surgery leads to severe pain and hyperdynamic response which is mainly due to central nervous system stimulation. Gabapentin has shown great successes in pain control after surgery and patients with neuropathic pain. Gabapentin could have a role in decreasing blood pressure rise in surgeries in which tourniquet is used.

Methods: 36 patients were enrolled in our randomized, double-blinded study. The first group received 600 mg gabapentin orally two hours before the surgery and the other group was treated by placebo. General anesthesia was administered both groups. Hemodynamic variables such as systolic and diastolic pressure and heart rate before and after tourniquet inflation and deflation were compared in both groups.

Results: Both groups were similar in demographic characteristic. We did not detect significant change in hemodynamic variables before tourniquet inflation, but development of increase in systolic and diastolic arterial pressure during tourniquet inflation was more frequent in the control group than the other group, mainly 45 and 60 minutes after the start of tourniquet inflation ($P < 0.05$).

Conclusions: The results of our study suggest that preoperative oral dose of 600 mg of gabapentin can significantly prevent tourniquet-induced systemic arterial pressure increase in patients under general anesthesia.

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SPINAL ANAESTHESIA FOR TRANSURETHRAL PROCEDURES. A TEN YEAR PERIOD EXPERIENCE

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Background and aims: The evaluation of spinal anaesthesia for transurethral procedures during a ten year period.

Methods: In a ten year period 4,694 patients who were submitted to transurethral procedures were studied. In all patients with no specific contraindication spinal anaesthesia was suggested as method of choice. Number of patients and reasons of refusing spinal anaesthesia were recorded. Anaesthesia was performed after midazolam (0.05-0.1mg/kg) sedation by Quincke type spinal needle with 2.5-5ml local anesthetic (lidocaine, bupivacaine, ropivacaine). Intra- and postoperative complications, as well as patients' opinion on anaesthetic technique were also recorded.

Results: 83 (1.76%) of 4,694 studied patients, refused spinal anaesthesia based on reasons such as fear of postoperative headache, back pain and permanent paralysis. Among the rest 4,611 who were submitted to spinal anaesthesia, intraoperatively, 118 (2.56%) expressed discomfort due to prolonged operation duration (>1hr) treated by midazolam, 531 (11.52%) mild hypotension treated by hydration, 71 (1.54%) moderate to severe hypotension treated by phenylephrine and 2 (0.04%) respiratory insufficiency treated by intubation and mechanical ventilation. Postoperatively, 5 (0.17%) patients demonstrated persistent headache treated by paracetamol, hydration and bed stay, 102 (2.21%) back pain treated by NSAIDs, and 278 (6.03%) expressed fear due to prolonged paralysis. No major complications were observed. In general, 4,253 (94.9%) patients answered that they were satisfied by the anaesthetic method and would prefer it on a future operation if possible.

Conclusions: Spinal anaesthesia, apart from being safe, which is already established, appears to be quite satisfactory and attractive method for patients submitted to transurethral procedures.

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MOBILISATION AND LENGTH OF STAY AFTER FRACTURE NECK OF FEMUR

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Background and aims: Hip fracture patients have a high mortality and morbidity rate. They occupy 20% of orthopaedic bed. The aim of the study was to assess if we were mobilizing patients early soon after the day of surgery as recommended by NICE and identify reasons for delayed discharges.

Methods: Retrospective audit. Data collected from 30 patients admitted with fracture neck of femur in July 2011 looking at

- Postoperative mobilisation
- Postoperative complications delaying discharge
- Length of stay in hospital
- In hospital mortality

Results: 27% (8) patients were not mobilized on the day after the surgery for

- Medical reasons -3 patients
- Patient uncooperative/confused-3 patients
- Not specified -2 patients

The average length of hospital stay is 19 days (range 7 days -63 days). The in hospital mortality 10 % (3 patients).

chest infection	3
heart failure	2
correction of INR	2
Awaiting bed	4
awaiting investigation	3
stroke	1
renal failure	1
deep vein thrombosis	1
dementia/confusion	3

[Causes of delayed discharge]

Conclusions: If medically fit multidisciplinary rehab should begin as soon as possible within 24hrs. These patients are frail and develop medical complications which increases their hospital stay.

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EFFECTIVE AWAKE THORACIC EPIDURAL ANESTHESIA FOR AORTOFEMOROPLOPTEAL SURGERY IN WITH ANKYLOSING SPONDYLITIS

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Background and aims: To describe the anesthesia and analgesia management of a patient with ankylosing spondylitis undergoing aortofemoropopliteal bypass.

Methods: A 58 years of old male patient with ankylosing spondylitis, diabetes mellitus was planned for aortofemoropopliteal bypass. An epidural

catheter via a Tuohy needle was introduced at T₄₋₅ intervertebral space using saline loss of resistance technique and 80 mg of 0.5% bupivacaine with 5 µg of sufentanyl was injected. We treated hypotension with a 20 mg bolus of ephedrine, twice in the first 15 min intraoperatively. Five mL h⁻¹ of an analgesic solution including 0.5% bupivacaine 80 mg with sufentanyl 5 µg was given through epidural catheter as a continuous infusion for 24 hours, postoperatively.

Results: No complications were observed preoperatively and postoperatively. The patient was discharged on the 10th day.

Conclusions: Awake thoracic epidural anesthesia method can be performed safely with the ankylosing spondylitis COPD patients.

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EFFECTIVE AWAKE THORACIC EPIDURAL ANESTHESIA FOR AORTOFEMORAL BYPASS SURGERY IN A HIGH-RISK PATIENT WITH SEVERE CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Background and aims: General anesthesia may cause a higher risk of aspiration and pneumonia in patients having chronic obstructive pulmonary disease (COPD) due to prolonged tracheal intubation and neuromuscular blockage. Awake thoracic epidural anesthesia has been reported to be a safe technique in patients with end-stage COPD. Our aim is to describe the anaesthesia and analgesia management in a patient with COPD.

Methods: A 63 years of old male patient with severe COPD, moderate hypertension was planned for aortofemoral bypass. He was hospitalized for the treatment of acute attack of COPD, one month ago. We monitored the patient, supplied 2 L/min O₂. An epidural catheter via a Tuohy needle was introduced at T₅₋₆ intervertebral space using saline loss of resistance technique and 50 mg of 0.5% bupivacaine with 50 µg of fentanyl was injected. We treated bradycardia with a bolus of 0.5 mg of atropine, twice in the first 5 min intraoperatively. We applied infusion of 0.5% bupivacaine 100 mg 3 mL.h⁻¹, bolus dose of 2 mL, and a lockout period of 20-min with patient-controlled epidural analgesia for 24 hours postoperatively.

Results: No complications were observed postoperatively. The patient was discharged on 12th day, postoperatively.

Conclusions: Awake thoracic epidural anesthesia method can be performed safely with the COPD patients, by taking care of bradycardia preoperatively.

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STUDY ON THE BLOOD TRANSFUSION AFTER MAJOR PRIMARY JOINT REPLACEMENTS IN A DISTRICT GENERAL HOSPITAL IN THE UK

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Background and aims: A retrospective study of the post-operative blood transfusion in primary joint replacements in a DGH. Aim was to find out the factors influencing the transfusion requirements including the type of anaesthesia, documentation of the details of transfusion & areas to improve.

Methods: After registering with the clinical governance/ethics department, data was collected retrospectively from the notes of 80 major primary hip and knee replacement cases over a period of 3 months. The data was analysed using simple statistical methods.

Results: Only one patient had a preoperative risk factor for transfusion. Eight cases received NSAIDs intra operatively but that didn't increase the need for transfusion. 10% received tranexaminic acid intra-operatively but that had no significant effect in avoiding blood transfusion. Nine cases (11.25%) were under GA and the rest were under regional. Three of the GA cases (33.3%) required autologous transfusion and none needed donor blood. Intra operative blood loss varied from minimal to one litre. 50% cases received autologous blood based on the existing practice to transfuse collections over 200ml. 10% patients needed donor blood. The documentation of the reasons for transfusion was found to be suboptimal.

Conclusions: The findings were consistent with previous similar studies. Tranexaminic acid did not appear to have a positive effect in this study possibly due to the small sample size. The need for a guideline for infusion of collected autologous blood was obvious and the documentation of transfusion needed to be clearer. We aim to implement clear guidelines and then re-do the study again next year.

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PRESCRIPTION PRACTICE IN ACUTE PAIN MANAGEMENT IN THE WARDS

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Background and aims: Pain relief is one of the most humanitarian cares which needs to be given to every patient in pain as the basic need. As improperly managed acute pain forms the basis of most miserable suffering of mankind, the chronic pain, it needs to be treated carefully by multimodal approach. Medication errors are the main cause of iatrogenic mishaps worldwide. The main aim of this audit was to point out the common medication errors and to notify that such error does not happen in future.

Methods: We randomly included 101 patients admitted in gynaecology and obstetrics, medicine, surgery and orthopaedics wards for our audit. We looked into whether analgesics were prescribed on regular basis, NSAIDs and opioids were prescribed only for limited duration in absence of any contraindication and also different combinations of same drug was used or not in acute pain.

Results: We found several key medication errors such as two NSAIDs and/or two opioids were prescribed simultaneously. Most analgesic prescriptions did not have any end date. NSAIDs were prescribed on two occasions in high risk patients and two different preparations of paracetamol were used at the same time.

Conclusions: After this audit we came with conclusion that regular basis use of analgesic in a multimodal approach is better than PRN and unimodal in pain relief. Limited use of NSAIDs and opioids in absence of contraindication with proper monitoring constitutes the rational evidence based approach.

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EFFECT OF LOCAL ANESTHETICS IN THE ACTIVITIES AND METABOLISM OF NEUTROPHIL GRANULOCYTES

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Background and aims: Neutrophil granulocytes is a class of granulocytes that represents the main pool (47-72%) of leukocytes circulating in the human blood responsible for multiple innate and specific immune reactions. To study the effect of local anesthetics in the activities and metabolism of neutrophil granulocytes.

Methods: Leucocytes were extracted from peripheral blood of healthy donors. 50 µl of 0.5% local anesthetic (procaine, lidocaine, bupivacaine and ropivacaine) and 50 µl of *S. aureus* culture were added to 100 µl of leucocyte suspension and incubated at 37° C for 60 minutes. Then 50 µl of Normal Saline (0.9% NaCl) was added in the mixture as control. After incubation, smears were taken, in which neutrophil phagocytizing activity was studied. Presence of glycogen in cytoplasm was measured using PAS cytochemical staining.

Results: Index of phagocytosis was 63.2±8% in control sample, 42±3% in sample with procaine, 11.6±2% with lidocaine, 39.8±2.5% with bupivacaine and 40.6±3% with ropivacaine. Glycogen level, measured using average cytochemical index, was 1.3±0.1 U in control sample, 1.5±0.1 U in sample with procaine, 1.9±0.15 U with lidocaine, 1.4±0.1 U with bupivacaine and 1.5±0.1 U with ropivacaine.

Conclusions: Changes in neutrophil granulocyte functional activity suggested the inhibition of phagocytizing function of *S. aureus*. Maximum inhibition of phagocytosis was induced by lidocaine (average decrease — 57%), which was confirmed by minimal glycogen usage in the cells during incubation. Average index of phagocytosis was almost equal for procaine, bupivacaine and ropivacaine.

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THE ROLE OF KETAMINE IN THE MANAGEMENT OF SEVERE PAINFUL CRISIS IN SICKLE CELL PATIENTS

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Background and aims: Acute pain is one of the main causes of hospital admission in sickle cell disease (SCD). Pain in SCD is of variable intensity with unpredictable onset and duration. Opioid tolerance and adverse effects

have been major barriers in providing those patients with effective pain relief. We studied the role of ketamine in painful sickling crisis management.

Methods: This is a retrospective analysis of 9 adult patients who were admitted to Intensive Care Unit (ICU) with severe painful crises that did not respond to high doses of morphine and other adjuvant analgesics. Ketamine was added to the ongoing opioids as initial bolus of 0.25 mg/kg, followed by infusion of 0.2-0.25 mg/kg/hr. Midazolam infusion of 0.5-1 mg/hr was added to reduce emergence. Reduction in morphine daily requirements and improvement in pain scores were the determinants of ketamine effect. Paired T-test was used for statistical analysis.

Results: Nine patients (8 females, 1 male) were assessed with mean age of 27 ± 11 years. The mean morphine requirement (mg/day) in the pre-ketamine day (D0) was 145.6 (SD 16.5), while it was 112 (SD 12.2) in day one of ketamine treatment (D1) ($P=0.007$). The Visual Analogue Scale (VAS) in D0 was ranging between 8-10 (mean 9.1). VAS improved to 5-7 (mean 5.7) in D1. The duration needed to bring VAS to 3 and discharge patients from ICU after ketamine was 2-5 days (mean 3.3).

Conclusions: Low-dose ketamine infusion can effectively reduce pain and opioid requirements in SCD patients with severe painful crisis.

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THE USE OF FLOTRAC (SENSOR) IN THE ENDOVASCULAR REPAIR OF ABDOMINAL AORTIC ANEURYSMS (EVAR) USING SPINAL ANESTHESIA AS MAIN ANAESTHETIC TECHNIQUE

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Background and aims: EVAR is evaluated as an alternative to open aneurysm repair. In this study we appreciated hemodynamic parameters, like as cardiac output (CO), stroke volume (SV), and stroke volume variation (SVV) using FloTrac in the surgical procedure of infrarenal EVAR.

Methods: Thirty eight patients undergoing EVAR were enrolled. We applied spinal anesthesia using levobupivacaine in combination with fentanyl. Intraoperative monitoring included pulse oxymetry, electrocardiogram with ST-segment analysis and FloTrac using Vigileo device via radial arterial pressure. We recorded through the Vigileo instrument values of CO, SV, SVV at the following times:

- (i) 5min after application of spinal anesthesia,
- (ii) 3 min before the expansion of endograft,
- (iii) 1min after the deployment of central graft and
- (iv) 1min after the deployment of peripheral graft limb. Differences between these specific times were evaluated by one sample t-test, Kolmogorov smirnov test, friedman test and pearson correlation.

Results: The mean operation time was 114.80min. There was strong position correlation between SV and CO in these times. In contrast to this, there was negative correlation between SV and SVV at the times (iii) and (iv).

Also there was significant difference in SV between (iii) and (iv) time period ($p<0.048$). The same findings we had in SVV between (ii) and (iii) ($p<0.035$).

Conclusions: The spinal anesthesia provides hemodynamic stability in the EVAR as it was detected in the measured values. Also there was minimal influence of the endograft's deployment in vascular tone.

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THE COMPARISON OF HEMODYNAMICS VARIABLES USING FLOTRAC (SENSOR) IN THE ENDOVASCULAR REPAIR OF ABDOMINAL (EVAR) AND THORACIC AORTIC ANEURYSM (TEVAR) USING DIFFERENT ANESTHETIC TECHNIQUES

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Background and aims: EVAR and TEVAR is being evaluated as an alternative therapeutic access to open aneurysm repair. In this study we estimated hemodynamic parameters, like as cardiac output (CO), stroke volume (SV), and stroke volume variation (SVV) using FloTrac and compare these variables between spinal anaesthesia (EVAR) and general anaesthesia (TEVAR).

Methods: Thirty eight (EVAR) and thirty five patients (TEVAR) were enrolled. Intraoperative monitoring included pulse oxymetry, electrocardiogram with ST-segment analysis and FloTrac (sensor) using Vigileo monitor (by Edwards Lifesciences) in combination with invasive radial arterial pressure. We recorded values of CO, SV, SVV, through the Vigileo device, at the following times: (i) 5min after application of spinal anesthesia or induction in general anaesthesia, (ii) 3 min before the expansion of endograft, (iii) 1min after the deployment of central graft and (iv) 1min after the deployment of peripheral graft limb. Differences between these specific times were evaluated by one sample t-test, Kolmogorov smirnov test, friedman test and pearson correlation ($p<0.05$).

Results: There was significance difference in CO in comparison two anesthetic technique in times (i), (ii) and (iii). Also there was significant difference in SV between two groups in (i) and (ii) time period. The same findings we had in SVV in (iii) and (iv) times.

Conclusions: The spinal anesthesia (EVAR) provides better hemodynamic stability in comparison with the general anaesthesia (TEVAR). Also there were differences between two groups in vascular tone (SVV), in (iii) and (iv) times, considering the need for low blood pressure in TEVAR technique.

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COMPARISON OF DIFFERENT ANESTHETIC TECHNIQUES IN URINE PRODUCTION IN ENDOVASCULAR ABDOMINAL AORTIC ANEURYSM REPAIR (EVAR) AND THORACIC ENDOVASCULAR AORTIC REPAIR (TEVAR)

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Background and aims: The endovascular access is an alternative method to open repair with good results. The purpose of this study is to estimate the influence of different anaesthetic technique in urine production in the EVAR and TEVAR.

Methods: 157 patients (EVAR) and 50 (TEVAR) were scheduled. The anaesthetic technique for TEVAR was general, while different were used for EVAR (125 - spinal, 4 - spinal+general, 24 - combined spinal epidural, 4 - Monitored Anaesthesia Care). The amount of crystalloids, Voluven, contrast and the urine production were recorded intraoperatively. For parametric data was used Student's t-test, t-test for paired samples and Analysis for Variance (ANOVA). The results are expressed as Mean $\pm$ Standard Error. Statistical significance was defined as $p<0.05$.

Results: Comparing demographics and preoperative laboratory tests, there is no statistically significant difference between the two groups of endovascular repair (abdominal and thoracic aorta). There is a statistically significant difference between different types of anesthesia and crystalloids, amount of contrast. Also, there is a statistically significant difference between different types of anesthesia and urine production. So we have: Spinal anesthesia: 669.43 ± 37.51 ml of urine output, General anesthesia: 933.26 ± 86.69 , $p=0.003$.

Conclusions: According to the surgical technique, TEVAR have higher urine output compared with EVAR. According to the anesthetic technique, in spinal anesthesia we have less urine output compared with general anesthesia. It is necessary the application and the preservation of a protocol to protect renal function prior to endovascular intervention.

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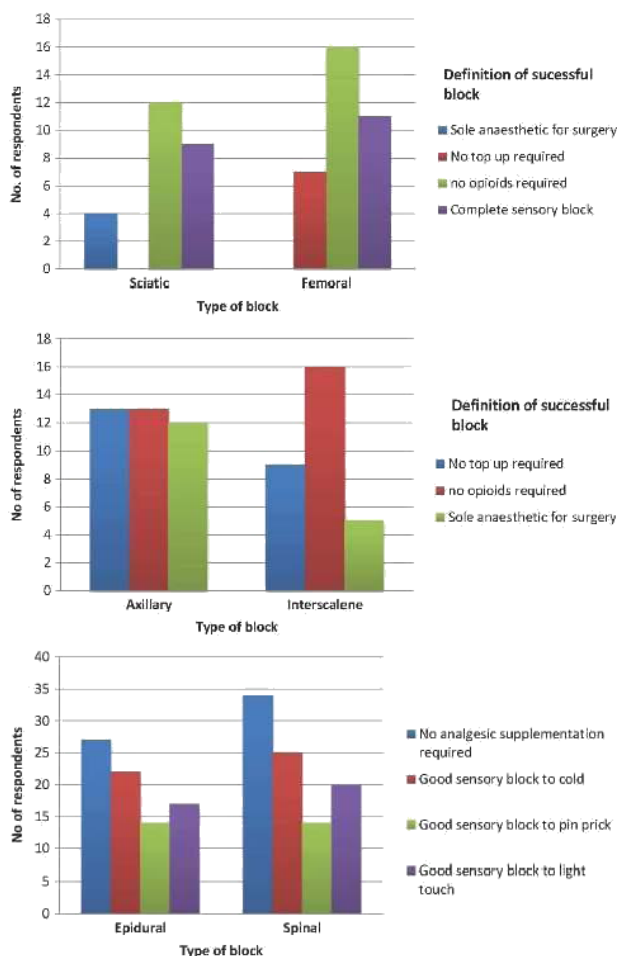
DEFINING SUCCESSFUL BLOCKS FOR REGIONAL ANAESTHESIA PROCEDURES TO MANAGE TRAINEE'S PERFORMANCE

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Background and aims: There is no consensus in the literature on an objective method to assess and manage trainees' regional anaesthesia performance. The aim of this survey was to define successful block for regional anaesthesia procedures which is the first step to establish CUSUM (cumulative sum) technique as a quality control and surveillance tool for this purpose.

Methods: An electronic questionnaire was sent to 250 anaesthesia consultants. It consisted of up to seven questions relating to the definition of successful block for brachial plexus, lower limb and neuraxial blocks.

Results: Forty consultants responded to our questionnaire (16%). There was wide variation amongst anaesthetists in defining a successful block e.g. i.e. 33% respondents defined successful axillary block as no need for top ups, 33% as no need for supplemental opioids, 31% considered block to be successful if it could be used as sole anaesthetic for the surgery. This variation existed for all anaesthesia procedures as demonstrated in picture-1.



[Definition of successful blocks (variation)]

Conclusions: Our survey highlights the lack of consensus on definitive criteria of successful block amongst anaesthesia consultants on assessment of regional anaesthesia techniques. A standard needs to be defined against which trainees can be objectively assessed. We propose the use of Delphi method to achieve this aim.

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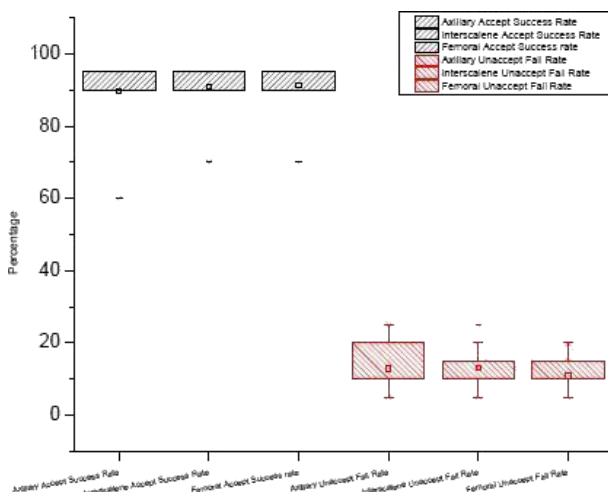
ACCEPTABLE SUCCESS RATE AND UNACCEPTABLE FAILURE RATES FOR PERIPHERAL NERVE BLOCKS

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Background and aims: This survey was conducted to find out acceptable success rates and unacceptable failure rates for commonly performed upper and lower limb blocks which is an essential prerequisite for CUSUM (cumulative sum) analysis.

Methods: The e-survey was sent to all anaesthetic consultants in the West Yorkshire region, UK. The questions asked information about acceptable success and unacceptable failure rates for three commonly performed blocks i.e. axillary, interscalene and femoral nerve block.

Results: The response rate was 16% (40/250) for our survey. The following box plot shows the results for acceptable success rate and unacceptable failure rates. The acceptable success rates {mean,(SD)} for axillary, interscalene and femoral nerve blocks were 89.8 (8.3), 90.9 (5.7) and 91.3 (5.5) and unacceptable failure rates were 12.9 (7.1), 13.1 (5.6) and 10.9 (4.6) respectively.



[Box plot: Success and failure rates]

Conclusions: The essential prerequisites for implementing CUSUM include the agreement for acceptable success rate and unacceptable failure rate. We could not find a clear consensus for these amongst anaesthetic consultants which highlights the difficulty in implementing this assessment tool. We suggest 90% as acceptable success rate and 12% as unacceptable failure rate for these blocks.

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THE ROLE OF SMARTPHONES IN PREVENTING DRUG CALCULATION ERRORS WITH LOCAL ANAESTHESIA

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Background and aims: Maximum permissible doses of local anaesthesia are commonly performed calculations, however, with multiple different drugs and routes often used on the same patient the calculations become increasingly complex. Smartphones provide a powerful and portable solution to offload calculation, and prevent drug error.

Methods: We wrote a self-deleting database named "How much more Local can I give?" which was designed to run within the Filemaker Go app for iPhone. The database calculates the remaining safe maximum dosage allowable



[App screenshot]

of local anaesthetic types available in the UK, based on manufacturers recommendations of 4 hourly maximums and body weight calculations. Where mixtures are input, the database can calculate proportionate dosages.

The “app” was distributed to the UCLH anaesthetic department and feedback was requested via a web form.

Results: Feedback was universally good with user ratings averages of 4/5.

Conclusions: Smartphones provide a portable way of quickly performing complex calculations, however caution must be used when relying on this data. In Europe healthcare apps that perform calculations are classed as class 1 medical devices. It is beholden to the practitioner to understand any automatic calculation and its limitations. We plan to apply for MHRA approval for our app prior to wider distribution.

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EPIDURAL BLOOD PATCH RATES FOR AUDITING QUALITY OF EPIDURAL SERVICE

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Background and aims: Accidental dural puncture (ADP) normally occurs in 0.3–1.5% of epidurals, although the rate may be expected to be higher in a teaching environment. Post dural puncture headache (PDPH) develops in 50–70% of cases of ADP. Conservative management, while it can be effective, may leave up to 15% of patients still symptomatic at 6 weeks after diagnosis. Epidural blood patch (EBP) remains the most effective treatment modality. The EBP rate would seem a good objective marker of the quality of an epidural service. EBP rates of 0.18–0.56% (mean 0.35%) have been reported for specialist private practice in Australia.

Methods: We analysed the EBP rate for the National Maternity Hospital in the first 3 months of the current and last 2 trainee anaesthetist rotations.

Results: In Jan-Mar 2011 period, the mean EBP rate was 1.0212%; in Jul-Sept 2011, 0.9711%; and in Jan-Mar 2012 0.2704%. The 72–73% decrease in the EBP rate for Jan-Mar 2012 is probably accounted for by the fact that our hospital has initiated 3 new Fellowship posts as of January 2012. During the Jan-Mar 2012 period, 42–51% of rostered anaesthetic calls were filled by these senior non-consultant hospital doctors (NCHD), each individual having more than 7 years anaesthesia experience.

Conclusions: While these results are intuitive, it does suggest that for the well being of our obstetric patient population, senior registrars (SpR 4 and SpR 5) should be assigned to all Obstetric anaesthesia departments and that fellowship programmes to recruit senior NCHD staff should be encouraged.

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RECURRENT HORNER SYNDROME AFTER LUMBAR EPIDURAL ANESTHESIA FOR LABOR: A SUBDURAL BLOCK AGAIN?

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Introduction: Horner syndrome (HS) is an uncommon side effect of cephalad spread of local anesthetic agents involving spinal nerves from C8 to T1.

Case report: A 38-year-old woman presented to labor of her second child. The patient had presented a HS after epidural analgesia for her first child 14 months before with complete recuperation.

She requested epidural analgesia. In the sitting position, a 20-gauge epidural catheter was inserted 4cm into epidural space through an 18-gauge Tuohy needle using the loss of resistance technique at L2–3 interspace. After a negative aspiration, a test dose of 2ml of 2% lidocaine was injected confirming correct placement. In the supine position, a total initial dose of 10ml of 0.25% levobupivacaine was injected with satisfactory pain relief. Ten minutes after, the patient complained of heaviness in her right eye. She presented right ptosis, miosis and ipsilateral facial congestion. The sensory level was T8 on the left and T6 on the right side. The patient’s and fetus’ vital signs remained within normal limits. The 0.125% levobupivacaine infusion was not stopped although close monitoring of clinical evolution was done. A healthy baby was delivered vaginally without complications. The symptoms resolved gradually.

Twenty-four hours after the delivery, a computed tomography scan with contrast was performed confirming a subdural distribution of the contrast achieving cervical levels.



[CT IMAGE]

Conclusion: Recurrent HS due subdural accidental block during lumbar epidural anesthesia is an uncommon complication. Various theories have been proposed being one of them the miscannulation of epidural catheter in a subdural location. It is generally transient and imaging studies are not routinely performed.

Subdural block is a potential cause of HS after epidural analgesia and definitive diagnosis requires X-ray with contrast administration, computed tomography or magnetic resonance imaging.

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CAUTION WITH EPIDURALS IN INTRA-UTERINE DEATH ASSOCIATED WITH ABRUPTION: A CASE STUDY

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The incidence of intra-uterine deaths (IUD) in the UK was 5.2 per 1000 births (Office of National Statistics 2009). Pain relief for these women at such a distressing time is of paramount importance, however if epidural analgesia is required there are serious concerns regarding coagulopathy.

A national survey in the Obstetric Anaesthetist Association (2010) stated that 93% of centres provide regional anaesthesia. 58% of centres performed Full Blood Count and Standard Clotting tests, whereas 22% of centres did not perform any routine tests.

Case report: An 18 year old primiparous presented at 36 weeks gestation, with a 3 hour history of PV bleeding. Ultrasound diagnosed abruption associated with IUD. After fluid resuscitation (1.5litres crystalloid) full blood count and clotting (PT & APTT) tests were sent. After 2 hours these results were reported as normal, and so an epidural was requested.

In view of the clinical picture, a Rotational Thromboelastometry (ROTEM) was performed which showed a severely abnormal clotting ability in the presence of an un-recordable fibrinogen level by FibTem therefore epidural was not offered.

Discussion: The incidence of coagulopathy associated with IUD is 3.2%. This increases significantly with placental abruption or uterine rupture, however there is little evidence in the literature or guidance for regional analgesia in this population. This case highlights the rapidity in which coagulopathy can ensue, and the need for high thresholds regarding epidural insertion. In this case a standard clotting test being normal may have led to a false sense of security with potentially disastrous consequence.

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A SURVEY OF THE USE OF LUMBAR ULTRASOUND IN OBSTETRIC ANAESTHESIA IN A LONDON TEACHING HOSPITAL

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Background and aims: Despite lack of conclusive evidence about the benefit of using ultrasound scan (USS) to aid the performance of neuraxial blocks in obstetric anaesthesia, there seems to be a growing interest in the

technique. Bedside USS more accurately determines the level of lumbar interspace and may result in less number of attempts in experienced hands but competence may not be easy to achieve in novices. Therefore, if we are to take advantage of any potential benefit of USS-guidance, we need to set mechanisms in place to help us gain experience in using it during day-to-day practice.

Methods: Paper questionnaires were handed out to Senior Trainees and Consultants (with obstetric sessions) in our hospital. Respondents were asked about their confidence level in performing USS-assisted neuraxial blocks, training they had received and the barriers that prevented them from using this technique.

Results: 42 of responses were received (100% response rate). Of the Consultants 40% were confident to perform neuraxial blocks with USS-guidance having done more than 5 unsupervised. None of the trainees was confident to perform this procedure on their own. 40% of the consultants and 55% of trainees agreed that USS could facilitate difficult neuraxial blocks. 60% of all respondents mentioned lack of training as a reason for not using this technique more frequently, however only 20% of the consultants and 30% of the trainees had attended training workshops or courses. Almost 90% would like more training on this technique.

Conclusions: The most important barrier to using this technique is lack of training.

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CASE SERIES OF ANAESTHESIA FOR PARTURIENTS WITH SEVERE CYSTIC FIBROSIS

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Background and aims: Cystic Fibrosis (CF) affects 1 in 1600 to 2500 live births and is inherited in an autosomal recessive manner. It primarily affects the respiratory, gastrointestinal and reproductive tracts, with impaired clearance of and obstruction by increasingly viscous secretions. The resultant severe respiratory disease, diabetes and gastroesophageal reflux is a source of concern to anaesthetists. Improvements in medical management and increasing survival of CF patients means more are committing to pregnancies. Management of pregnancy and delivery while managing a severe respiratory and multi system disorder presents challenges.

Methods: We present a series of 3 CF patients with very poor respiratory function and discuss their successful management during pregnancy and delivery.

Results: The risk of preterm labour and delivery is increased. However we have shown that it is possible that pregnancy and delivery can be successfully managed to a sufficient gestational stage whereby fetal concerns are less focal.

Conclusions: Patients with severe CF require multi-disciplinary input and should be managed in a tertiary referral centre. Close monitoring of respiratory function and preoperative optimisation during pregnancy is mandatory. Regional anaesthesia and analgesia should be the technique of choice for delivery. Post operative care should be carried out in a critical care setting with the provision of post operative ventilation if necessary.

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SPLENIC ARTERY ANEURYSM RUPTURE: A RARE CAUSE OF ANTEPARTUM HAEMORRHAGE

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Background and aims: Splenic artery aneurysm (SAA) is the most common visceral artery aneurysm. It occurs most often in the female population. Up to 95% of them present during pregnancy. The majority of them are asymptomatic until rupture, which is associated with a high maternal and fetal mortality rate.

Methods: We report the case of a 35 year old multiparous woman at 37 weeks gestation. She presented somewhat atypically with a one day history of vomiting and lower back pain. She underwent an emergency category one caesarean section in our stand-alone maternity hospital for a pathological CTG and suspected placental abruption. The operation was converted to exploratory laparotomy and splenectomy upon discovery of a non-uterine bleed.

Results: Although a successful outcome was achieved for the mother, unfortunately the fetal outcome was less successful.

Conclusions: We believe the positive maternal outcome in this case was a result of our prompt resuscitation, early surgical intervention and multidisciplinary approach. Peripartum haemorrhages can have a non-obstetrical origin. This case highlights the need to consider ruptured SAA as a differential diagnosis in all haemodynamically unstable obstetric patients.

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A RETROSPECTIVE AUDIT OF ANAESTHETIC MANAGEMENT OF PARTURIENTS WITH PLACENTA PRAEVIA FOR CAESAREAN SECTION IN A DISTRICT GENERAL HOSPITAL

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Background and aims: Placenta praevia is a major cause of massive obstetric haemorrhage. It occurs in approximately 4.3 per 1000 live births. Perinatal mortality rates are up to four times higher than in normal pregnancies.

Methods: We looked at the parturients with ultrasound-diagnosed placenta praevia having caesarean sections over a 2 year period, in a DGH with approximately 3000 deliveries per annum. We recorded data regarding: parity, grade of placenta praevia, level of operator, emergency or elective surgery, mode of anaesthesia, level of anaesthetist, arterial line and intravenous access, blood loss, blood transfusion and postoperative complications.

Results: 23 cases were identified. 78.3 percent of cases were carried out electively with consultants present. The remaining emergency cases happened out of hours with registrars only. 58.2% had GAs, 43.5% had arterial lines. The mean estimated blood loss was 1130 mls with approximately 20% needing transfusion. All patients requiring transfusion had a GA.

Conclusions: The rate of caesarean delivery in the US and the UK is at an all-time high. With the increased rate of repeated caesarean deliveries we are correspondingly going to see an increase in the occurrence of placenta praevias. There are no widely adopted guidelines for the management of these cases despite the significant clinical problem they represent. Our audit illustrated that the most dangerous emergency cases occurring out of hours had a lack of senior input. We also noted that all patients requiring blood transfusions had general anaesthesia, so perhaps regional anaesthesia should have an increasing role to play in these cases.

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A PROSPECTIVE AUDIT OF PAIN RELIEF AFTER CAESAREAN SECTION

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Background and aims: Adequate postoperative analgesia is important for women who have undergone caesarean section (CS) in order to allow early mobilisation [1].

Methods: We undertook a prospective audit of pain relief after CS in July to September 2011. We audited our practice against the standards set by RCoA [1]. RCoA standards are that > 90% women should have a worst pain score < 3 on a VAS of 0-10, 100% women should receive intrathecal or epidural opioids if a regional technique is performed and > 90% women should be satisfied with their pain management [1].

Results: 80 cases were audited, 36 elective and 44 emergency. All elective cases had spinal anaesthesia. 20/36 (55.6%) of these women had VAS > 3 in first 24 hours and 17/36 (47.2%) had VAS > 3 in second 24 hours. Of the patients who underwent an emergency CS, 1 had GA, 18 had epidural anaesthesia and 25 spinal anaesthesia. 20/44 (45.5%) had VAS > 3 in first 24 hours and 19/44 (43.2%) had VAS > 3 in second 24 hours. 100% women who had a regional technique had epidural or intrathecal diamorphine. 69/80 (86.25%) women were satisfied with their pain management.

Conclusions: In the first 48 hours following CS women commonly had VAS > 3. During the period of this audit a new early warning score observation chart was implemented which did not record pain scores. This may have resulted in inadequate management of pain.

References:

1. RCoA 'Raising the standard', 2006; 8.9:168 -169.

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THE PREDICTED DURATION OF THE FIRST AND SECOND STAGE OF LABOR IN EPIDURAL ANAELGESIA IS IN DEPENDENT FOR PREGNANT BMI

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Background and aims: Complications of labour and delivery occur more frequently among obese mothers than normal controls. Several studies have demonstrated a significant relationship between increasing maternal BMI and Caesarean delivery, citing cephalopelvic disproportion and failure to progress as the primary cause of this association. The literature would suggest that this risk is in the order of 2-3 folds with a BMI greater than 30 kgm.

Methods: The examined group consisted of 4922 patients (3871 with BMI < 30 and 1051 with BMI ≥ 30) classified to delivery in epidural anaesthesia from January 1999 to December 2011. Epidural anaesthesia was started in cervical dilatation was evaluated in 4 cm. In every group analyzed duration of the epidural anaesthesia time, duration of the first and second stage of labour and indications to caesarean delivery.

Results: Groups which were studied did not differ statistically in respect of the descriptive characterization. The epidural anaesthesia time was significantly longer in maternal with BMI ≥ 30 ($p < 0.05$). The predicted duration of second stage of labor was the longest in maternal with BMI = 30. Patients with BMI > 30 and < 30 was significant shorten duration of second stage. This studies have demonstrated significant ($p < 0.05$) relationship between maternal BMI and caesarean section (18% in normal group v 27% in obese group).

Conclusions: The predicted duration of the first and second stage of labor in epidural anaesthesia is in dependent for pregnant BMI. There is a significant relationship between increasing maternal BMI and Caesarean delivery.

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THE IMPACT OF THE TYPE OF ANAESTHESIA ON NEONATAL ACID-BASE STATUS

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Background and aims: Vast majority of studies reporting neonatal acid-base data shows significantly lower cord pH and base excess (BE) associated with spinal than with general anaesthesia. The aim: to compare neonatal acid-base status after general and spinal anaesthesia, where intravenous fluid coload and phenylephrine were used for prophylaxis of hypotension.

Methods: Following informed consent, twenty term ASA I-II parturient undergoing elective caesarean delivery were randomly assigned to spinal (n=10) or general (n=10) anaesthesia. Patients undergoing spinal anaesthesia received 12,5 mg isobaric bupivacaine with 15 micrograms fentanyl intrathecally and intravenous coload with Hartman's solution 500 ml and 6% Hetastarch solution 500 ml and phenylephrine boluses 50 micrograms when systolic arterial pressure was < 80% of baseline. General anaesthesia was induced with propofol and suxamethonium and maintained with 50% nitrous oxide and 1% sevoflurane in oxygen. Immediately after delivery umbilical venous (UV) and arterial (UA) blood samples were taken. Statistical significance has been tested by t-test with Cochran's and Cox's modification for small samples with the level of 5% as upper limit of statistical significance.

Results: There were no statistically significant differences in UA pH between spinal and general anaesthesia group (7.239 ± 0.04 vs. 7.26 ± 0.03 , $p = 0.1572$) as well as UA BE (-6.38 ± 4.09 vs. -5.94 ± 2.56 ; $p = 0.402657$) and also in Apgar scores (8.9 ± 0.3 vs. 8.8 ± 0.6 ; $p = 0.457472$).

Conclusions: Prophylaxis and treatment of hypotension with intravenous coload and phenylephrine make spinal anaesthesia as safe for the fetus as general anaesthesia.

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FIVE YEARS OF EXPERIENCE WITH ACCIDENTAL DURAL PUNCTURE AND POST-DURAL PUNCTURE HEADACHE IN A TERTIARY OBSTETRIC ANAESTHESIA DEPARTMENT

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Background and aims: An important complication of obstetric regional anaesthesia is the accidental dural puncture (ADP) and the post-dural

puncture headache (PDPH). It is estimated that the incidence of ADP is from 0.19% to 3.6% and PDPH 50% to 75%. This study aimed to review the incidence of ADP and its complications in a university hospital.

Methods: Retrospective analysis of all analgesia delivery between January 2006 and December 2010. Records of all parturients who experienced either ADP or PDPH were reviewed. Descriptive statistical analysis and the chi-square test were used.

Results: During this period, 10191 neuraxial blocks were recorded: 8783 epidurals; 1293 combined spinal-epidural and 115 spinal. There were 39 ADPs (0.39%), 29 (74.4%) confirmed during the execution of the technique and 10 (24.6%) not recognized in the act. Following known ADP, 38% (11/29) had epidural catheters re-sited in the superior space, 17.2% (5/29) in the space below, 24.1% (7/29) in the subarachnoid space and 20.7% (6/29) abandonment of the technique. The PDPH occurred in 25 (64.1%) patients. In 21 (53.8%) women PDPH prophylaxis was instituted, with bed rest, oral hydration and systemic analgesia. Treatment with blood patch was required in 12 women; in 2 prophylaxis had been instituted. One needed to repeat the procedure. PDPH prophylaxis has significantly decreased her incidence ($p = 0.001$).

Conclusions: The incidence of ADP, PDPH and blood patch treatment in our institution is similar to that found in the literature. Prophylaxis instituted shown to significantly reduce the incidence of PDPH in our series.

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AUDIT OF PAIN DURING CAESAREAN SECTION FOLLOWING EPIDURAL TOP-UP

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Introduction: Epidural top up is a well established technique of anaesthesia for caesarean section (CS), and has been advocated for use in high risk parturients. Limited data is available about patients who have pain during a CS with an epidural top-up not requiring general anaesthesia. We audited our practice in this area.

Methods: Ethics committee approval has been requested. We prospectively collected data from 50 consecutive CS done under epidural topups over 10 week period. We collected information about local anaesthetics (LA) and opioid used for topup, block height and quality attained, degree of motor block, pain experienced during section and treatment given.

Results: Nine out of 50 (18%) patients with top-up epidurals had pain during CS. All women were topped up with the 2% lignocaine with 1:200000 adrenaline as choice of local anaesthetic. All had at least grade III motor block. None of the patients required conversion to GA. Table below summarises the results.

Pain vs No pain	LA volume	Diamorphine before delivery	Fentanyl before delivery	Block below T4	Unequal block (sensory)
	Median (Range)				
Pain	20(15-23)	4/8	0/9	0/9	3/9
No pain	20(15-20)	11/32	10/41	0/41	8/41
Both	20(15-23)	15/40	10/50	11/50	11/50

[Intraoperative pain following epidural topups]

Conclusions: There was a high incidence of pain during CS in our patients. None of the mothers with pain received fentanyl. The epidurals were topped up and the blocks were assessed appropriately. We feel further work is required to determine the optimal method for topping up and assessing epidurals for CS.

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CAESAREAN SECTION IN A QUADRIPLEGIC WOMAN - SPINAL ANAESTHESIA

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Background and aims: The quadriplegic pregnant patients presents a serious challenge to the anaesthetist. The women are at risk to develop autonomic hyperreflexia during labour, suffer from chronic infections of the genitourinary system and respiratory tract, anaemia and decubitus. Risk of venous thrombosis is increased. There are no uniform guidelines regarding delivery in these patients; both caesarean section and vaginal delivery might be safely conducted.

Methods: Review of medical records.

Results: The patient had become quadriplegic 16 years earlier after a car accident in which she had sustained C₆ and C₇ fractures. There was no sensation from T₁ down, but her general condition was satisfactory. The fetus was hypotrophic, with a left-sided hydronephrosis. Despite regular contractions, there was no progress in the delivery and caesarean section was performed under spinal anaesthesia via the L₃-L₄ lumbar interspace. A 2.8 ml dose of hyperbaric bupivacaine produced a satisfactory block, although precise determination of the anaesthesia level was impossible. The patient's cardiovascular status was stable. After the first three minutes of surgery her blood pressure increased to 17.3/10.7 kPa, but quickly returned to normal. The surgery and postoperative period were uneventful, and she was discharged home 7 days later.

Conclusions: Spinal anaesthesia was chosen because it is a simple procedure, and also it prevents autonomic hyperreflexia, frequently present in paraplegic parturient women.

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PURINES IN THE BLOOD AND CEREBROSPINAL FLUID AT THE END OF PREGNANCY

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Background and aims: It is assumed that hyperuricemia may be useful, at least in identifying pregnant women with hypertension who are likely to develop pre-eclampsia. The aim of the study - to investigate the diagnostic value of the exchange rates of purines in the blood and cerebrospinal fluid (CSF) at the end of pregnancy.

Methods: We examined 78 pregnant women, who before starting spinal anesthesia for cesarean section was performed over the fence of venous blood, in the performance of spinal anesthesia (before the introduction of anesthesia) - fence CSF. Purines was determined by direct spectrophotometry.

Results: Pregnancy disasters (nephropathy, preeclampsia, pregnancy steatosis, HELLP-syndrome) differs from the normal pregnancy by significantly increased body mass index (BMI- with its excess to obesity), increased CSF concentrations of adenine, guanine, hypoxanthine and UA, increased blood level malondialdehyde (MDA) and UA. Sensitive risk factors for disasters of pregnancy may be considered a reduced concentration of adenine in blood, increased MDA blood level, with a BMI over 27 kg/m². Strongly associated with the pathology of pregnancy: positive - the high level of guanine in the CSF, and high and low UA blood level, BMI over 27 kg/m², negative - decreased CSF concentration of hypoxanthine.

Conclusions: The level of UA and other purines in pregnant women is desirable to investigate not only in the serum, but when this is possible - and in the cerebrospinal fluid.

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ANTENATAL ANAESTHETIC REVIEW AND MATERNAL OBESITY: ARE WE DOING ENOUGH?

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Background: CMAE/RCOG recommend that pregnant women with a booking BMI ≥ 40 must have antenatal anaesthetic consultation and a management

plan for child birth. We aimed to audit the correlation between anaesthetic clinic management plan and the actual management during child birth.

Methods: Data of 81 women were collected retrospectively from clinic letters, case notes and local database over one year. Descriptive statistics was used for analysis.

Results:

Ante-natal Clinic: Average BMI was 42.2 kg/m². Early epidural was advised in 23 (28%) patients. Regional blocks were predicted to be difficult (no palpable landmarks) in four (5%) patients. Third trimester weight was done only in 25 (31%) patients.

Mode of Delivery	Number of patients	Anaesthetic interventions
Spontaneous vaginal delivery	39	11 Epidurals, 3 Remifentanyl PCAs, 1 Remifentanyl PCA converted to Epidural
Elective Caesarean section	14	14 Spinal anaesthetics
Emergency Caesarean section	15	4 Epidurals, 6 Spinals, 2 Epidurals converted to Spinals, 1 Epidural converted to GA, 1 Spinal converted to GA and 1 primary GA
Instrumental	13	8 Epidurals, 1 Spinal, 3 Epidurals converted to Spinal
[Intra-partum events]		

Outcome: Two out of four patients with predicted difficulty for neuraxial blocks developed complications (dural puncture and inadequate epidural). Nine epidurals were inadequate requiring resiting or conversion to spinal or GA for operative delivery. Three (4%) had GA, two of which were due to failed regional blocks. Only eight had early epidurals.

Conclusion: 56 (66%) patients required anaesthetic intervention and epidural failure rate was higher. We recommend standardising the clinic letters, weighing during labour-suite admission and sticking 'alert stickers' on the notes after ante-natal anaesthetic consultation to highlight the presence of a management plan for labour and delivery.

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INFLUENCE OF EPIDURAL ANALGESIA ON ABDOMINAL WALL PAIN TENSION AND LEVEL OF ABDOMINAL PRESSURE IN LABOR

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Background and aims: Painful cramps in labor lead to intra-abdominal pressure (IAP) growth. This process increases negative influence of intra-abdominal hypertension on system of mother-placenta-fetus. The most probable cause of IAP rising during cramps is painful tension of anterior abdominal wall. Influence of an epidural analgesia on painful tension of anterior abdominal wall and level of intra-abdominal pressure during delivery was the subject of present study.

Methods: After ethics committee approval 124 patients in first stage of labor were included into the study. They were divided into 2 groups: epidural analgesia was provided for patients of group I, opiate analgesics - for group II. Efficacy of analgesia was estimated by visual analogue score. IAP was assessed by bladder pressure measurement. Abdominal wall tension was estimated by its compliance.

Results: In group I pain intensity decreased from 6.29 ± 0.82 to 0.92 ± 0.54 points (p < 0.05), in group II - from 6.31 ± 0.63 to 3.26 ± 0.84. In group I IAP decreased from 25.12 ± 0.76 to 19.73 ± 0.69 mmHg (p < 0.05). In group II IAP decreased from 24.79 ± 0.73 to 22.86 ± 0.9 mmHg. Compliance in group I increased by 22.11 ± 0.7 ml/mm Hg, and in group II - by 2.11 ± 0.2 ml/mm Hg (p < 0.001). Strong direct correlation was found between pain intensity and parameters of anterior abdominal wall tension r = 0.739.

Conclusions: Use of epidural analgesia decreases severity of pain during labor, level of abdominal wall pain tension and level of abdominal pressure during delivery.

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RELATIONSHIP BETWEEN ABDOMINAL PRESSURE AND LEVEL OF SENSORY BLOCK DURING DELIVERY UNDER SPINAL ANAESTHESIAD. Marshalov¹, I. Salov¹, E. Shifman², A. Petrenko¹ ¹Saratov State Medical University, Saratov, ²Peoples Friendship University of Russia, Faculty of Medical Retraining, Moscow, Russia.

Background and aims: It is well known that in pregnancy and obesity volume of subarachnoidal space decreases. This leads to more cranial spread of local anaesthetic solution and development of less predictable block. The most probable cause of such changes is high level of intra-abdominal pressure (IAP). We studied the relationship between the spread of sensory block in spinal anaesthesia and IAP in pregnant obese patients.

Methods: After ethics committee approval spinal anaesthesia was performed in 37 pregnant patients with body mass index $>30 \text{ kg/m}^2$. IAP was assessed by bladder pressure measurement before introduction of spinal anaesthesia. Subdural space was punctured at level L III-IV. Bupivacaine 0.5% solution (3.5 ml) was injected intrathecally. We assessed the level of sensory block by pin prick test.

Results: Mean IAP before surgical intervention was 20.27 ± 2.35 (Min-12.0; Max-25.0) mmHg. Strong negative correlation was found between IAP and level of sensory block ($r=-0.7$; $p=0.003$). For subgroup of patients with IAP < 20 mmHg, mean level of sensory block was Th 8.5 ± 0.5 ; for IAP = $20-21$ mmHg - Th 7.4 ± 0.72 ; IAP > 21 mm Hg - Th 5.87 ± 0.9 . This data shows that use of spinal anaesthesia in pregnant patients with IAP > 21 mm Hg may lead to high level of sensory block and high risk of arterial hypotension development.

Conclusions: While planning spinal anaesthesia in pregnant patients anaesthesiologist should take into account that rising of intra-abdominal pressure increases probability of high sensory block.

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REGIONAL SURVEY ON THE USAGE OF FENTANYL AS EPIDURAL TOP UPS FOR CAESAREAN SECTIONSA. Singh, A. Joseph, M. Mushambi, S. Francis *University Hospital Leicester, Leicester, UK.*

Background and aims: It is common practice in the UK to use neuroaxial opioids for labour analgesia and caesarean sections. The addition of Fentanyl by the epidural route has been shown to improve the quality of anaesthesia. There is a wide variation of drugs used for topups for caesarean sections¹. A recent study found no advantage when 75mcg of Fentanyl was added to 0.5% Laevobupivacaine as a topup following established labour analgesia². The evidence to support the use of Fentanyl in these situations is conflicting¹. So we wanted to evaluate the common practice in the region.

Methods: Postal questionnaires were sent to Obstetric Anaesthetic Consultants in the Midlands. We enquired about Fentanyl usage for topups and ascertained the dosage preferences and drugs used for topups.

Results: The response rate was around 65% (63). 57% of the consultants used 0.5% Bupivacaine and Fentanyl for topups. After a cumulative dose during labour, 67% still added Fentanyl. 10% added it for intra operative discomfort.

50 mcg	75 mcg	100 mcg	variable
27%(13)	14%(7)	45%(22)	14%(7)
[Fentanyl topup]			

Conclusion: Our survey showed variability of practice. A majority of consultants preferred to use 0.5% Bupivacaine with Fentanyl. 67% of the respondents always used Fentanyl for topups. There was a variation with the dosage of Fentanyl. Overall Fentanyl was being widely used for epidural topups.

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EPIDURAL VOLUME EXTENSION TECHNIQUE AND ITS EFFICACY IN HIGH RISK CARDIAC CASES - OUR EXPERIENCE IN HIGH RISK CARDIAC CASESA.K. Tiwari *Department of Anaesthesia, St. Stephen's Hospital, New Delhi, India.*

Introduction: The technique of injecting normal saline into the extradural space following an intrathecal injection is known as epidural volume extension (EVE) and has been shown to increase the cephalad spread of the block.

Case report: We are presenting a case series of 10 high risk cardiac cases posted to us from various different department including Obstetrics to Urology, with wide variety of presentation and various degree of comorbidities and included cases with takayasu arteritis, severe pulmonary artery hypertension to critical aortic stenosis and Peripartum cardiomyopathy among various others.

Conclusion: Epidural volume extension technique reduces the incidence of hypotension following subarachnoid block with adequate level of analgesia using low doses of local anesthetics. It has distinct advantages over general anaesthesia in terms of improved pulmonary and myocardial function, early mobilization leading to reduced chances of thromboembolism and post-op analgesia.

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IMPROVING OBSTETRIC ANAESTHESIA FOLLOW UP IN A DISTRICT GENERAL HOSPITALA. Vaughton, R. Ford, R. Swanton, J. Walker *Anaesthetics, Dorset County Hospital, Dorchester, UK.*

Background and aims: In the UK there are around 700000 central neuraxial blocks per year, 45% of these are for obstetric indications. Complications in the obstetric population are extremely low. However complications that occur in all populations are often compounded by failure to identify and monitor developing signs and symptoms.¹ Guidelines recommend that all women who have received an anaesthetic intervention for labour and delivery should be reviewed following delivery.² This audit set out to assess follow up rates in one district general hospital and introduce new documentation with the aim of improving our practice.

Methods: Audit forms for the months of July and November were analysed for documented follow up and correct annotation. Following the audit in July new forms were introduced with more emphasis placed on procedure, complications and symptoms using a tick box format.

Results: Prior to intervention obstetric followup rates were 46% with only 22% of followup forms being adequately completed. Post intervention 80% women were followed up with 90% of forms being correctly completed.

Conclusions: Sustaining high levels of anaesthetic follow up in a small obstetric unit can be challenging due to a varied workload and limited numbers of obstetric anaesthetists. We have shown that with improved documentation this can be significantly improved.

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EFFECTIVE AND SAFE OF FENTANYL IN DELIVERY LABOURP. Villarejo, D.A. Martinez, V. Pérez Millon, P. Moreno, C. Auriolos *Complejo Hospitalario Carlos Haya, Málaga, Spain.*

Background and aims: Spinal block for labour analgesia has been associated with somnolence and heart rate abnormalities in the foetus and the neonate. Our aim was to compare the efficacy and safety of epidural analgesia with 12 ml/h low-dose of bupivacaine 0.125% plus fentanyl 100 mcg(B+F, n=63) vs medium dose of bupivacaine 0.125%(B, n=54) during labour.

Methods: In a randomized, double-blinded study 117 ASA I-II parturients, primiparous with monofoetal gestation, at 37-42 week's gestation and rhythmic labour contractions. Clinical stage, labour characteristics and evolution, drugs used during labour, maternal and foetal-newborn status and complications were recorded.

Results: There were no differences in hemodynamic or obstetric characteristics between the two groups. Delivery labor modes were (% in B/B+F): eutocic 24.1%+33.3%, non eutocic 75.9%/66.7% (instrumental 40.7%/28.6% an caesarean 35.2%/38.1%). B+F showed a shorter time between the beginning of the epidural analgesia induction and final delivery (1.3 h) with respect to B. The complementary intra labour and post labour analgesia requirements were lesser in B+F than in B. number PCEA bolus were B=8+/-1.2 and B+F= 3+/-0.5; use of intra-labour complementary analgesic were B=35.2% vs. B+F=25.4%; . Adverse reactions incidence were (% in B/B+F): absence of RAM 59.3%/65.1%; nausea-vomiting (14.8%/20.6%), cephalalgia (3.2%/1.9%), hypertension (11.1%/3.2%). There was a slightly more post-labour antiemetic drugs use with B+F (16.9%) than with B (9.2%). No adverse neonatal outcomes were observed in both groups.

Conclusions: Addition of fentanyl to bupivacaine significantly enhanced analgesia and increased the labour's delivery eutocic rate without adverse maternal and neonatal outcomes.

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HEMODYNAMIC STABILITY DURING EPIDURAL ANAESTHESIA FOR FETOSCOPIC SURGERY

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Background and aims: Anaesthesia for fetal surgery may be carried out in regional anaesthesia depending on the type of intervention (1,2,3). The aim of this retrospective study was to analyse the impact of epidural anaesthesia on maternal hemodynamics during fetoscopic interventions.

Methods: Anonymous retrospective chart review (n=15). The local ethics board did not require formal review for this type of study. Invasive arterial blood pressure was obtained. In two cases transpulmonary hemodynamic measurements were carried out. Mann-Whitney testing versus baseline was applied.

Results: A lumbar epidural catheter was equipped with 0.1 ml/cm ropivacaine 0.75% and sufentanil 0-20 µg, resulting in anaesthesia to a median level of Th6/7. During induction phase median maternal heart rate dropped from 92 to 84 bpm. The lowest mean arterial blood pressure (MAP) was 79 mmHg (median value, p<0,01). During fetoscopy the lowest maternal heart rate was 59 bpm, the lowest MAP was 79 mmHg (p<0,05). In 44% of cases beta-mimetics (cafedrine/theodrenaline) with a median dose of 60/3 mg were applied. Cardiac index, intrathoracic blood volume and extravascular lung water did not change significantly.

Conclusions: Although MAD dropped during induction and during the intervention maternal hemodynamics was within normal range in the majority of cases. If hemodynamic support was necessary only low doses were needed to ensure hemodynamic stability.

References:

- (1) Hering R et al. Br J Anaesth 2009.
- (2) van de Velde M & de Buck F Fetal Diagn Ther 2012.
- (3) van de Velde M et al. Anesth Analg 2005.

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GASTROSCHISIS. USING OF COMBINED SPINAL-EPIDURAL ANESTHESIA AS ALTERNATIVE GENERAL ANESTHESIA

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Background: Administration of general anesthesia for gastroschisis repair is associated with several problems including the need for postoperative ventilation. Central neuroaxial block for gastroschisis repair in neonates is an alternative technique which proved to be safe with minimal complications.

Aim: The aim of this study was to present a comparative study evaluating outcome after gastroschisis repair with general anesthesia and with combined spinal-epidural block.

Methods: A review about nonrandomized study of a cohort of 34 neonates born with gastroschisis between November 2006 and March 2012 was performed. Fifteen neonates (group 1) had conventional reduction under general anesthesia, and 19 (group 2) had minimal intervention reductions with combined spinal-epidural block.

Results: Groups were comparable in regards to gestational age, birth weight, and quality of eviscerated bowel. Statistical significance was seen between groups 1 and 2 in regards to age with reduction of gastroschisis and time taken for completion of gastroschisis reduction. No statistical significance was seen with respect to start of feeds, duration of total parenteral nutrition, and total hospital. Admission to the intensive care unit was required in 100% in group 1 for 1 to 16 days vs 47% in group 2 for 3 to 10 days. There was 1 death in group 1.

Conclusions: Neonates with gastroschisis whose bowel was reduced with general anesthesia were in need for additional postoperative ventilation, increased time spent in the ICU, though the mortality rate and feeding start time were substantially the same.

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ULTRASOUND GUIDED SUBCOSTAL TAP BLOCK COMBINED WITH CONTRA LATERAL RECTAL SHEATH BLOCK. HOW MUCH MORPHINE DO WE REALLY NEED?

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Background and aims: We are presenting case studies of pain management of five neonatal patients who required emergency laparotomy.

Methods: Perioperative analgesia was managed successfully with ipsilateral subcostal transabdominal plane (STAP) block in combination with contralateral rectal sheath (RS) block, both USS guided.

Results: We think that STAP block with or without RS block is very useful for abdominal surgery in neonates. It provides very good analgesia intraoperatively, facilitates early extubation, and probably decreases the amount of morphine needed for analgesia postoperatively without risks associated with neuraxial blockade.

Case	Weight	Age	Procedure	Intraoperatively		Postoperatively				
				TAP Block	Analgesia	FLACC	FLACC	Paracetamol	Morphine	Postoperative
				Rectal Sheath Block		4h	24h		24 hours	Complications
1.	1.5kg	8d	Duodenal Atresia	+	IV Paracetamol	1	2	Regularly	0.11 mg.kg ⁻¹	-
			Repair	+						
2.	2.0kg	10d	Laparotomy Division of Congenital Adhesions	+	PR Paracetamol	1	3	Regularly	0.11 mg.kg ⁻¹	-
			LADP's Procedure	+						
3.	2.0kg	3d	Laparotomy with Hartmann's Procedure for Spenic Flexure Atresia	+	-	1	2	Regularly	0.08 mg.kg ⁻¹	Desaturated after 5h postop on NCA
4.	2.5kg	6d	Laparotomy, Excision of Ileal Duplication Cyst	+	-	1	1	Regularly	0.12 mg.kg ⁻¹	-
5.	2.5kg	3d	Laparotomy for Volvulus + LADP's Procedure	+	-	0	0	Regularly	0	-

[Results]

Conclusions: However, one patient needed tracheal intubation after morphine infusion has been started. It indicates that morphine nurse controlled analgesia (NCA) should be tailored properly according patient's needs especially if analgesia is supplemented by TAP block.

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EVALUATION OF THE FLACC SCALE AS A POSTOPERATIVE PAIN ASSESSMENT OF YOUNG CHILDREN UNDERWENT DAY-SURGERYN. Miyazawa, C. Igarashi, T. Minayoshi, S. Yamamoto *Anesthesia, Tokyo Metropolitan Children's Medical Center, Tokyo, Japan.*

Background and aims: Young children tend to lack the verbal and cognitive skills to express pain and discomfort. This may lead to under-treatment of pain in young children. The FLACC scale (facial expression, leg position, activity, crying, consolability) is one of pain assessment scales for toddler-preschool children. We evaluated usefulness of this scale in recovery room in the view of nurses.

Methods: This study was approved by the ethical committee of our institute. Twenty-six recovery room nurses were involved. They scored postoperative pain of children underwent inguinal-hernioplasty every 15 minutes using the FLACC. After their shift, they answered questions in written form.

Results: Eighteen of 24 nurses appreciated the FLACC was useful and preferable for scoring young children in recovery room. Most suitable age was preschool age (12/24). What they felt difficulty to judge was facial expression (11/24). Distinguishing pain from agitation or discomfort was most difficult part, and some felt discrepancy between their scoring results and vague impressions. All nurses appreciated that this behavioral scoring is useful as an objective assessment.

Conclusions: The FLACC scale is consisted of five categories, which is scored from zero to two. This simple structure is useful in a busy clinical setting. We used the FLACC categories which were translated from English to Japanese, and this might blur a subtle distinction of expressions. The FLACC score was evaluated as a useful and objective pain assessment method for post-operative pain of young children in recovery room by nurses.

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ESTIMATION OF SKIN-EPIDURAL DISTANCE IN INFANTS AND CHILDREN FOR EPIDURAL CATHETER PLACEMENTN. Miyazawa, C. Igarashi, M. Sato *Anesthesia, Tokyo Metropolitan Children's Medical Center, Tokyo, Japan.*

Background and aims: The skin-epidural distance varies in the growing children. A number of formulas have been developed for estimating the distance. Ultrasound-guided epidural catheter insertion is an excellent method. However this method requires a skilled assistant to perform the imaging in real time during catheter placement, and it is hard to get an assistant in busy clinical hospitals. Estimation of the distance using calculation formula is still useful to avoid complication of epidural catheter insertion. Former formulas sometimes show insufficient correlation in infants. Therefore we prospectively measured skin-epidural distance and aimed to derive simple formulas for infants and children, respectively.

Methods: After ethics committee approval and parental written consent was obtained, children scheduled for elective major surgery was enrolled. Epidural catheter insertion was performed under general anesthesia in lateral position for all children. The site of epidural punctures were chosen by attened anesthesiologists, using hanging-drop technique. Depth from skin to epidural space was measured with a graduations of Tuohy needle.

Results: 717 children under fifteen years old were participated, including 159 infants. We derived an estimation formula as $D(\text{cm}) = 0.05W(\text{kg}) + 1$ (D : skin-epidural distance, W : body weight) for children more than one years old, and $D = 0.1W + 0.5$ for infants.

Conclusions: We derived skin-epidural estimation formulas for infants and children between one and fifteen years old. These formulas were simple and useful for estimation of distance in operation theaters.

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PAEDIATRIC SPINAL ANAESTHESIA FOR INFRAUMBILICAL OPERATIONS IN A NIGERIAN TEACHING HOSPITALA. Rukew¹, T. Alonge², A. Fatiregun³ ¹Department of Anaesthesia, ²Orthopaedics & Trauma, ³Epidemiology & Medical Statistics, University College Hospital, Ibadan, Nigeria.

Background and aims: This study was conducted to assess duration of spinal block, the length of surgery, length of spinal needle to establish lumbar

puncture, and the incidence of complications among a cohort of children < 12 years who received spinal anaesthesia at our centre.

Methods: After obtaining institutional approval, records of seventy-five children between the ages of 1 and 12 who had spinal block for infraumbilical procedures were prospectively reviewed. Spinal block was carried out at L5 / S1 interspace, and the dose of bupivacaine was 0.25-0.5 mg/kg.

Results: Forty-one children had orthopaedic surgeries, 22 had plastic reconstructive procedures and 2 had abdomino-pelvic operations. The demographic, block characteristics and complications are shown in Tables 1, 2 and 3. There was a positive correlation between the weight (in kg) of the child and the needle length (in cm) to establish spinal anaesthesia ($r = 0.6$, $P = 0.0001$).

TABLE 1. Patient characteristics, data are median, range, and number**Characteristics n = 75**

Sex M/F	30 / 45
Age (years)	Median 8
Range (1-12)	
Weight (kg)	
Median	21
Range	10-39
ASA physical status I / II	65 / 10

TABLE 2. Characteristics of spinal block

Median duration of surgery (min)	70
Range	10-240
Median duration of spinal block (min)	138
Range	40-300
Median needle length to establish spinal block (cm)	3.4
Range	2.2-4.8
Median sensory level	T10
Range	T6-T12

TABLE 3. Incidence of complications n = 75

Postspinal shivering	12 (16%)
Insufficient spinal block	7 (9.3%)
Nausea and vomiting	4 (5.3%)
Position dependent headaches	2 (2.7%)
Hypotension	1 (1.3%)
Bradycardia	1 (1.3%)

Conclusions: This study demonstrates that paediatric spinal anaesthesia is safe and effective for infraumbilical surgeries.

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AUDIT OF PAIN AND VOMITING IN PAEDIATRIC DAY SURGERY RECOVERYS. Belu Suderson¹, S. Sharma² ¹Dept of Anaesthesia, Royal Infirmary Glasgow, ²Anaesthesia, Southern General Hospital, NHS Greater Glasgow and Clyde, Glasgow, UK.

Background and aims: Paediatric Daysurgery is becoming increasingly common (50-60%). The main anaesthetic problems in recovery are acute pain and postoperative nausea and vomiting (PONV). We wanted to audit how we are managing them in our set up.

Methods: After getting audit and ethic committee permission we prospectively collected data of the children coming to daysurgery recovery over 3 weeks period. The audit data was completed by the anaesthetic colleagues

and recovery room staff. We excluded children who were getting imaging or investigative procedures.

Results: We collected data from 135 children coming to day surgery recovery. Among them 70%(95) children received either paracetamol or NSAID, 14.8%(20) children received opioids and 52%(70) children received local or regional analgesia. Only 22%(30) children received any prophylactic antiemetic.

The incidence of Postoperative pain and PONV in day surgery children in recovery was, as in table 1.

Finding	Percentage(Number)
Mild pain	11.8%(16)
Moderate pain	5.2%(7)
Severe pain	1.5%(2)
PONV	4.4%(6)

[Incidence of Postop Pain and PONV in day surgery]

Conclusions: Audit showed that we are keeping in with the APA guideline[1] for incidence for moderate to severe pain 6.7%(< 20%). And the incidence of PONV is less(4.4%) compared to incidence of PONV(7.3%) cited by Tan S.G.M.et.al[3], this is due to reduced use of intraoperative opioids and increased use of prophylactic antiemetic, regional techniques and intravenous paracetamol in modern day surgery setup.

Reference:

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USE OF ULTRASOUND IN PERFORMING EPIDURAL ANESTHESIA IN CHILDREN < 8 KG

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Background and aims: Performing epidural anesthesia in newborns and neonates requires skills and experience of the performer. Does it consumes more time to use an echo of the vertebrae to perform an epidural anesthesia with a catheter as an extra information when one is using the loss of resistance technique.

Methods: We performed an ultrasound examination of the vertebral column, measured the time to get the information about the distance between the skin and the epidural space.

We measured the time to perform the epidural block by the loss of resistance technique with an ultrasound examination and without an ultrasound technique.

Results: We performed in 48 patients an ultrasound examination before the epidural block and registered the time consumed to do the ultrasound and the epidural puncture.

We compared this group with 25 patients we performed an epidural puncture without an ultrasound.

The procedures with use of an ultrasound technique took in average 1.5 minutes longer than the procedures without. The advantage of using an ultrasound technique before an epidural puncture is the knowledge of the median structures and the distance between skin and epidural space. In clinical settings it doesn't play a big role to have an epidural procedure that takes 1.5 minutes more time.

Conclusions: The time it takes to perform an epidural ultrasound examination to perform the puncture, is clinically irrelevant and can be neglected on the total induction time of anesthesia.

Ethical Committee Approval: No permission was necessary to collect this data in normal routine procedures.

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PEDIATRIC REGIONAL ANESTHESIA: 14 YEARS OF EXPERIENCE

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Background and aims: We present our data on 14 years of experience in pediatric regional anesthesia. In our hospital we introduced ultrasound (US) guidance for peripheral blocks since 2006. Our analysis aims to evaluate the trend between peripheral and central blocks and the impact of US in clinical practice.

Methods: The data were divided into period A (PA) from September 1998 to June 2006, 7 years and 9 months, and period B (PB) from July 2006 to April 2012, 5 years and 9 months, when US was started for peripheral blocks. Were used Ropivacaine 0.2% or Bupivacaine 0.5% (from 2001 Levobupivacaine 0.5%) and clonidine as adjuvant, when needed. Success rate and complications were recorded.

Results: Age range: 1 day -18 years, total blocks: 16594. In PA: 7605 total blocks, 3204 (42.1%) peripheral blocks, 4401 central blocks; 105 central continuous infusion, 42 peripheral catheters. In PB: 8286 total blocks, 3277 (39.3%) peripheral and 5009 central blocks; 420 central continuous infusion, 78 peripheral catheters. Complications: 0.12% in PA (9 dura punctures with 1 headache) and 0.05% in PB (2 dura punctures with 1 headache; 2 infected peripheral catheters). The success rate of peripheral blocks was 94-95% in PA and 97-98% in PB.

Conclusions: The number of total blocks and the number of peripheral and central continuous infusions were increased in PB. Complications rate is very low in our experience. US shows a reducing failure rate of peripheral blocks and increasing the spread of less frequent block such as ilioinguinal/iliohypogastric and supraclavicular blocks.

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PAEDIATRIC LMA-SUPREME AND CUFF PRESSURE RELATIONSHIP WITH QUALITY OF INTRAOPERATIVE ANALGESIA OF CAUDAL BLOCK

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Background and aims: The Supreme laryngeal mask airway (SLMA) is a single-use device with a rigid curved anatomical shape now available in paediatric sizes 1, 2. It has a new cuff to improve seal and a drainage tube to provide a channel for regurgitated fluid and gastric tube placement. Caudal block with low-doses of local anesthetic drugs during combined anesthesia has the advantage of producing a sensitive block of good quality without motor block. SLMA cuff inflation exerting pressure on laryngeal and pharyngeal structures becomes a painful stimulus and can reduce the quality of anesthesia. We evaluated the relationship between filling volumes and pressures of SLMA and quality of intraoperative analgesia of caudal block during combined paediatric anesthesia.

Methods: After insertion the masks were inflated with a manometer to 20, 40 and 60 cm H₂O respectively in group A, B and C. The effective airway was defined by the presence on monitor of a normal spontaneous chest movement and an adequate square-wave capnograph trace. The Caudal blocks were randomly allocated to receive 1 ml kg⁻¹ of levobupivacaine 0.25% and 0.20%.

Results: Supraglottic airway devices were less tolerated in groups with low doses of levobupivacaine combined with higher cuff pressures.

Conclusions: SLMA cuff pressures are inversely related to a minor quality of sensitive block if used with the low-doses of local anesthetics during combined paediatric anesthesia. To ameliorate the surgical effectiveness of caudal analgesia is mandatory to control with a manometer the cuff pressures of the laryngeal masks.

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A MODEL OF CONTINUOUS ANALGESIC TREATMENT USING LOCAL ANESTHETIC AT HOME IN OPEN SURGERY OF THE FOOT

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Background and aims: Treatment of moderate to severe pain in open foot surgery often requires hospitalization. We present a model of continuous perineural infusion of bupivacaine through a catheter placed in the popliteal fossa for foot ambulatory surgery.

Methods: It is a prospective observational study in patients scheduled for hallux valgus repair. 37 patients were included in the study. A catheter was placed next to the sciatic popliteal nerve, and 30 ml of mepivacaine 1.5% were administered. After the surgery it was connected to an elastomeric infusion pump of bupivacaine 0.125%, at 4 ml/h for 24h. The patient was discharged home with non-opioid oral analgesia and tramadol as rescue. A telephone control was made at day of surgery, 24 and 48h, to assess pain at home (visual analogue scale (VAS), quality of sleep, need for opioid medication, side effects and patient's satisfaction.

Results: We revised pain control in 37 patients at 24 and 48h. 81 % of them reported VAS ≤ 3 at 24h, and 70% at 48 h. Mean VAS at 24h: 1.47 ($\pm$ ED 1.76) and 48h: 1.84 ($\pm$ ED 2.11). 24 patients (65%) reported good sleep quality, and 11 (29.7%) needed rescue opioid. There were not significant side effects in any case and 2 patients presented early consultation for catheter problems. 83.8% of patients were satisfied with this technique.

Conclusions: According to our results, the continuous perisciatric infusion of local anesthetic is safe and effective for postoperative analgesia after ambulatory open foot surgery.

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ANALGESIC EFFECT OF TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK FOR ABDOMINAL SURGERY: COMPARISON WITH STANDARD POST OPERATIVE CARE

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Background and aims: Transversus abdominus plane block is a new technique for post operative analgesia in patients undergoing abdominal surgery. There have been few studies comparing the analgesics efficacy of this technique with standard postoperative care. To compare post operative pain in patients undergoing TAP block with standard post operative care in patients undergoing abdominal surgery.

Methods: Fifty patients (21 males, 29 females) with ASA class I and II undergoing abdominal surgery were included in the study. Half of the patients selected through randomization received TAP block using landmark technique at the end of surgery under anaesthesia. The remaining half received standard postoperative analgesia with nalbuphine and diclofenac sodium injections. All patients were questioned regarding the degree of analgesia on a Pakistan Coin Pain Scale at 12 hours post operatively. Use of analgesics was compared in the two groups postoperatively.

Results: The degree of pain was significantly lower in patients receiving TAP block compared with standard postoperative care (mean score 06 vs 16 $p < 0.05$). The quantity of nalbuphine (0.32 vs 4.08 $p < 0.01$) and anti inflammatory drugs (9.0 vs 63 $p < 0.01$) was significantly reduced in patients receiving TAP block compared with standard post operative care.

Conclusions: Transversus abdominis plane block provides effective post operative analgesia and is associated with markedly reduced analgesic consumption.

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THE EFFECT OF ULTRASOUND-GUIDED THORACIC PARAVERTEBRAL BLOCK ON POSTOPERATIVE ANALGESIA IN PATIENTS UNDERGOING NEPHRECTOMY

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Background and aims: The thoracic paravertebral block (PVB) has a large number of indications for postoperative analgesia. A real-time ultrasound guidance could increase accuracy and success rate of paravertebral block. We

evaluated if adding ultrasound-guided PVB to IV patient controlled analgesia (PCA) could improve postoperative analgesia compared to using IV PCA alone.

Methods: In this prospective randomized controlled study, subjects were randomized to receive a thoracic PVB using 18 ml of 0.75% ropivacaine combined with IV PCA (Group P) or an IV PCA alone (Group C). Total volume of IV PCA was 100 ml including fentanyl 1600 ug, with a bolus dose of 1 ml, lockout time 5 min, without baseline infusion. Outcome measures included hemodynamic variables (Heart rate [HR] and mean arterial pressure [MAP]) following skin incision and postoperative pain score (NRS), opioid consumption, inspiratory volume using the incentive spirometer and complications at 1, 3, 6, 12 and 24 hour after operation.

Results: The increase of HR after skin incision was lower in group P compared to group C. The postoperative NRS (4/10 vs 8/10) and the opioid consumption (57 ug vs 112 ug) were lower in group P compared to Group C at the first hour.

Conclusions: The ultrasound-guided PVB provided hemodynamic stability following skin incision as well as improved immediate postoperative analgesia by reducing postoperative NRS and opioid consumption in patients undergoing open nephrectomy.

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HAEMODYNAMIC STABILITY IN CAROTID ENDARTERECTOMY IN HIGH RISK PATIENTS - COMPARISON OF INTERMEDIATE CERVICAL PLEXUS BLOCK AND GENERAL ANESTHESIA

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Background and aims: General or regional anesthesia is the choice for patients undergoing preventive open carotid surgery. The aim of our study was to assess the hemodynamic stability (HS) of intermediate cervical plexus block (ICB) and general anesthesia (GA) in high risk patients.

Methods: Study was performed in 89 ASA III and ASA IV patients with carotid endarterectomy from January 2006 till November 2010 in University hospital Zagreb approved by ethics committee. Thirty five patients were done in ICB and 54 in GA. Data collected included age, sex, ASA status. The change of mean arterial pressure during the operation for more than 20 % was considered as hemodynamic instability (HI).

Results: Patients are classified as ASA III and ASA IV. Median age was 59 year. In the group of patients with ICB 18 patients were HS and 17 patients were HI. In the group of patients done in GA only two patients were HS, in contrast to 52 patients who were HI. Significantly higher HS is found in the group of patients with ICB (chi-square test=27,763, $p < 0.01$). The median ICU stay was 2,47 days, but mostly 24 hours.

Conclusion: In comparison of general anesthesia for carotid endarterectomy, intermediate cervical plexus block is more hemodynamically stable.

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DENTISTS AS LEADERS OF TEAMWORK IN PALLIATIVE CARE FOR THE PATIENTS WITH HEAD AND NECK CANCER

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Background and aims: In spite of no organization related with palliative medicine in Tabriz hospitals, there are a few non organized activities for relieve the suffering of terminally ill patients. So far, Patients with incurable head and neck tumors may live for months and even years, and this means that the palliative care should be considered more.

Materials and methods: Problems such as pain, difficulty in speech, hard swallowing, poor oral hygiene, bad chewing and depression are common problems in these patients. In general, pain reducing, infection preventing, and ultimately the extreme comfort for them will be the goal. Three patients referred to speech therapist, Gastroenterologists, and a psychologist then to a psychiatrist. In one case because of unbearable pain in left mandibular, Inferior alveolar nerve anaesthesia used repeatedly by dentist (author) Status and data were recorded before and after treatment and referring.

Results: After dental treatments, infection-related problems in the oral cavity, bad breath, TMJ joint pain and tenderness, prostheses problems improved in three patients. Feeling of satisfaction in all three patients with an

average increase of 61 percent, was measured on Likert system. Speech therapy was Satisfactorily useful for 2 patients with problems in speaking. Feeling of satisfaction in all three patients with an average increase of 22 percent, was measured on Likert system.

Discussion: According to results, palliative care can help the patients and it is useful. Dentists can relieve the suffering of patients with head and neck cancer by leading palliative care team work and they have to do their best to improve of group efficiency.

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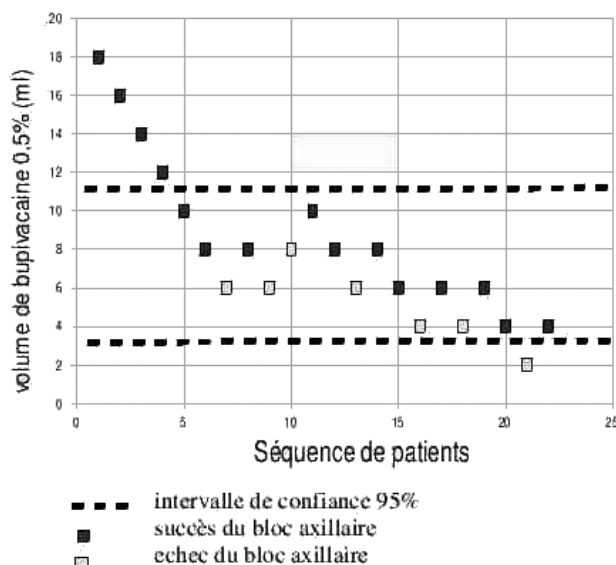
THE MINIMUM EFFECTIVE ANESTHETIC VOLUMES FOR THE SUCCESS OF AXILLARY PLEXUS BLOCK. PRELIMINARY RESULTS

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Background and aims: Previous studies have demonstrated that lower local anaesthetic (LA) volumes can be used for ultrasound (US)-guided axillary plexus block (AX). However, no study has examined whether US can reduce the volume required for surgical anesthesia. Our aim was to determine the minimum effective anesthetic volumes (MEAV).

Methods: After ethics approval and informed consent, patients undergoing hand or forearm were recruited to this up-down sequential allocation study. The volume used for US was dependent upon the success or failure of the previous block starting at 18ml with a testing interval of 2 ml. A 5-12 MHz probe was used to visualize the brachial plexus at the axilla using Logic7® ultrasound machine (GE Medical systems; USA). The LA was then injected so that each nerve received ¼ of total dose allocated to the patient. Success was defined as a verbal rating score of 0/10, 30 min before surgery. MEAV values were estimated using up-down method of Dixon.

Results: figure 1): 13 patients were enrolled. The MEAV required to provide effective anesthesia was 6 ml [95% confidence interval (CI) 3.8-10.6].



[up-and-down sequence of patients]

Conclusions: US reduces the LA volume necessary for AX plexus block.

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DOCUMENTATION OF REGIONAL ANAESTHESIA IN A DISTRICT HOSPITAL

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Background and aims: Consent is an integral part of anaesthetic practice. The AAGBI working party suggested that anaesthetists should record

details of the elements of a preoperative discussion in the patient record, noting what risks, benefits and alternatives were explained.

The main aim of this audit was to assess the documentation of risks associated with RA. Moreover we have looked at the recording of technique, use of Ultrasound (U/S) and aseptic techniques used.

Methods: We did a retrospective audit consisting of 100 Regional anaesthesia (RA) cases over three months.

Results: 32% of anaesthetic charts did not contain information about discussed risks of RA. U/S guided RA was used in 24 out of 100 cases. There was no documentation about the technique in 13 % of the cases. There was no record of aseptic technique in 43% of anaesthetic charts.

Conclusions: This audit highlights the inadequate documentation of discussed risks of RA, detail of technique and aseptic approach during RA. Use of U/S is not common despite NICE guideline recommendation. Providing written leaflets to the patients not only will allow us to deliver necessary information but also would standardize the documentation of risks of RA.

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TRENDS IN REGIONAL ANAESTHESIA AT A UK DISTRICT GENERAL HOSPITAL: DATA COLLECTION FROM 2006/2007 AND 2011/2012

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Background and aims: The numbers and types of peripheral nerve and central neuraxial blocks performed at a district general hospital were assessed from two sample twelve month periods, five years apart.

Methods: Annual summary statistics were retrieved from the hospital's theatre administration system to determine the total number of anaesthetics conducted and the contribution of regional anaesthesia either as a sole technique or in conjunction with general anaesthesia. Cases performed entirely under local anaesthesia by surgeon were excluded, as were all ophthalmology cases.

Results:

	Total caseload	Peripheral Nerve Blocks (n)	Peripheral Nerve Blocks (%)	Central Neuraxial Blocks (n)	Central Neuraxial Blocks (%)	Any Regional Anaesthesia (n)	Any Regional Anaesthesia (%)
2006/2007 Daycase	5587	142	2.5	5	0.1	147	2.6
2011/2012 Daycase	6201	558	9.0	85	1.4	643	10.4
2006/2007 Inpatient	6842	1059	15.5	2835	41.4	3894	56.9
2011/2012 Inpatient	5441	882	16.2	2318	42.6	3200	58.8

[Numbers of CNB and PNB performed]

The percentage contribution of regional anaesthesia increased for both day surgery and inpatient groups over the review period; most notably in the use of spinal anaesthesia for day surgery. The acquisition of a departmental ultrasound machine in 2009 also altered the types of nerve blocks inserted with TAP and saphenous nerve blocks increasing from none to 19% and 9% respectively.

Conclusions: There is a marked difference between usage of regional anaesthesia for inpatient and day surgery populations in our hospital. We have scope to build on this and potentially utilise peripheral nerve blocks to augment analgesia and facilitate the transition of certain procedures to a daysurgery pathway.

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INFLUENCE OF ANESTHETIC VOLUME ON COMFORT SCORE DURING ULTRASOUND GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK (US-SCB)

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Background and aims: Involuntal changes of brachial plexus in elderly allowed a 35% reduction of local anesthetic (LA) volume for an effective

US-SCB (1). It is unknown whether the reduction in LA volume in elderly would affect Comfort score during block placement.

Methods: 40 patients undergoing upper limb surgery using US-SCB were divided into two groups (42 ml LA for patients < 45 years and 27 ml LA for patients > 65 years). Comfort score consisted of maximum pain intensity (VAS), the satisfaction of the patient (unsatisfied, acceptable, satisfied, very satisfied) and the number of unpleasant events declared by the patients (2). Score was calculated as the sum of each criterion, which was attributed a value of 1 for VAS < or = 30/100 or 0 for VAS > 30/100; number of unpleasant events (none, 1; one or more, 0) and satisfaction (satisfied or very satisfied, 1; acceptable or unsatisfied, 0). Comfort score of 3 or 2 was considered as comfortable while score 1 or 0 as uncomfortable block placement.

Results: In the elderly group, none (0/20) of the patient had Comfort score < or = 1 as compared with 25% (5/20) of patients in the younger group (P = 0.0471). Number of patients with unpleasant events (supraclavicular pressure, cold sensation) was higher in younger group (30% vs 0%, P = 0.020).

Conclusions: Reduction in LA volume during US-SCB is more comfortable and associated with less unpleasant events.

1. Tomulic K et al. 8AP2-8 *Eur J Anaesthesiol* 2011; 28: 113.
2. Bloc S et al. *Eur J Anaesthesiol* 2010; 27:628-633.

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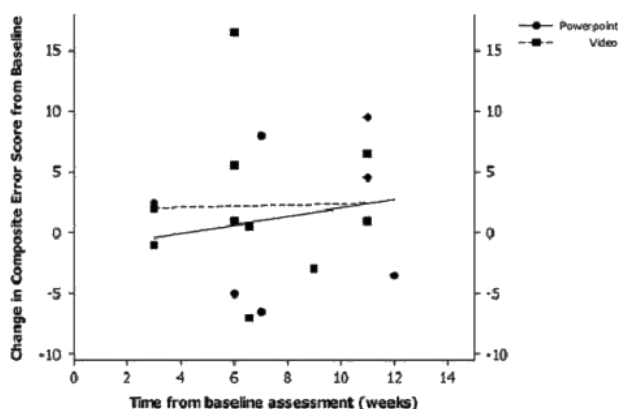
SKILLS LEARNING AND RETENTION IN ULTRASOUND GUIDED NEEDLE ADVANCEMENT

J.C. Bradley¹, L. Purushothaman¹, P. Townsley¹, J. Maybin¹, T. Davies², M. Dowling¹, N. Bedford¹, J. Hardman¹, R. McCahon¹
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Background and aims: Clinical opportunities for training are limited due to the European Working time regulations, patient safety concerns and increased theatre productivity. We aim to compare two teaching interventions with regard to skills acquisition and retention of ultrasound-guided needle advancement.

Methods: Fifty medical students were randomized to watch a video or view a PowerPoint presentation, which demonstrated image optimisation and ultrasound-guided needle advancement in a turkey breast. Participants performed the modelled task and two independent observers assessed image quality, number of errors and needle advancements to give a composite error score. Participants repeated the task several weeks later.

Results: Participants had no ultrasound experience. The initial median (IQR [range]) composite error score for the PowerPoint (n = 25) and Video (n = 25) groups was 9.0 (6.0 - 15.5 [1.0 - 17.5]) and 6.0 (3.5 - 11.25 [1.5 - 21.0]) respectively (Mann-Whitney, p = 0.10); high score equals weak performance. Data for 7/25 (PowerPoint) and 10/25 (Video) returnees are summarised in Figure 1.



[Figure 1]

Conclusions: Video-based teaching is associated with improved performance compared to PowerPoint-based teaching. However, the composite error score may be too blunt to adequately differentiate performance. Small sample size and low numbers of returnees have reduced the study power.

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POSTOPERATIVE ANALGESIA FOLLOWING INTERSCALENE BLOCK: NERVE STIMULATOR VERSUS ULTRASOUND VERSUS COMBINED GUIDANCE

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Background and aims: The interscalene block (ISB) is widely used to provide analgesia for shoulder surgery using a nerve stimulator and/ or ultrasound guidance [1]. This service review compares three different guidance techniques.

Methods: 775 consecutive shoulder surgery patients who have had ISB done for postoperative analgesia were analysed in three groups namely nerve stimulator (N), ultrasound (U) and combination (C) for time pain free, time to complete recovery, undisturbed sleep time (TUS), complications and supplemental opioids requirement.

Results:

	Nerve stimulator (n=240)	Ultrasound (n=327)	Combination (n=208)	'p' value
Time pain free (hr)	14.4 ± 3.7	14.6 ± 2.2	14.5 ± 1.4	p=0.73
Time to complete recovery (hr)	18.7 ± 4.4	18.5 ± 2.7	18.1 ± 1.6	p=0.12
Undisturbed sleep time (hr)	4.7 ± 1.8	3.9 ± 1.3	3.7 ± 1.0	p<0.05
Opioid postoperatively	30 (12.5%)	31 (9.5%)	16 (7.7%)	p=0.22
Complications	31 (12.9%)	6 (1.8%)	0 (0%)	p<0.05

[Values are mean ± SD or count (percentage)]

Complications included patchy block, prolonged block, difficult insertion and pain at block site.

Conclusions: Long acting analgesia and similar good patient satisfaction was observed with all techniques. Although, mean TUS was highest in N group, C group contained more patients with undisturbed sleep lasting ≥ 4hr (79.2% vs 68.8% in U and 62.5% in N groups). Combination of nerve stimulator with ultrasound provides safer and superior analgesia than either technique alone.

References:

1. Spencer S et al. A prospective, randomized, controlled trial comparing ultrasound versus nerve stimulator guidance for interscalene block for ambulatory shoulder surgery for postoperative neurological symptoms. *Anesthesia & Analgesia* July 2009; Vol. 109, No. 1: 265-271.

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ANATOMICAL INVESTIGATION OF A MODIFIED CORACOID APPROACH FOR THE BRACHIAL PLEXUS BLOCK

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Background: Different techniques have been described to perform a brachial plexus block using a neurostimulation at the infraclavicular level. Blocking the musculocutaneous nerve might be challenging. We investigated a combination of two described techniques, subcoracoid and infraclavicular brachial plexus block, concerning its morphological feasibility.

Methods: Fifteen cadavers (29 sides respectively), embalmed with Thiel's method were investigated. The insertion point of the needle, arm positioning and the direction are combinations of 2 established blocks. The needle was advanced in lateral and distal direction to be positioned dorsally to the axillary artery. The positioning of the needle was controlled by ultrasound and the needle tip was placed close to the nerve structure to be located dorsal to the artery. 20ml of green coloured water was injected and the colouration of cords or nerves verified and documented by dissection.

Results: In 21 cases, all three cords of the brachial plexus were coloured with a combined axillary distribution in 16 cases and reaching the region of the middle of the brachial region in two cases. In three cases only the lateral and posterior cords were coloured, in one case the lateral cord was solely coloured. Separate nerve colouration was found in 4 cases and additional spread to the thoracoscaphular space in one case.

Conclusions: This new combined technique seems to be an alternative for single shot and catheter placement offering a good spread of the local anesthetic. Clinical studies with single shot and catheter placement are warranted.

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DO PATIENTS LIKE AWAKE SURGERIES?

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Background and aims: The goals of day surgery such as rapid recovery, minimal side effects, adequate analgesia, early discharge and overall cost containment are met with regional anaesthesia. The 2007 document by the British society for hand surgery recommended most procedures as suitable for day surgery. Hence, The Queen Elizabeth Hospital, Kings Lynn, started a dedicated hand surgery service under regional block in 2009. We performed Subclavian PeriVascular (SPV) block using a modified oblique posterior to anterior approach guided by ultrasound +/- nerve locator on awake patients.

The patients were discharged with a protective arm sling and post-operative instructions and were followed-up over phone by nurses.

Methods: In a prospective postal survey, 80 questionnaires with pre paid envelopes were handed to the patients at the time of discharge. The data was analysed by the audit department.

Results: We received 64(80%) responses. 97% patients felt, they received adequate information about the procedure. 4(6%) patients felt, an information leaflet would be helpful. 1 patient found the procedure uncomfortable. Block was successful in 98% of patients. 14% of the patients experienced pain during the night. 87% patients found the follow up calls very useful. The service was well rated from excellent (81%) to good (19%).

Conclusions: Overall the service is liked by the patients. Providing patient information leaflets and education about the timing of analgesics during post-op period would benefit patients. With a good organisation and training, hand surgery in awake not only increases efficiency and throughput, but also improves patient satisfaction.

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COMBINED ULTRASOUND-GUIDED ANKLE AND POPLITEAL NERVE BLOCKS FOR FOOT & ANKLE SURGERY

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Background and aims: We present a combined technique of ultrasound-Guided Ankle and popliteal blocks providing awake surgical anaesthesia for patients undergoing ankle and foot surgery.

Our aim is to prove that this combined technique can be used as an alternative to general anaesthesia or central neural blockade to provide surgical anaesthesia, prolonged postoperative analgesia and to determine patient satisfaction.

Methods: We include a case series of 25 patients.. Blocks were performed in the anaesthetic room prior to surgery. Popliteal block was performed first under ultrasound guidance using 20mls of 0.5% L-Bupivacaine fol-

lowed by ultrasound guided ankle block (Posterior tibial, saphenous, superficial & deep peroneal nerves) using 20mls of 2%Lignocaine with Adrenaline1:10,000.

Patients were awake during surgery, but those patients who were very anxious or requiring thigh tourniquets, were offered conscious sedation using propofol TCI.

Results: Being a superficial block, ankle blocks have a rapid onset time allowing surgery to start within 5 minutes, while the popliteal blocks with a typical onset time of 15-30 minutes provided prolonged surgical anaesthesia and post-operative analgesia.

Duration of surgery varied between 30 min-3 hours.

No rescue analgesia was required. Patient satisfaction was high.

there were no immediate complications.

Post operative analgesia lasted between 8-15 hours depending on the type of surgery.

Conclusions: The combination of ankle and popliteal nerve blocks can be used as a safe alternative technique to provide awake surgical anaesthesia and prolonged post-operative analgesia.

References: The efficacy of combined popliteal and ankle blocks in forefoot surgery, JBone Joint Surg 2008

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EFFECTIVE BOLUS VOLUME OF ROPIVACINE 0.75% THROUGH A CATHETER REQUIRED FOR A TIMELY ONSET OF INTERSCALENE BRACHIAL PLEXUS BLOCKADE

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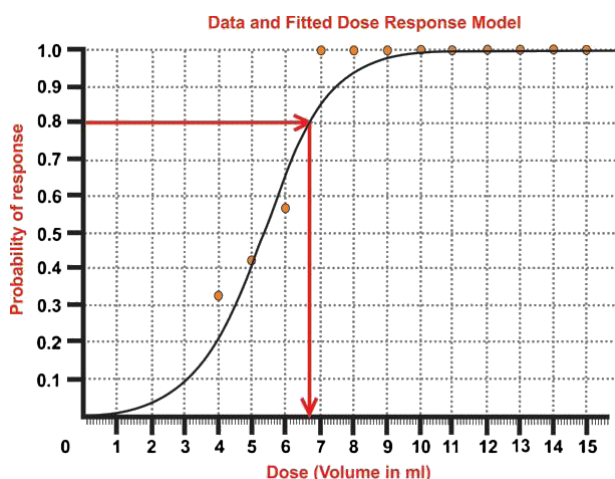
Background and aims: Ultrasound-guided interscalene brachial plexus block (ISB) has allowed for significant reduction in dose and volume of local anesthetic required to accomplish successful blockade using multiple injections. However, multiple injections are not possible through a catheter. Therefore, we undertook this study to determine the minimal effective volume required to accomplish successful ISB through the catheter.

Methods: After institutional ethics committee approval, patients aged 18-75years and scheduled for shoulder surgery under ISB were enrolled. All patients using a step-up/step-down method and the starting dose of 15mL of 0.75% ropivacaine, received an ultrasound-guided ISB through the catheter. The injection volume was increased or decreased by 1mL in case of block failure or block success, respectively (presence of motor and sensory blockade in C5-C6 within 30min).

Results: We found that 6.75mL of ropivacaine 0.75% administered in an ultrasound-guided ISB through the catheter results in successful blockade in 80% of patients. The proportion of patients with successful blockade rose sharply from approximately 57% at 6mL to 100% by 7mL(Figure 1). For the group as a whole, the median(min-max) sensory block onset time was 5(5-20)min, and the median(min-max) motor blocks for the biceps and the deltoid muscles were 7.5(5-15)min and 10(5-15)min, respectively. The median(min-max) block duration was 8.9(3-15)h(Table 1). Volume for successful block at 30min did not correlate with duration of analgesia (Pearson $r=0.345, p=0.126$).

Age,years:(mean±SD)	61±12
Gender:(F/M)	13/16
Weight,kg:(mean±SD)	76±13
Height,cm:(mean±SD)	165± 9
ASA I/II/III	12/10/7
Duration surgery,minutes:(mean±SD)	64±28
Sensory block onset time,minutes:median(min-max)	5(5-20)
Motor block for the Biceps muscle,minutes:median(min-max)	7.5(5-15)
Motor block for the Deltoid muscle,minutes:median(min-max)	10(5-15)
Block duration (time to first analgesic request), hours:median(min-max)	8.9(3-15)

[Patient demographics,data and measures]



[Ropivacaine volume and ISB success correlation]

Conclusions: An injection of a minimum of 7mL of ropivacaine 0.75% through the catheter is required for predictable success rate and timely onset of surgical anesthesia with continuous ISB.

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CAN WE IMPROVE PATIENT SATISFACTION FOR BRACHIAL PLEXUS BLOCK WITH THE INTRODUCTION OF A PATIENT INFORMATION LEAFLET?

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Background: Patient satisfaction depends on a congruence between patient expectations and occurrence.

Upper limb surgery is frequently performed under interscalene block as day stay. It was noted that patients were not always fully satisfied despite apparently effective analgesia and a low complication rate.

Method: Audit of patient satisfaction using a telephone questionnaire revealed patients were largely satisfied but wanted more information in certain areas. We introduced a patient information leaflet designed around previous models and re-audited satisfaction scores.

Overall, 102 patients consented to receive a telephone interview following surgery.

Results: 100% of patients who received the leaflet found it useful. There was a 28% improvement in awareness of side effects and complications of a brachial plexus nerve block. Patients became aware of what a nerve block was, demonstrating the leaflet had a positive impact but there was only 3% increase in feeling 'well informed' about complications of the block.

There was no change in satisfaction with pain control or overall satisfaction with service. Most would opt to have the same anaesthetic again, apart from one patient who, despite having no pain, had a dense motor block for 3 days which caused some distress.

Conclusion: With the introduction of the leaflet we aimed to address patient understanding of the variability between individuals, of pain experienced, normal side effects and complications. The leaflet achieved this aim but 8% patients felt further emphasis was needed.

However, quality of patient communication was consistently found to be at the root of high patient satisfaction.

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ULTRASOUND-GUIDED INTERCOSTOBRACHIAL NERVE BLOCK WITH ULTRASOUND-GUIDED AXILLARY BRACHIAL PLEXUS BLOCK: A PRELIMINARY STUDY

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Background and aims: Intercostobrachial nerve is not included in brachial plexus but responsible for the sensation in the medial aspect of the upper arm. Although ultrasound-guided axillary brachial plexus block provides good

anaesthesia for surgery in the forearms and/or hands, intercostobrachial nerve sometimes needs to be additionally blocked. Traditionally intercostobrachial nerve block has been conducted by subcutaneously infiltrating 5 to 10 ml local anaesthetic in the medial axilla. In this preliminary study, we assessed sensory block after intercostobrachial nerve block using smaller volume of local anaesthetic with ultrasound.

Methods: After obtaining approval from our IRB, 10 patients undergoing forearm and hand surgery were enrolled. The arm was abducted to 90 degrees and a probe was placed perpendicularly to the arm at the lateral border of pectoralis major muscle. Two ml of 1% lidocaine was injected subcutaneously over the axillary artery with an in-plane approach. Sensory blockade were assessed in the upper, middle, and lower parts of the medial upper arm every minute until 5 minutes, at 10 minutes after the injection and before surgery. Patients received ultrasound-guided axillary brachial plexus block.

Results: Sensory block in the upper, middle and lower parts was obtained in 9, 6, and 1 of 10 patients, respectively, at 5 minutes. Only 4 patients developed sensory block in all the areas by 10 minutes, but the remaining patients did eventually.

Conclusions: The intercostobrachial nerve was successfully blocked by using 1% lidocaine 2 ml with ultrasound in patients who later received ultrasound-guided axillary brachial plexus block.

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THE COMPARISON OF INTERSCALENE AND SUPRACLAVICULAR APPROACH OF BRACHIAL PLEXUS BLOCK USING ULTRASOUND-GUIDED REGIONAL ANESTHESIA FOR ARTHROSCOPIC SHOULDER SURGERY

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Background and aims: We had performed ultrasound-guided interscalene brachial plexus blocks (ISB) on arthroscopic shoulder surgery for more than 150 patients; however, the catheter removal sometimes caused serious problems.

ISB is effective for shoulder arthroscopy, but ultrasound-guided supraclavicular block (SCB) is a novel approach for shoulder anesthesia that might be less risky for neurological symptoms than ISB. In this study, we examined the difference between ISB and SCB using pain score and catheter position.

Methods: Thirty patients undergoing ultrasound-guided regional anesthesia for ambulatory shoulder arthroscopy were enrolled in our study. Researches were carried out on pain score, side effect and catheter position conformation using ultrasound on the postoperative three days. This study was approved by our hospital ethics committee.

Results: Ultrasound-guided ISBs (n = 15) and SCBs (n = 15) had remarkable anesthetic success on the postoperative days without making any side effects. The incidence of unexpected removal of the catheter was greater in ISB group. There was no clinically apparent pneumothorax in both groups. The incidence of PONV was very low, and there was no incidence of nerve injury.

Conclusions: Ultrasound-guided interscalene and supraclavicular blocks are effective and safe for shoulder arthroscopy. For keeping adequate position of catheter, the supraclavicular approach should be recommended.

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FEMOROPLOTEAL BYPASS ELECTIVE PROCEDURE UNDER FEMORAL-SCIATIC NERVE BLOCK IN A PATIENT WITH ABNORMAL COAGULATION PROFILE

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Background and aims: Regional anesthesia may help to reduce the risk for perioperative mortality in patients with severe chronic cardiac and lung diseases. We present the case of a 77 year old male, habitual smoker, with a history of COPD, severe ischemic heart disease and diabetes. He had myocardial infarction a month ago. The patient came to our hospital with severe pain in his right leg. After emergency procedure Fogarty-thrombectomy under local anesthesia, the surgical team discussed with us this patient. He had a critical chronic limb ischemia and was on anticoagulant therapy clopidogrel and aspirin at home and heparin and pentoxifylline infusion for the last 24 hours. The both teams decided that the best option for this patient is a femoropopliteal bypass with saphenous graft under regional anesthesia.

Methods: We performed ultrasound guided sciatic and femoral nerve block with single shot technic 25ml 0.25% Bupivacaine for sciatic nerve and 15 ml 0.25% Bupivacaine for femoral nerve. The patient was sedated with Midazolam, Fentanyl 150mcg, Propofol infusion to Ramsey score 4-5.

Results: There wasn't any intra- or post-operative complications. One month later the patient was admitted to the ICU and died of mesenteric thrombosis.

Conclusions: We suggest this approach provides maximum patient safety, despite the risk of hematoma.

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TOPICAL LOCAL ANESTHETICS CREAM APPLIED BEFORE BRACHIAL PLEXUS BLOCK CAN OFFER BETTER PATIENT SATISFACTION AND COMFORT - A SIMPLE SURVEY

A. Jayaraman¹, B. Manickam² ¹Anaesthesia, Northern Deanery, Newcastle upon Tyne, ²Anaesthesia, Darlington Memorial Hospital, Darlington, UK.

Background and aims: Patient comfort during interscalene and supraclavicular approach for brachial plexus block (BP) is usually done by lignocaine infiltration, but injecting lignocaine itself is painful and distressing for patients.

David Samson et al (1) showed that the patients who received EMLA cream had less pain with needle puncture during humeral block. The purpose of this audit is to assess the pain score and patient satisfaction during interscalene BP block when topical local anaesthetic cream was used pre procedure.

Method: After local audit committee approval.

We evaluated use of topical local anaesthetics in patients having interscalene approach block using Pajunk 50mm sonoplex needle under ultrasound guidance. LA cream 4% lidocaine was applied 30min pre procedure.

We evaluated 20 patients for **Patient pain score during the block** Patient satisfaction.

Results: Pain score - All patients had pain score less than 4

Patient satisfaction- very satisfied-15 Satisfied- 10

Conclusion: Patients satisfaction and pain during the interscalene approach for brachial plexus block could be improved by topical local anaesthetic cream.

It also has the added advantage of marking the site with the cream patch, avoiding the wrong sided block.

Also there is no puncture site from the infiltration needle which could decrease infection and needle stick injury.

This also can give the anesthetist an added advantage to explain to the patients and examine their anatomy before hand while applying the cream.

Ref: 1. David Samson **Eutectic Mixture of Local Anesthetic (EMLA®) Decreases Pain During Humeral Block Placement in Nonsedated Patients** *Anesth Analg* August 2007 105:512-515.

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PAIN AND PATIENTS SATISFACTION DURING BRACHIAL PLEXUS BLOCK- CAN WE IMPROVE IT USING TOPICAL LOCAL ANAESTHETIC CREAM?- A SURVEY

A. Jayaraman¹, B. Manickam² ¹Anaesthesia, Northern School of Anaesthesia, Newcastle upon Tyne, ²Anaesthesia, Darlington Memorial Hospital, Darlington, UK.

Background and aims: Patient comfort during interscalene and supraclavicular approach for brachial plexus block (BP) is usually done by lignocaine infiltration, but injecting lignocaine itself is painful and distressing for patients.

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502

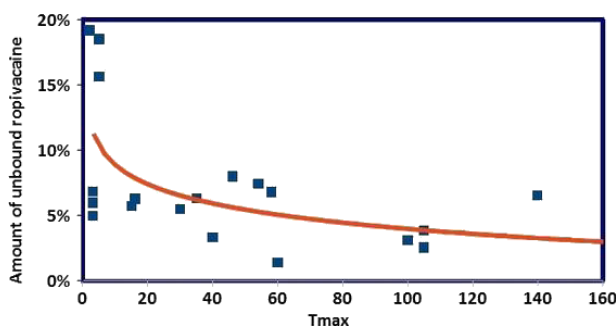
RATE OF ABSORPTION AS AN IMPORTANT DETERMINANT OF ROPIVACAINE TOXICITY. A META-ANALYTIC APPROACH

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Background and aims: Alfa-1 acid glycoprotein (AAG, formerly known as orosomucoid) binds ropivacaine in plasma. AAG is a "stress protein" with increased concentration in inflammatory disorders and after surgery. While this intuitively may lead to reduced plasma levels, hepatic clearance is similarly reduced, causing the unbound (and potentially toxic) concentration of ropivacaine largely unchanged. Other states such as acidosis may in itself reduce plasma binding of ropivacaine, but the eventual outcome on the toxic potential of the drug remains obscure. Using a meta-analytic approach, we wanted to evaluate if the degree of unbound local anaesthetic is related to its rate of absorption after peripheral nerve blocks or intravenous administration.

Methods: We conducted an extensive cross-referenced Medline search on all human studies and case reports relating either serum values of ropivacaine or toxic systemic reactions resulting from its use. Available data on maximum concentration (Cmax, bound and unbound) and time to Cmax (Tmax) were extracted from each study. We excluded studies on neuraxially administered ropivacaine.

Results: 19 publications were available for analysis (Figure 1). A logarithmic relationship between Tmax and the relative amount of unbound ropivacaine proved the best fit.



[Unbound ropivacaine as a function of Tmax]

Conclusions: Intravenous administration of ropivacaine is related to high levels of unbound drug, while perineural administration (and delayed absorption) significantly reduces the levels of unbound drug.

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A COMPARISON OF ROPIVACAINE 0.1% OR 0.2% FOR CONTINUOUS INTERSCALENE BLOCK AFTER SHOULDER SURGERY

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Konyang University, Daejeon, ³Anesthesiology and Pain Medicine, Yeungnam University, Daegu, Republic of Korea.

Background and aims: There is no consensus about the optimal concentrations of ropivacaine for continuous interscalene block.

Methods: In a double-blind, randomized, prospective design, 56 patients scheduled for shoulder surgery received a continuous interscalene block with either ropivacaine 0.1% or 0.2% for 48 h. Pain scores, supplemental analgesia, ropivacaine consumption, motor block, side effects, and patient satisfaction were assessed. In a double-blind, randomized, prospective design, 56 patients scheduled for shoulder surgery received a continuous interscalene block with either ropivacaine 0.1% or 0.2% for 48 h. Pain scores, supplemental analgesia, ropivacaine consumption, motor block, side effects, and patient satisfaction were assessed.

Results: Except for supplemental analgesia ($P = 0.011$), pain scores, ropivacaine consumption, motor block, side effects, and patient satisfaction were comparable in both groups. Except for supplemental analgesia ($P = 0.011$), pain scores, ropivacaine consumption, motor block, side effects, and patient satisfaction were comparable in both groups.

Conclusions: This study suggests that continuous interscalene block with ropivacaine 0.1% and 0.2% provides similar pain relief after shoulder surgery.

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ANALGESIA FOR PROXIMAL FEMORAL/HIP FRACTURE - PRE OPERATIVE FASCIA ILIACA CATHETER WITH INTERMITTENT BOLUS I/A ADMINISTRATION

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Background and aims: Hip fractures are a common cause of increased morbidity and mortality in an ageing population. Adequate pain relief has been traditionally fraught with difficulty in assessment of pain and limitation in the use of opioid analgesia due to side effects. Pre operative fascia iliaca block with catheters is a safe alternative method to provide effective analgesia in the peri operative period.

Methods: Prospective observational audit of fascia iliaca block with catheter and intermittent bolus of 0.25% levobupivacaine administration for proximal femur fractures. Patients upon referral to the anaesthetist by orthopaedic team, were consented and blocks performed in the dedicated operating theatre suite. The fascia iliaca catheter insertion was performed under ultrasound guidance by inplane approach using Pajunk stimulong sono kit. Subsequently, the patients received 12 hrly boluses of 0.25% levobupivacaine for upto 48hrs.

Results: 42 patients with fascia iliaca catheters were audited. Prior to block, 56% of patients had NRS of 6-10 at rest and 80% had NRS 6-10 on movement. Post block, 0% had NRS 6-10 at rest, 68% had NRS 1-2, 32% had NRS 3-5 and 20% had NRS 6-10 on movement. 23% of patients required morphine (10-30mg) and 7% codeine (240-360mg) during the first 48 hrs after the block. There were no major complications apart from 2 catheter dislodgements.

Conclusions: This is the first observational audit of ultrasound guided fascia iliaca block with indwelling catheter inserted pre operatively for proximal femoral fractures. With intermittent bolus administration we demonstrated extended analgesia in the pre and perioperative period with significant reduction in systemic analgesia and their associated adverse effects. With the use of ultrasound and meticulous monitoring we have further demonstrated a low complication rate and a high success rate.

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HAS ULTRASOUND MADE ANY DIFFERENCE TO ANAESTHETISTS' PRACTICE? A SURVEY OF SIX DISTRICT GENERAL HOSPITALS

H. Kuttambakam, S. Randive, P. Baraggia, R.I. Emamdee *Anaesthetics, Mid Essex Hospitals NHS Trust, Chelmsford, UK.*

Background and aims: Ultrasound-guided regional anaesthesia (USRA) was introduced into practice in 1978¹ and is currently viewed as the 'gold standard' for regional anaesthesia². As NICE (UK) guidelines³ support the use of USRA, we investigated the impact (if any) of ultrasound on regional anaesthesia in our region.

Methods: An internet-based anonymous survey was sent to anaesthetists in six hospitals in Essex, UK. Questions included anaesthetists' block practice

pre and post-ultrasound and whether block efficiency and outcome improved post-ultrasound.

Results: 93 anaesthetists responded to the survey. Pre-ultrasound, respondents attempted a cumulative total of 304 landmark-based blocks (114 upper limb, 115 lower limb, 37 truncal); post-ultrasound introduction, only 130 blocks (cumulative total) were attempted 'blind' (29, 72 and 29 respectively). The commonest pre-ultrasound block done was axillary brachial plexus (47 anaesthetists); post-ultrasound, only 5 respondents did this block 'blind'. The biggest increase in ultrasound-guided blocks were TAP blocks (22 anaesthetists pre-ultrasound; 40 with ultrasound) and supraclavicular (11 pre-ultrasound; 33 with ultrasound) blocks. 44 respondents (47%) believed ultrasound represented advancement in their practice (increased success and improved block quality); 43(46%) believed their block repertoire increased with ultrasound. Importantly, 38(41%) of respondents thought ultrasound blocks were more efficient (time to surgical readiness). 59 anaesthetists have been on formal ultrasound training programmes. These results illustrate definitive progress in ultrasound related block practice.

Conclusions: The increasing use of ultrasound technology in regional anaesthesia practice is promising and is to be encouraged. It is unlikely that landmark based blocks will ever be completely eliminated.

References:

1. BJA 1978;50:965-7.
2. BJA 2007;98:299-301.
3. NICE IPG 285;Jan2009.

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A REVIEW OF NON-PHYSICIAN DELIVERED UPPER LIMB REGIONAL ANAESTHETIC BLOCKS AT A TERTIARY REFERRAL HAND CENTRE

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Background and aims: The Birmingham Hand Centre is based at the Queen Elizabeth Hospital and provides trauma and elective tertiary hand services for the West Midlands and specialist reconstructive surgical expertise for military combat injuries through the RCDM. There are approximately 2500 trauma and 1000 elective operative procedures each year. The regional block service has developed alongside the hand service and the physicians' assistant (anaesthesia) role has become integral to delivery of a safe and efficient service.

Methods: Since 2010, prospective data was collected on patients having a regional block as part of their surgical management and was recorded in a database. Patients undergoing axillary block anaesthesia using a standard ultrasound and nerve stimulation technique were identified and a subgroup of those administered by a PA were analysed. Data recorded included patient demographics, failed block requiring either peripheral top up or conversion to general anaesthesia and complications.

Results: 2536 upper limb regional blocks were recorded of which 1382 were performed by PAs. The PA general anaesthesia conversion rate at less than 1% was significantly lower than the non-PA group. Two patients in the non-PA group suffered neurological complications (1:1218). There were no neurological complications in the PA group.

Conclusions: Non-physician practitioners of regional anaesthesia are able to provide a safe and efficient service with low rates of conversion and neurological injury.

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MEDIAL TECHNIQUE FOR COMBINED POPLITEAL SCIATIC AND SAPHENOUS NERVE BLOCKADE

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Background and aims: Combined popliteal sciatic and saphenous nerve blockade for lower extremity anesthesia is a widely accepted practice. Combined sciatic and saphenous nerve blockade under ultrasound guidance from the medial approach is described. This technique is performed faster than the two injection technique, does not require repositioning, and significantly

reduces both pain and risk of infection. Future advances in needle technology will allow continuous nerve blockade by this approach.

Methods: With the patient supine the lower extremity is externally rotated and the knee and hip are slightly flexed. The adductor groove and saphenous nerve are identified by ultrasound and the probe is placed in the popliteal fossa to identify the sciatic nerve. The needle is inserted medially at the saphenous nerve injection site and advanced to the sciatic nerve and local anesthetic is injected. The needle is withdrawn to the saphenous nerve and the remainder of local anesthetic is injected.

Results: Combined sciatic and saphenous nerve blockade using a medial approach eliminates repositioning for its performance. The single injection technique eliminates needle reinsertion, and pain from the procedure and risk of contamination from excessive ultrasound probe and needle manipulation are also reduced.

Conclusions: Combined medial sciatic and saphenous nerve blockade by a single injection approach improves ease and speed of this technique by reducing the need for operator or patient repositioning and reduces the pain and risk of infection from a multiple injection approach. Future developments in needle technology will allow continuous infusions to be placed by this technique.

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SHORT-TERM AND LONG-TERM NEUROLOGICAL COMPLICATIONS OF PERIPHERAL NERVE BLOCKS IN ORTHOPAEDIC AND TRAUMA SURGERY IN THE UNIVERSITY TEACHING TERTIARY CENTRE

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Background and aims: The goal of this prospective study was to record neurological complications associated with peripheral nerve blocks used for trauma/ orthopaedic surgery in the University Hospital.

Methods: After having obtained an informed consent with regional technique all patients with a peripheral nerve block on the upper or lower extremity operated from January to December 2011 were prospectively studied. The blocks were used either as a single anaesthetic procedure or as a part of combined anaesthesia or analgesia. Following data were recorded: demographic parameters, block location, guidance (landmarks, nerve stimulation, ultrasound), onset, quality and duration of the block. For neurological complications the patients were checked after the procedure and at 24h, 48h and 3 and 6 months.

Results: 189 blocks on upper and 71 on lower limb were performed in 260 patients during study period using landmarks (6.2%), nerve stimulation (20.4%) and ultrasound guidance technique (63.2%) respectively. We found 23 prolonged blocks or temporary hypaesthesia/paraesthesia (8.8%, 19 for upper and 4 for the lower extremity blocks). The incidence of complications was not related to type of guidance technique used. 4 long-term neurological complications (1.5% - 3 hypaesthesias, 1 paraesthesia) lasting longer than three months were also found.

Conclusions: Peripheral nerve blocks for orthopaedic/trauma surgery were associated with acceptable rate of neurological complications. There was no difference between the extremities or techniques of nerve location. However, it is not fully clear whether complications were connected to nerve blocks only or to surgical technique too.

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RANDOMIZED, CROSSOVER, OBSERVATIONAL SIMULATION-BASED EVALUATION OF A NEEDLE GUIDE (NG) FOR IN-PLANE ULTRASOUND-GUIDED REGIONAL ANAESTHESIA (RA)

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Background and aims: We hypothesized the Infiniti NG (Civco Medical Solutions, USA) would facilitate IP US guided RA in a simulation model in comparison to freehand (FH) techniques.

Methods: A prospective randomised single blind crossover observational evaluation of the Infiniti NG using a training device (Blue Phantom, Sonosite, UK) was conducted with 22 anaesthetists. Each localised a specific 'nerve' IP with a 10cm Stimuplex needle (B Braun, Germany) using either

FH or NG technique, whilst observed by a RA specialist who was blinded to the technique and could see only the screen of the US machine (Micromaxx, Sonosite, UK). The fraction of time the needle tip remained in view, time taken to complete the task, number of needle passes, anaesthetist preference for ease of use and confidence and supervisor preference for confidence of supervision were recorded. Parametric data were analysed using the paired t-test, non-parametric data the Chi-squared test.

Results: There was no significant difference in time to target (NG 23.0s±16.3; FH 17.9s±11.7; p=0.17), number of needle passes or needle tip or shaft visualisation. Ten anaesthetists (45%) preferred and felt more confident with the NG. Eleven anaesthetists (50%) preferred and felt more confident using FH. The supervisor's confidence correlated with the preference and confidence of the anaesthetist performing the block except on two occasions.

Conclusions: The NG did not improve needle visualization or facilitate IP nerve blockade. Approximately half of the anaesthetists surveyed preferred using the NG. The supervisor usually felt more confident supervising the technique preferred by the anaesthetist.

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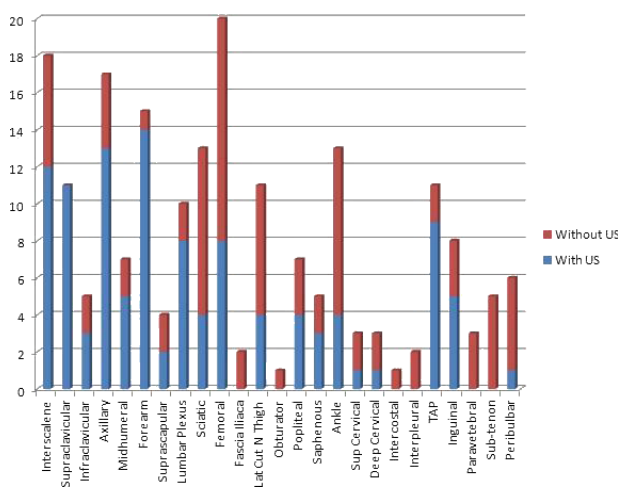
A SURVEY OF THE PRACTICE OF NON-NEURAXIAL REGIONAL ANAESTHESIA IN A LARGE TEACHING HOSPITAL

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Background and aims: The practice of regional anaesthesia (RA) varies greatly, including aspects which may impact on patient safety. We sought to document the practice of RA amongst consultant anaesthetists at our institution.

Methods: 39 consultant anaesthetists responded to a questionnaire regarding their practice of RA. Which RA techniques they performed, whether a landmark or ultrasound guided technique was used and if the technique was performed with the patient awake, sedated or under general anaesthesia (GA) was asked. Local anaesthetic (LA) used, including concentration, volume and additives was also recorded.

Results: 8 responders performed no non-neuraxial regional techniques. The total number of responders performing each RA technique and the use of ultrasound is shown in graph 1. 56% of all RA techniques were performed with ultrasound guidance. 93% of upper limb blocks (excluding forearm blocks) were performed with the patient awake or sedated. 59% of lower limb blocks were performed under GA. Bupivacaine 0.25%-0.5% was the most common LA used. Prilocaine was used by two responders. A combination of bupivacaine 0.25% with lidocaine 1% was most commonly used with non-GA RA. Only 2 responders regularly used an additive; one using 1:500 000 adrenaline the other 1mcg/kg of clonidine.



[Graph 1]

Conclusions: Non-neuraxial RA is performed by 79% of consultant anaesthetists in our institution. Ultrasound use is common but not ubiquitous. It

is usual to perform upper limb RA techniques with the patient awake. The use of additives to LA is rare.

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THE SPREAD OF LOCAL ANESTHETIC SOLUTION IN THE LONGITUDINAL DIRECTION AFTER ULTRASOUND-GUIDED RECTUS SHEATH BLOCK

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Background and aims: Rectus sheath block is the most popular peripheral nerve block for abdominal surgery. In this study, we investigated whether the spreading area of local anesthetics depends on its injected volume for rectus sheath block.

Methods: After the Hospital Ethics Committee approval and written informed patient consent, this study included 20 adult patients (ASA-PS I or II) scheduled for operations requiring a midline skin incision. Following the induction of general anesthesia, we performed rectus sheath block with either 10 or 20 ml 0.25% levobupivacaine at the umbilical level. Levobupivacaine was injected bilaterally in the space between the rectus abdominis muscle and the posterior sheath using a 15-6 MHz linear probe. We measured the spreading area of local anesthetics in longitudinal direction within 3 minutes after the injection. We also measured the thickness of the rectus abdominis muscle at the umbilical level.

Results: The rectus abdominis muscle and posterior sheath were adequately identified in each patient by ultrasonography before the injection. The mean spreading area of levobupivacaine in the longitudinal direction depended on the volume injected. In addition, the caudal extent of levobupivacaine was much greater than the rostral extent. The extent of spreading area in the longitudinal direction had a correlation with thickness of the rectus abdominis muscle.

Conclusions: The volume of injected local anesthetic solution affects the extent of the spreading area during ultrasound-guided rectus sheath blocks. Furthermore, the local anesthetic spreads much more easily in a caudal rather than a rostral direction.

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LARYNGEAL MASK WITH SPONTANEOUS BREATHING VERSUS AXILLARY BLOCK FOR HAND AND WRIST SURGERY

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Background and aims: The aim of our study was the comparison between the laryngeal mask with spontaneous breathing and axillary block for hand and wrist surgery.

Methods: Sixty (60) patients were selected for our study, aged 40±23 years, (ASA I-II) with similar demographic data, randomized blindly in two groups. Group A (n:30) received general anesthesia with laryngeal mask and spontaneous breathing. Anesthesia was induced with propofol 2mg/kg, suxamethonium 1mg/kg and fentanyl 1µ/kg. Anesthesia was maintained with N₂O/O₂ 60/40, sevoflurane 2.5% and infusion with fentanyl 1µ/kg. Group B (n:30) received 5ml of ropivacaine 0.75% and 50γ of clonidine in each of the four nerves (median, ulnar, radial, musculocutaneous) in the region of axilla. Blood pressure, heart rate, EtCO₂, SpO₂ were monitored intraoperatively in both groups. We studied the onset ready to surgery time, the presence of any postoperative complications and the postoperative need of analgesic-drugs administration. Statistic analysis used the ANOVA method.

Results: The onset ready to surgery time was 35±2.5min for Group A, and for Group B 9.5±1.5min (p< 0.005). Vomiting was recorded in one patient of Group A, during recovery, and ondasetron was given. There were no differences in hemodynamic variables between the two Groups. Postoperative analgesia for patients in Group A was first administered after 60±15.5min and in Group B 47±65min (p< 0.005).

Conclusions: Axillary block has many advantages compared to general anesthesia with spontaneous breathing for hand and wrist surgery and it should be preferred in most cases.

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DOES THE RETENTION IN FINGER BLOOD FLOW AGAINST POSTURAL CHANGE BECOME AN INDICATOR OF SYMPATHETIC BLOCK IN UPPER LIMBS WHEN PERFORMING STELLATE GANGLION BLOCK?

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Background and aims: Stellate ganglion block (SGB) is used for treatments in pain management. To identify sympathetic block in upper limbs, we measure skin temperature, or the decrease of sweat. Baroreflex, caused by postural change, induces a reduction in peripheral blood flow to sustain systemic blood pressure. Ultrasound-guided SGB has broadened, however there is little data on sympathetic block in upper limbs. We hypothesized that sympathetic block in upper limbs, induced by ultrasound-guided SGB, affect little change in skin blood flow against postural change.

Methods: Eighty SGBs were performed on 7 patients for therapeutic indications. SGB was done at C6 level under an ultrasound-guided technique using 5 ml of 1% mepivacaine. We measured skin blood flow on bilateral thumbs using laser blood flowmeter at the supine position and again in the sitting position before SGB was performed and again 20 minutes afterwards. The criterion for determining effective sympathetic block in upper limbs was defined as a sustained blood flow of over 90 % compared with the blood flow beforehand.

Results: We excluded two cases where the procedure failed to satisfy the Horner's sign. Before the SGB trials, sustained blood flow was 3 in the non-SGB site and 2 in the SGB site. After SGB the number was 3 in the non-SGB site and 45 in the SGB site.

Conclusion: The retention in finger blood flow against postural change has the possibility to become a new indicator of sympathetic block in upper limbs when performing SGB.

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AUDIT OF POSTOPERATIVE PAIN RELIEF WITH ULTRASOUND GUIDED CONTINUOUS FASCIA ILLIACA BLOCK IN REVISION HIP SURGERY

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Background: Revision hip surgery is a major procedure and cause severe postoperative pain. Epidural or continuous psoas block provide excellent post op pain relief in >80% patients and considered as gold standard. Fascia iliaca block is a modified form of psoas block. Research shows it provides good postoperative pain relief and reduces opiate consumption in hip surgery.

Aim: To assess if ultrasound guided continuous fascia iliaca block provides good post op pain relief and decreases morphine consumption in revision hip patients.

Methods: After local ethics committee approval ten consecutive patients undergoing revision hip surgery were included prospectively over a period of 3 months. They received either GA with ultrasound guided continuous fascia iliaca block (GAFIB) or spinal with ultrasound guided continuous fascia iliaca block (SFIB). For the fascia iliaca block, patients received bolus of 40 mls of 0.25%-0.375% chirocaine at induction followed by a post op infusion of 0.1% @10-20mls/hr through the catheter for first 24 hours. Post op all patients received regular paracetamol, codeine, NSAID if not contraindicated and prn Oro-morph. In the first 24 hr the pain scores and Oro-morph consumption were collected.

Results: Out of ten patients, the pain score was 0 in seven patients and 0 to mild in three patients. The three patients with mild pain had a maximum of 10 mg of oromorph and the rest had none.

Conclusion: Ultrasound guided continuous fascia iliaca block provided excellent post op pain relief and significantly decreased morphine consumption in our patients undergoing revision hip surgery.

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ULTRASOUND GUIDED CONTINUOUS PHRENIC NERVE BLOCK FOR THE TREATMENT OF PERSISTENT POSTOPERATIVE HICCUPS

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Background and aims: A single ultrasound guided injection of the left phrenic nerve was performed, injecting 60mg of 1% Lidocaine and 40mg of Triamcinolone depot. The patient's symptoms showed a mild decrease in intensity, without resolution. The same procedure was performed on the right phrenic nerve with no response. A second blockade was performed using 50mg of 0.5% Levobupivacaine, with a reduction in the frequency of hiccupping, but with recurrence 24 hrs after the procedure. An ultrasound guided neurostimulable catheter was placed in the left phrenic nerve. A 3ml bolus of 0.75% Levobupivacaine was administered, followed by two infusions of 0.375% Levobupivacaine at a rate of 1ml/hr for 24 hrs.

Methods: A single ultrasound guided injection of the left phrenic nerve was performed, injecting 60mg of 1% Lidocaine and 40mg of Triamcinolone depot. The patient's symptoms showed a mild decrease in intensity, without resolution. The same procedure was performed on the right phrenic nerve with no response. A second blockade was performed using 50mg of 0.5% Levobupivacaine, with a reduction in the frequency of hiccupping, but with recurrence 24 hrs after the procedure. An ultrasound guided neurostimulable catheter was placed in the left phrenic nerve. A 3ml bolus of 0.75% Levobupivacaine was administered, followed by two infusions of 0.375% Levobupivacaine at a rate of 1ml/hr for 24 hrs.

Results: Complete response was obtained after 30 minutes of the 0.375% Levobupivacaine infusion. The patient was discharged from the hospital with the catheter in place, and a 48 hr follow-up check was performed, with satisfactory results. Four days after the patient's discharge, the catheter was discontinued, and the patient presented total remission of her symptoms. One month after discharge, the patient continues to be asymptomatic without respiratory symptoms.

Conclusions: Phrenic nerve blockade is described in the literature as a reliable treatment for persistent postoperative hiccupping. In our case hiccups disappear completely after 4 days continuous infusion.

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LEVOBUPIVACAINE 0.5% VERSUS ROPIVACAINE 0.5% IN ULTRASOUND-GUIDED BLOCK OF THE SCIATIC NERVE AT MIDDHIGH FOR FOOT SURGERIES

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Background and aims: In sciatic nerve block according to traditional and gluteal approach, Casati [1] has found no difference between ropivacaine and levobupivacaine. We hypothesize that accurate ultrasound-guided sciatic nerve block at midhigh may provide different results.

Methods: After institutional approval (BRD 08/05-D) and consent, 35 patients ASA I-II, scheduled for foot surgeries were randomized to receive 20 mL of either levobupivacaine 0.5% (n=16) or ropivacaine 0.5% (n=19). The blinded local anesthetic was injected via the needle (Sonoplex stim 21Gx80 mm, Pajunk Germany) around the sciatic nerve. The needle was inserted according to the midhigh approach, using Sonosite M-turbo and HFL 38 transducer. All patients received a femoral single block with 10 mL lidocaine 1% with epinephrine. Motor and sensory tests were performed to assess the onset time and duration of complete motor and sensory loss (complete block) of the sciatic nerve in particular. Data was expressed as mean $\pm$ SD.

Results: The femoral block was complete in all patients. For the sciatic block, there were two delayed blocks till 120 min in each group. Otherwise, the onset time to complete block was comparable after ropivacaine (37 $\pm$ 18 min) and after levobupivacaine (42 $\pm$ 18 min). The sensory block lasted longer after levobupivacaine 0.5% than after ropivacaine 0.5% (23 $\pm$ 13 hrs vs 15 $\pm$ 13 hrs, p=0.04).

Conclusions: Accurate ultrasound-guided sciatic nerve block permitted levobupivacaine to appear superior to ropivacaine in terms of sensory block duration.

1. *Anesth Analg* 2002; 94: 987-90.

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COMPLICATIONS FOLLOWING PERIPHERAL NERVE BLOCKS - A PROSPECTIVE AUDIT

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Background and aims: Peripheral nerve blockade provides excellent anaesthesia and perioperative analgesia. This prospective audit over 3 years

aims to describe the complications of all peripheral nerve blocks done in a local teaching hospital.

Methods: Institutional ethics committee approval was waived. Details of all patients receiving peripheral nerve blockade in our institution from November 2008 to October 2011 were recorded. They were followed-up on Day 1 and between Day 7 to 10 postoperatively. Data collected included potential complications from peripheral nerve blocks. Neurological consults and further testing were arranged for patients with persistent neurological symptoms.

Results: A total of 3263 blocks were done for 2699 patients in the specified period, majority were under ultrasound guidance. Of these, 564 patients had more than one block. Immediate complications include pain or paraesthesiae on injection (92 patients, 2.8%) and inadvertent intravascular puncture (20 patients, 0.6%). One patient had symptoms of local anaesthetic toxicity, and another sustained a pneumothorax during an interscalene nerve block. Five hundred and twenty nine patients were lost to follow up post operatively upon discharge. Out of the remaining 2170 patients, 17 (0.5%) had persistent neurological deficits in the first week post block, including persistent pain, paraesthesiae, or weakness. All resolved with subsequent management, except for one patient who had nerve demyelination documented on nerve conduction studies.

Conclusions: Our audit had shown that peripheral nerve blocks could be safely administered for anaesthesia and analgesia. The incidence of neurological complications in our institution (0.5%) was comparable to other prospective audits.

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THE BLOCKADE OF THE SCIATIC NERVE WITH A MIXTURE OF ROPIVACAINE AND LIDOCAINE WITH ULTRASOUND GUIDANCE

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Background and aims: Desing of a new mixture of local anesthetics, one with short time of block development and short action term (5 ml 1% lidocaine solution) and other with longer time of anesthesia development, but long analgetic effect (5 ml 0.75% naropin)(blocks of sciatic nerve).

Methods: Sixty blocks of sciatic nerve were done under ultrasonic guidance, using electric stimulator or peripheral nerves. Sixty patients were divided into 3 equal groups. In the 1st group sciatic nerve block was performed with 5 ml 0.75% naropin solution (37.5 mg), in the 2nd group - with 10 ml 0.75% naropin solution (75 mg), in the 3rd group - with a mixture of 5 ml 0.75% naropin and 5 ml 1% lidocaine solution (50 mg). The assessment of the time of sensory block development was carried out from the beginning of local anesthetic solution injection.

Results: The time of achievement the complete motor and sensory block was reduced owing to the mix of 1% lidocaine solution with 0.75% ropivacaine solution. The time of complete sensory block development in groups treated with 5 and 10 ml ropivacaine was 45 (40; 48) and 30 (28; 30) min accordingly, in contrast with 12 (10; 13) min when the mixture of anesthetics was applied (p< 0.01). There was no difference in analgesia duration in post-operative period between groups at p>0.05.

Conclusions: Mix of 5 ml 1% lidocaine with 5 ml 0.75% ropivacaine leads to reduction of the time, required for development of complete sensory block of sciatic nerve.

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AUDIT ON TOURNIQUET PAIN FOLLOWING REGIONAL ANAESTHESIA

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Background and aims: Pneumatic tourniquets are used to provide bloodless field in peripheral surgeries. Tourniquets are associated with many complications the commonest of which is pain. Tourniquet pain can lead to dissatisfaction of an otherwise excellent regional block. We aim to assess the incidence and management of tourniquet pain to develop a protocol and improve practice.

Methods: After local audit committee approval data was collected prospectively on consecutive regional blocks performed for upper limb plastic surgeries. The data included

1. Type of block, technique, operator grade
2. Type and amount of local anaesthetic
3. Ease of block performance
4. Tourniquet time
5. Onset of tourniquet pain and severity(NRS)
6. Interventions to relieve pain

Results: Data collected on 61 cases over one month included 50 axillary, 6 infraclavicular and 5 supraclavicular blocks. In all patients tourniquet was inflated to 250mmHg. 67%(41) were performed by registrars, 26%(16) by consultants and 7%(4) by staff grades. 11% (7) had tourniquet pain of which 6 were following axillary blocks and 1 following supraclavicular block. All these blocks were performed by registrars. More than half(57%,4) had severe pain (NRS ≥ 8), 2(29%) moderate and 1(14%) patient mild pain. Pain was managed by fentanyl in 2 cases, fentanyl and midazolam in 1, alfentanil in 1 and by releasing tourniquet in 3 patients.

Conclusions: Tourniquet pain occurred only in blocks performed by registrars suggesting an element of operator competence. Releasing tourniquet was the most effective way of treating pain. We found no correlation between tourniquet time and onset of pain.

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AUDIT OF PAIN RELIEF, POST-OPERATIVE MOBILISATION AND LENGTH OF HOSPITAL STAY IN TOTAL KNEE REPLACEMENTS

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Background and aims: Management of postoperative pain and early mobilisation is an important concern in patients undergoing knee arthroplasty. The aim of this audit was to evaluate the efficacy of femoral nerve blocks in patients undergoing total knee replacement in terms of quality of pain relief, early mobilisation and the effect on the length of hospital stay, if any.

Methods: Prospective data collection was undertaken during post-operative visits on the ward. Patients in this hospital were getting spinal or GA for knee replacements with or without femoral nerve block but no spinal opioids. No changes were made in the existing anaesthetic practice for this audit. The data collection included pain scores, time of mobilisation on post-operative day one and length of hospital stay.

Results: Data was collected for 75 patients out of which, 60 had nerve block and 15 were given oral or intravenous analgesics. Average pain score in patients with nerve block was 3.9/10 compared to 6.2/10 in patients without nerve block (p value= 0.0003). Average length of hospital stay in patients with nerve block was 5.4 days compared to 4.7 in patients without the block (p value=0.14). 64% patients with nerve block were mobilised next day in the morning while 60% patients without block could mobilise.

Conclusions: The use of nerve blocks has a positive clinically important impact in patients undergoing total knee replacement. It improves pain relief without causing delays in mobilisation or length of hospital stay.

Ethical Committee Approval: Local audit department authorized the audit.

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FASCIA ILLIACA BLOCK (FIB) SERVICE IMPROVEMENT AT EAST SURREY HOSPITAL

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Background and aims: Fascia Iliaca block (FIB) provides effective analgesia in patients with fracture neck of femur(NOF) and negates the need for strong systemic analgesia. The aim of the audit was to look for improvement in early access to FIB in patients with a fractured NOF in our hospital and suggest some solutions to increase the number of block.

Methods: Retrospective audit. We compared incidence of FIB block in July-August 2010 and July-August 2011 and reasons for not doing the block.

Results: 50 patients were admitted for each 2 month period (July-August) for each year in 2010 and 2011.

19 (38%) patients did not receive FIB block in 2010 compared to 11(22%) in 2011.

	No of patients in 2010	No of patients in 2011
patient refusal	2(4%)	2(4%)
deranged INR	1(2%)	2(4%)
Anaesthetist busy	6(12%)	1(2%)
patient comfortable	2(4%)	2(4%)
patient unwell	2(4%)	1(2%)
patient uncooperative	1(2%)	1(2%)
Unknown	5(10%)	2(4%)

[Reasons for not doing block]

Conclusions: FIB service has improved over the year at our hospital.

Some suggestions for improving the service-

- raising awareness
- auditing
- multidisciplinary approach
- Anaesthetist carrying the bleep doubled up in theatres
- Regional anaesthesia bleep introduced in 2011
- Non Anaesthetist or nurse led service could be the future

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SIDE EFFECTS OF CONTINUOUS FEMORAL BLOCK COMBINED WITH MORPHINE PCA VERSUS SIDE EFFECTS OF INTRAVENOUS MORPHINE INFUSION FOR POSTOPERATIVE ANALGESIA AFTER TOTAL KNEE REPLACEMENT

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Background and aims: Total knee arthroplasty has a painful recovery period if postoperative analgesia is not adequate or effective. Peripheral femoral blocks with catheters providing continuous infusion of local anaesthetic can be effective and opioid sparing alternative anaesthetic technique.

Methods: We included 200 patients aged 66+-15 years old, randomized blindly in two groups. Both groups had spinal anaesthesia between L3-L5 level with 15 mg of bupivacaine 0.5% and 40 mg i.v. parecoxib every 12 h for the first 48h. Group F had continuous femoral block (12 ml/h ropivacaine 0.2%) with morphine PCA (1 mg/ml lock out every 20 min) and Group M had continuous intravenous morphine infusion (2 ml/h containing 0.06 mg/ml of morphine). We recorded haemodynamic parameters (BP, HR, SpO2) post-operatively on the hours T4, T8, T12, T24, T36, and the presence of side effects like nausea, vomiting, itching, hypotension. Statistic analysis used the ANOVA method.

Results: Noone from Group F complained for PONV or itching. Only one of them complained for severe dizziness. Twelve patients from Group M had PONV and three of them suffered from itching, although ondasetron was added regularly. In four of them the infusion was stopped because of the severity of symptoms. Fourteen patients from Group M suffered from hypotension (SAP < 70 mmHg). All of them were treated with boluses of crystalloids, colloids and vasopressors. Furthermore, in eight patients infusion stopped due to haemodynamic instability and discomfort. Our study showed a statistical significant difference on the BP (lower values on Group M) but not on HR.

Conclusions: Continuous femoral block provides adequate postoperative analgesia for total knee arthroplasty without the side effects and the influence on the haemodynamic parameters that characterize morphine infusion.

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ULTRASOUND-GUIDED SUBCOSTAL TRANSVERSUS ABDOMINIS PLANE BLOCK FOR ANALGESIA AFTER LAPAROSCOPIC CHOLECYSTECTOMY; RANDOMIZED-CONTROLLED TRIAL

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Background and aims: The transversus abdominis plane (TAP) block affected lower thoracolumbar nerves (T10-12) and has been described to provide analgesia for laparoscopic cholecystectomy(LC). However, the port sites

of LC are above the umbilicus (T10). This study was designed to evaluate the effect of oblique subcostal transversus abdominis plane (OSTAP) block for analgesia in patients undergoing LC.

Methods: Thirty patients undergoing LC were randomized to receive standard care, comprising fentanyl, pethidine, nalbuphine and ketorolac, as required, or to undergo OSTAP block and TAP block with standard care. All blocks were performed with ultrasound guidance and injected 20 mL of 0.375% ropivacaine bilaterally. The postoperative verbal numerical rating scale (VNRS) was assessed at 10, 30 min, and 1, 3, 6 and 24 hrs. Postoperative demands of rescue analgesics were recorded. The extent of sensory block was also evaluated using cold alcohol swab.

Results: The OSTAP block reduced VNRS compared to standard care at 10, 30 min and 1 hr after the operation. The postoperative VNRS also were lower in the OSTAP block group than the group receiving the TAP block at 10 min and 1 hr. Total fentanyl requirements in the first postoperative 1 hour were reduced in the OSTAP, TAP block groups. The OSTAP block commonly produced a sensory block of T7-10, whereas the TAP block produced a block of T11-12 dermatomes.

Conclusions: The OSTAP block can provide better analgesia than the TAP block at early postoperative period in patients undergoing LC.

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LEARNING CURVE OF NOVICES: ULTRASOUND-GUIDED VS. NERVE STIMULATION

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Background and aims: Peripheral nerve blocks (PNBs) can be performed with ultrasound (US) or nerve stimulation (NS). US-guided PNBs provide high success and low complication rates, but may be more difficult to perform. We examined the learning curve for US-guided plus NS femoral nerve block (FNB) vs. NS-guided FNB for 8 residents without prior experience with PNBs.

Methods: The residents were taught the basic theory of PNBs. Then they were trained to apply both techniques by seeing 5 blocks performed by an experienced anesthesiologist and by performing themselves 10 other blocks under supervision. Each resident was evaluated for each technique on 15 patients. We measured the time needed to perform the FNB, the success rate, and the complications.

Results: For the first 14 blocks, the average success rate amongst the residents was 78.57%. During the next 16 blocks, the average success rate was significantly greater (91%). Considering all blocks, the average success rate was 85%. Out of the 36 failed blocks, the 22 (61.1%) were performed with NS. For all residents, the time needed for the US FNBs was greatly reduced (from 18±2min to 10±3min) after performing the 6th block and became shorter than the time needed for the NS FNBs. No complications were encountered.

Conclusions: Residents without a previous experience in PNBs may achieve a high success rate for FNB within 15 attempts. With US-guidance, shorter times were achieved early in the learning curve of each novice.

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CAROTID ENDARTERECTOMY AND CHOICES OF ANESTHESIA: THE ONGOING DILEMMA

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Introduction: Carotid Endarterectomy (CEA) is an operation for patients at increased risk of primary or recurrent cerebral vascular accident (CVA). We report a case of CEA performed under loco-regional anesthesia where intraoperative ischemia was easily detected and managed by using selective carotid shunt.

Case report: A 60 year old male patient was admitted for elective CEA. He had a history of left CVA five months prior to admission with partial recovery. His CT angiography revealed 70% stenosis of left internal carotid artery. He had no history of coronary artery disease or respiratory problems but he was hypertensive on 3 antihypertensives. In theatre, patient received a combined superficial and deep cervical plexus block (CPB). Baseline assessment of patient neurological status was performed before application of carotid clamp. Test clamp was applied, it was uneventful. Five minutes following arteriotomy, the patient became restless and sweaty, and had worsening of his neurological status. The surgeon immediately performed a temporary carotid

shunt. The patient had immediate improvement with recovery to baseline. A conventional CEA was then completed followed by uneventful recovery period.

Discussion: CEA can be done under general or loco-regional anesthesia. The major concern during CEA is cerebral ischemia during cross clamping. The best way of intraoperative monitoring during CEA is controversial, but many consider a conscious patient as the best monitor. The types of loco-regional anesthesia for CEA include superficial, intermediate and CPB.

Conclusion: Loco-regional anesthesia can allow better monitoring of neurological status in CEA during arterial cross clamping.

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HIGHER BODY MASS INDEX IS ASSOCIATED WITH GREATER ANGLE OF NEEDLE INSERTION AND MORE DIFFICULT NEEDLE VISUALIZATION DURING LATERAL SAGITTAL INFRACLAVICULAR BRACHIAL PLEXUS BLOCKS

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Background and aims: Whilst real time ultrasound (US) increases infraclavicular brachial plexus block (IBPB) success, needle visualization can be difficult. [1] Our study aimed to establish the needle insertion angle from the anterior chest wall during US guided IBPB. The secondary aim was to examine for any correlation between body mass index (BMI) and ease of needle visualization.

Methods: A 38 mm linear probe was placed in the parasagittal plane in the deltopectoral groove. The needle was inserted in-plane aiming initially for the 6 o'clock position relative to the axillary artery. Needle angle in relation to the anterior chest wall was measured using Screen Protractor 4.0 (Iconico, New York).

Results: 23 patients were studied. Results (Table 1) are expressed as mean [range], mean (SD) or absolute. The data was examined using Pearson correlation coefficient and receiver operating curves (ROC).

Body mass index (kg.m-2)	28.5 (5.4)
Needle Angle (degree)	50 [33-60]
Needle visibility (Static/Dynamic/Hydrolocation)	9/5/9
Quality of block (Good/Incomplete/Nil)	22/1/0
Visualization of needle (Easy/Moderate/Difficult)	5/11/7

[Table 1]

BMI moderately correlated with needle insertion angle (0.357). ROC suggested that a BMI>35 best predicted difficult needle visualization (Likelihood Ratio 7.5 [95%CI 0.8-182.6]).

Conclusions: The median needle insertion angle in our patients was much steeper than reported by other researchers. [2] BMI influenced both needle insertion angle and visualization.

References:

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ULTRASOUND GUIDED REGIONAL NERVE BLOCKS - AN AUDIT OF PRACTICE AND EDUCATIONAL PROPOSAL

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Background and aims: To establish the current practice of ultrasound guided regional anaesthesia in University Hospital Lewisham, London.

Methods: A questionnaire was sent to all members of the Anaesthetic department, detailing the participants' experience of ultrasound guided peripheral nerve blocks.

Results: Out of the 30 respondents, 28 (93.3%) indicated they perform ultrasound-guided regional nerve blocks as per national and European

guidelines. The level of training of these practitioners was variable, with 17 of the 28 (60.7%) having had no formal training in regional anaesthesia except on the job training. 25 of the respondents (83.3%) found limitations in using ultrasound, ranging from availability of equipment (30%) to poor visualisation (16.6%). 12 of the responders (40%) indicated lack of experience as a major impediment in the use of ultrasound for regional anaesthesia. The majority of the respondents (26, or 86.6%) considered they needed further training and thought a structured training program would suit their training needs.

Conclusions: The current practice at our hospital is consistent with national and European guidelines regarding the use of ultrasound in performing regional nerve blocks. However, the audit identified training in ultrasound guided regional anaesthesia to be lacking the structured approach suggested by the guidelines published by the Association of Anaesthetists of Great Britain and Ireland (2011) and a joint ESRA and ASRA statement from 2007, which is not, in itself, simply of local concern. Several proposals have been made in order to improve training within our trust.

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ULTRASOUND-GUIDED (USG) BRACHIAL PLEXUS (BP) BLOCK EFFICACY AT THE SUPRACLAVICULAR (SCL), LATERAL-INFRACLAVICULAR (LIC) AND AXILLARY (AX) LEVEL: RANDOMIZED, OBSERVER-BLINDED STUDY OF THE SINGLE-PENETRATION MULTIPLE-INJECTION-TECHNIQUE

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Background and aims: We compared BP block efficacy (surgical anaesthesia) with the USG single-penetration multiple-injection-technique at the SCL, LIC and AX level for upper-extremity surgery (elbow, forearm, wrist, hand).

Methods: Observer-blinded RCT. Following IRB approval 110 patients were prospectively randomized to an USG BP block administered as a single-penetration multiple-injection-technique at one of three different levels: (1) SCL (2) LIC (3) AX. Ropivacaine 0.75% (20 mL) was used for all blocks prior to surgery.

Outcome measures were total performance time (primary measure), number of needle passes, block-related pain, success rate, time to complete motor and sensory block onset. Serum-ropivacaine was measured between 0-180 minutes.

Results: Block performance time at the SCL level was significantly shorter ($p < 0.01$). Statistical comparisons between groups are presented for all outcome measures. Serum-ropivacaine pharmacokinetics is calculated for all groups. Magnetic resonance imaging (MRI) shows pattern of local anaesthetic distribution at all three levels. Significantly lower volumes of local anaesthetics were used compared to previous studies.

Conclusions: Performing USG BP blocks at the SCL level was significantly faster. BP blocks at the SCL, LIC and AX levels all provided for safe and successful surgical anaesthesia. Various USG BP blocks result in significantly different outcome measures.



[USG brachial plexus blocks ESRA 2012]

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CLINICAL EFFICACY OF PROPOFOL AND KETAMINE (KETOFOL) FOR DEEP SEDATION FOR COLONOSCOPY

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Background and aims: The objective of the study is to compare and evaluate the clinical efficacy of the combination of propofol and ketamine (ketofol) versus propofol alone when each regimen is used as sedative agents for deep sedation (DS) for colonoscopy.

Methods: 194 patients who underwent colonoscopy in two years, were randomly assigned to PN and PK groups. 97 patients in group PN received propofol and normal saline and 97 patients in group PK received propofol and ketamine for DS. All patients were premedicated with 0.02-0.03 mg/kg of midazolam intravenously. The primary outcome variable was the successfully completed colonoscopic procedure. The secondary outcome variables were patient tolerance, discomfort during insertion, patient and endoscopist satisfaction, hemodynamic responses, and complications during and immediately after procedure.

Results: All endoscopies were completely successfully. Mean total dose of propofol in group PK and PN was 6.98 (2.90) mg/kg/hr and 7.73 (3.45) mg/kg/hr, respectively ($p=0.413$). Mean total dose of ketamine in group PK was 1.49 (0.61) mg/kg/hr. There were no significant differences in patient tolerance, discomfort during insertion, patient and endoscopist satisfaction, hemodynamic responses, procedural pain, recovery time and recovery score. Overall, cardiovascular and respiratory adverse events were not significantly different between the two groups. These adverse events were transient and easily treated with no sequelae.

Conclusions: DS in both regimens provided effective and safe for colonoscopy. Adverse events were relatively high in both groups. However, these adverse events were mild and transient. No serious adverse events were observed.

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EFFICACY OF CONTROLLED RELEASE OXYCODONE FOR POST-OPERATIVE PAIN CONTROL FOLLOWING TOTAL HIP OR KNEE REPLACEMENT SURGERY

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Background and aims: Oxycodone is an opioid analgesic with better bio-availability than morphine when given orally and is better suited for acute post-operative pain. Controlled release preparation of oxycodone (oxycotin) gives steady state analgesia and immediate release preparation (oxynorm) is useful for breakthrough pain.

We audited the efficacy of regular Oxycotin and Oxynorm on first three post-operative days after Total Knee Replacement (TKR) or Total Hip Replacement (THR).

Methods: 50 patients undergoing elective TKR or THR under spinal or general anaesthesia with nerve blocks were studied and their pain scores on arrival in recovery and morphine dosage was recorded. In the ward TKRs received oxycotin 20 mg twice daily and THRs received 15mg Oxycotin twice daily. All patients were given Paracetamol but Diclofenac was given only to suitable patients per orally. Oxynorm 5 to 15 mg PRN three hourly was prescribed for break through pain. Pain scores and side effects were recorded three times a day. Daily Oxynorm consumption was also recorded.

Results: Average pain score in recovery, day 0, day 1, day 2 and day 3 respectively were 0.86, 0.6, 0.68, 0.59, and 0.67.

Oxycotin consumption in milligrams on day 0, day 1, day 2, day 3 were 12, 34.79, 35, 26.2 and Oxynorm were 7.3, 7.9, 6.4 and 2.3 respectively.

Conclusions: Oxynorm twice daily with Oxycotin for break through pain gives effective pain relief with minimal side effects following THR and TKR under spinal or general anaesthesia with suitable nerve blocks.

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EVALUATION OF ULTRASOUND-GUIDED SELECTIVE DISTAL BLOCKS FOR POSTOPERATIVE ANALGESIA AFTER AMBULATORY HAND AND WRIST BONE SURGERY PERFORMED UNDER AXILLARY BRACHIAL PLEXUS BLOCK

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Background and aims: Long-acting proximal blocks for upper extremity surgery lead to prolonged motor and sensory blockade. We retrospectively evaluated our routine practice consisting of a short-acting proximal block for surgical anesthesia, followed by one to three ultrasound-guided (USG) long-acting distal block(s) for postoperative analgesia.

Methods: The local ethics board waived review for this anonymous retrospective data analysis. Patients undergoing hand or wrist bone surgery received an axillary block using 2% lidocaine with epinephrine for surgical anesthesia, followed by one to three USG analgesic distal block(s) using 0.75% ropivacaine. Patients were prescribed standing non-opioid analgesics and NSAIDs, as well as opioid analgesics for breakthrough pain.

Results: Complete data was available for 125 patients. One out of 20 ulnar blocks alone and 4 out of 70 combined median-radial blocks were ineffective (VAS > 3 at the sixth postoperative hour). Average block duration was 11:44 hrs $\pm$ 4:13. Eighty percent of patients took their standing treatment as prescribed. Once the blocks wore off, 25% used their rescue treatment and 7% experienced mild opioid-related adverse effects. Over 86% of patients had a sleep of good or moderate quality. On POD1, fewer than 25 % of the patients had a VAS > 3. Almost 90% of patients gave a satisfaction score between 8 and 10. No patient complained of insensate arm or of uncomfortable paresthesias.

Conclusions: In this retrospective series, USG distal long-acting nerve blocks provided excellent analgesia for about 12 hours with no opioid rescue after outpatient hand and wrist bone surgery.

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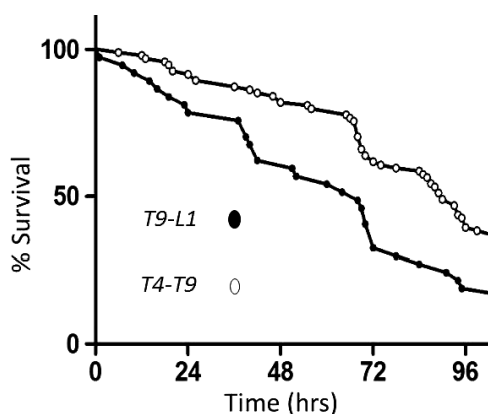
ANALYSIS OF EFFECT OF LEVEL OF EPIDURAL INSERTION AND SURGICAL INCISION UPON ADEQUACY OF ANALGESIA FOLLOWING MAJOR SURGERY

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Background and aims: Epidural analgesia is commonly used to limit pain following major surgery, with evidence that it may also reduce postoperative morbidity and mortality. Epidural analgesia is however associated with a 15-45% failure rate. With local audit committee approval we followed the course of epidural analgesia over a 24-month period following major surgery, aiming to ascertain how insertion level affected epidural failure for various surgical incisions.

Methods: Over the 24-month's, 633 epidurals were inserted with complete data collected from 582. Patients were assessed daily for 96-hours postoperatively, with pain scores, decision to remove and insertion/incision level recorded. Surgical incisions were defined: above umbilicus (AUI), below umbilicus (BUI) or above and below umbilicus (ABUI). Inadequate analgesia was defined as moderate to severe pain, for 2 or more hours despite clinician intervention.

Results: Overall 96⁰ failure rate was 36% (208/582). Insertion between T4-9 for AUI resulted in fewer epidural failures within 96⁰ compared to lower insertions ($p=0.04$), with a prolonged time to epidural removal. fig.1 ($p<0.001$). Rate of epidural failure and time to epidural removal for BUI and ABUI showed no such dependence upon level of epidural insertion.



[Figure 1]

Conclusions: Epidural insertion between T4-9 results in fewer epidural failures compared to lower insertions for upper abdominal incisions.

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THE DEVELOPMENT OF THE TAP BLOCK: ENHANCED RECOVERY FOR LAPAROSCOPIC RADICAL PROSTATECTOMY SURGERY

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Background and aims: Length of stay (LOS) has been proposed as a direct measure for the quality of major procedures¹. Following laparoscopic surgery patients may suffer from symptoms of pain, nausea and opioid hang-over thereby prolonging LOS. The Transversus Abdominis Plane (TAP) block has been described for open radical prostatectomy patients², reducing both morphine requirements (70%) and PONV (50%). We evaluated the role of the TAP block in Laparoscopic extraperitoneal Radical Prostatectomy (LRP) versus standard morphine analgesia, using LOS and morphine consumption as end points.

Methods: An audit of analgesia usage and postoperative pain was conducted before and after introduction of bilateral TAP blocks. The audit data was collected prospectively and included 20 patients prior to introduction of the TAP block and 59 patients post introduction of TAP blocks (n=79). Pain was assessed using a categorical pain scoring system with visual aids. Data was collected on duration of stay and surgical complications.

Results:

	Mean Perioperative morphine usage (mgs)	Mean Postoperative morphine usage (mgs)	Mean Postoperative pain scores
Pre-TAP cohort (n=20)	17.3	1.9	1.47
Post-TAP cohort (n=59)	1.3	0.2	1.3

[Table 1]

Conclusion: The introduction of the TAP block onto our care pathway led to a significant reduction in morphine use. Reduction of morphine usage prevents some of the postoperative problems that can delay discharge. Early discharge after LRP benefits both patients and healthcare providers through an earlier return home and a reduction of inpatient costs. Following the audit TAP blocks were routinely performed in all patients.

References:

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A COMPARISON OF THORACIC EPIDURAL ANALGESIA VS. PARAVERTEBRAL BLOCK FOR OPEN NEPHRECTOMY

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Background and aims: Epidural analgesia is an effective method for postoperative pain relief after loin incision. Paravertebral block is an alternative method with better side effect profile. Aim of our study was to compare the two methods regarding postoperative pain control, patient satisfaction and the occurrence of side effects.

Methods: 30 patients undergoing open nephrectomy with loin incision were enrolled in the study. All patients received general anesthesia for the conduction of the operation. In group A (15 patients) thoracic epidural was performed in T8-T9 interspace and postoperatively they received continuous analgesia with ropivacaine 0.2% at a rate 7-10 ml per hour. In group B (15 patients) thoracic paravertebral block was performed at the end of the surgery at T6-T10 levels and 4 ml of a mixture of ropivacaine 0.5% plus 150 μ g clonidine were administered per level. VAS score in 100 mm scale, patient

satisfaction in 5 point scale and patient anxiety in 100 mm scale were recorded every 6 hours for 24 hours. The patients were followed for the occurrence of hypotension and PONV.

Results: mean VAS score was 20 ± 11 in group A vs. 15 ± 10 in group B ($p > 0.05$). Patient satisfaction score was 4.1 ± 0.7 in group A vs. 4.5 ± 0.6 in group B ($p > 0.05$) and patient anxiety score was 28 ± 3 in group A vs. 26 ± 3.1 in group B ($p > 0.05$). 2 patients in group in A experienced PONV and 4 patients experienced hypotension vs. none in group B.

Conclusions: paravertebral block provides equal postoperative analgesia with thoracic epidural for open nephrectomy with fewer side effects.

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SPINAL VERSUS GENERAL ANAESTHESIA IN POSTOPERATIVE PAIN MANAGEMENT FOR PATIENTS UNDERGOING ANORECTAL SURGERY

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Background and aims: The aim of this study was to compare the analgesic efficacy of spinal and general anaesthesia following anorectal procedures.

Methods: A total of 50 ASA physical status I-II patients underwent anorectal surgery (Hemorrhoidectomy, fissurectomy and sphincterotomy) were randomly allocated in two groups, 25 patients for spinal anaesthesia (SA) and the other 25 patients for general anaesthesia (GA). After a detailed pre-anaesthetic check-up and informed consent, all of the patients of both groups were premedicated by intravenous (iv) midazolam (0.05 mg/kg) 15 minutes prior to the procedure. Spinal anaesthesia was administered as a single shot of 15 mg bupivacaine. Induction to general anaesthesia was done with iv administration of 2.5 mg/kg of propofol, followed by 2 microgram/kg fentanyl along with 0.1 mg/kg of vecuronium bromide. Maintenance of anaesthesia was achieved with sevoflurane. Postoperative pain were recorded using an 11 point visual analogue scale (VAS) and managed by intravenous patient controlled analgesia (PCA) with tramadol hydrochloride. Total analgesic delivery was recorded.

Results: Patients in the GA group had greater VAS score (0, 1h, 3h, 6h, 24h, 36h, 48h) than patients in the SA group ($P < 0.001$, $P < 0.001$, $P < 0.001$, $P = 0.805$, $P = 0.287$, $P = 0.069$, $P = 0.244$). Spinal anaesthesia was more effective especially during the first 3 postoperative hours. Patients in the GA group needed more analgesics than patients in the SA group at 24h and 48h ($P = 0.095$, $P = 0.676$) significantly.

Conclusions: Spinal anaesthesia is more effective than general anaesthesia in postoperative pain management for patients undergoing anorectal surgery.

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EPIDURAL CATHETER REMOVAL: COMMON PRACTICES

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Background and aims: Catheter manipulation in patients under epidural analgesia has always been matter of controversy. Although epidural hematoma is a rare consequence of catheter removal, it can have a catastrophic outcome.

During a six-month time period, from all patients submitted to epidural analgesia at our center, postoperative coagulation tests revealed that 64% had prolonged prothrombin time and 16% had $INR > 1.5$, which raises questions about how safe it is to remove the catheter.

Methods: A sample of anesthetists were surveyed through a multiple choice questionnaire.

Results: We received 100 answers from 501 questionnaires sent.

63% of the inquiries don't have any protocol for catheter removal at their hospital.

Prior to removal, 72% request coagulation tests in patients with underlying hematological disorder, 51% to those under antithrombotic or oral anticoagulants, 27% to those who had intraoperative transfusion.

Prior to catheter removal, the most important laboratory parameter was INR (80%), followed by platelet count (67%) and aPTT (53%).

If removal was not performed due to abnormal coagulation results, 71% starts periodic monitoring, 47% initiates therapeutic measures.

Conclusions: There seems to be a tendency to a prolongation of the prothrombin time and INR after major surgery. The majority of respondents don't have any established protocol for catheter removal at their hospital.

Currently, there is no consensus about requesting coagulation tests to all patients prior to epidural catheter removal and it remains unclear what degree of laboratory abnormality identifies patients at increased risk and when to remove catheters if a coagulation disorder develops.

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POSTOPERATIVE ANALGESIA AFTER BREAST CANCER SURGERY PERFORMED WITH WOUND INFILTRATION BY 0.5% LEVOBUPIVACAINE

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Background and aims: The purpose of this study was to compare postoperative analgesia with wound infiltration by 0.5% levobupivacaine on catheter placed in the wound with continual analgesia delivered by PCA pump and group that received 0.5% levobupivacaine in bolus three times a day. We evaluated hand grip strength before and one year after surgery on operated side.

Methods: 79 women undergoing breast carcinoma surgery with axillary dissection were enrolled. Women in PCA group ($n = 40$, mean age 55.41 years) received approximately 0.05 mg/kg 0.5% levobupivacaine during 24 hours on catheter placed in the wound. In bolus group ($n = 39$, mean age 57.28 years) patients received 0.5 mg/kg 0.5% levobupivacaine 3 times a day. Parameters measured included subjective pain in rest and in movement, evaluated by VAS score through 4 days. Hand grip strength was registered using handheld dynamometer. Statistical analysis was performed using T-test. We had ethical committee approval.

Results: Average VAS in the group with pump was in rest/movement for the first day (VAS1) 0.58/2.70, VAS2 0.25/1.58, VAS3 0.03/0.85, VAS4 0.05/0.58. In the second group average VAS1 was 0.85/2.49, VAS2 0.10/1.26, VAS3 0.03/0.72, VAS4 0.03/0.44. Hand grip strength on the operated side preoperative and after one year didn't significantly differ in both groups (PCA 0.40 vs. 0.39 bar; bolus 0.37 vs. 0.34 bar, $p > 0.05$).

Conclusions: Both methods provided sufficient analgesia in early postoperative course. There was no clinically impaired hand grip strength in both groups one year after surgery.

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PREEMPTIVE ANALGESIA WITH LOW DOSE KETAMINE AND CONTINUOUS EPIDURAL ROPIVACAINE INFUSION REDUCES CYTOKINE EXPRESSION AND LIQUOR PROSTAGLANDIN E LEVEL AFTER MAJOR ABDOMINAL OPERATION IN NEWBORN

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Background and aims: Our studies were directed towards determining if administration ropivacaine with low dose ketamine preemptive analgesia alter cytokine production and liquor prostaglandin E after major abdominal operation in newborn.

Methods: A 40 newborn after abdominal operation was used to measure the effects of infiltrative administration ropivacaine 0.2% with low dose ketamine preemptive analgesia (0.1 mg/kg continuous infusion before 60 min to starts operation) administration on cytokine production in blood and liquor prostaglandin E level on 60 minutes, 6 hours after operation. We examination 40 patient, undergoing major abdominal operation in newborn, first group receive combination epidural infusion of ropivacaine 0.2% with low dose ketamine preemptive analgesia, second group receive morphine (0.1 ml per year). For statistical analysis 2 tests were used.

Results: Blood and liquor samples second group patients showed enhanced levels of 3 cytokines: IL-1 β , IL-6, tumor necrosis factor alpha (TNF α) in blood and prostaglandin E2 in liquor. Ropivacaine with low dose ketamine preemptive analgesia administration reduced levels. First group lower cytokines levels over second group (mean $\pm$ SD, IL-1 β - 7.1 ± 1.5 vs. 20.4 ± 4.2 pg/mg protein; IL-6 - 105.4 ± 25.4 vs. 333.2 ± 44.4 pg/mg protein; TNF α - 8.0 ± 1.2 vs. 24.4 ± 2.4 pg/mg and liquor prostaglandin E2 - 2.0 ± 1.1 vs. 7.2 ± 2.2 pg/ml) ($p < 0.001$).

Conclusions: Continuous epidural infusion ropivacaine with low dose ketamine preemptive analgesia administration reduces cytokine expression and liquor prostaglandin E level.

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COMPARISON OF SUBPLEURAL PATIENT-CONTROLLED ANALGESIA BY BUPIVACAINE AGAINST INTERMITTENT ANALGESIA IN POST-OPERATIVE THORACOTOMY: A DOUBLE-BLIND RANDOMIZED CLINICAL TRIAL

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Background: The efficacy of sub pleural analgesia to reduce postoperative pain intensity in patients after lateral thoracotomy is controversial. In this study, we demonstrated efficacy of two types of subpleural analgesia.

Methods: This prospective, controlled, randomized, and double-blinded trial was performed in department of thoracic surgery of Alzahra hospital of the University of Isfahan Medical Science from Jun 2009 until Aug 2010. After posterolateral thoracotomy and admission to the ICU, patients were randomly assigned into two groups, Subpleurally patient-controlled analgesia (SPCA) (0.2cc/kg/h of 0.5% bupivacaine) and subpleurally intermittent analgesia (SIA) (1cc/kg/6h 0.5% bupivacaine). Data of age, sex, visual analog scale (at 8, 16 and 24h after initiation of analgesia), morphine consumption, systemic adverse effects, length of ICU, hospital stay, complications, PHS criteria and cost. Data were analyzed by Mann-Whitney U-test, measured repeated test, chi square test and the Fisher's exact test. A $P < 0.05$ was considered significant.

Results: 90 patients participated in the study. There were no differences in sex, age, weight, intraoperative analgesics, and duration of one-lung ventilation and adverse effects between SPCA and SIA groups. It means pain scores were significantly reduced at 16 h after the first SP instillation of bupivacaine 0.5% with patient-controlled analgesia. However, there was no difference between the groups when comparing mean pain scores at 8 and 24h the first SP instillation of bupivacaine 0.5%. There were also no differences between the groups, there weren't any differences between sex and VAS scores at three times ($p < 0.05$).

Conclusion: SPCA bupivacaine for postoperative pain treatment is more effect than SIA bupivacaine if used optimal. The consumption rate of opioid and bupivacaine is also decreased in SPCA group.

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REAUDIT ON THE EFFICACY OF THE ON-Q PAINBUSTER® (I-FLOW CORP, USA) LOCAL ANAESTHETIC INFUSION SYSTEM FOLLOWING DIEP (DEEP INFERIOR EPIGASTRIC ARTERY) FREE FLAP RECONSTRUCTIVE SURGERY

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Background and aims: Our original study in 2011 demonstrated the On-Q Painbuster®'s effectiveness at reducing opioid requirements and pain scores postoperatively however rejected reduction in length of hospital stay. This reaudit aimed to reaffirm the benefits, identify improvements and analyse data from non-DIEP surgical patients with Painbusters.

Methods: Patients admitted to Intensive Care postoperatively with a Painbuster and standard PCA were audited with ethical approval. Routine catheter insertion was employed and the elastomeric pump delivered 2ml/h 0.375% levobupivacaine over two days whilst equipotent doses of morphine, fentanyl or oxycodone were available on demand. Prospective data included pain scores (numerical rating scale 0-10), opioid use at 24 and 48 hours, opioid side effects and length of hospital stay.

Results: Data from eleven non-DIEP and nine DIEP operations was compared to twenty-eight DIEP patients from the original study (fourteen per group).

	Painbuster & PCA 2011 - 14 DIEP patients		PCA alone 2011 - 14 DIEP patients		Painbuster & PCA 2012 - 9 DIEP patients		Painbuster & PCA 2012 - 11 non-DIEP patients	
	Day one	Day two	Day one	Day two	Day one	Day two	Day one	Day two
Average opioid use (mg)	16	18	32	21	18	16	53	69
Pain score at rest (median)	1	1	2	2	0	0	1	0
Pain score on movement (median)	4	4	5	6	0	2	2	2
Length of stay (days)	6.5		6.4		5.6		9 (1 day in ITU)	
Opioid side-effects	Nausea (7), Vomiting (1), Sedation (1)		Nausea (7), Sedation (4), Vomiting (3), Constipation (1)		None		Sedation (1), Nausea (1), Hallucination (1)	

[Results from the original and repeat audits]

Conclusions: Comparisons with the original study corroborate Painbuster benefit with opioid sparing, low pain scores and minimal side-effects. Further investigation regarding the improved length of stay in 2012 is required and comparison of non-DIEP patients with PCA alone should be considered.

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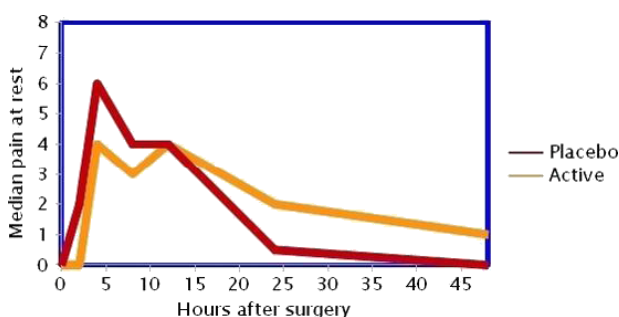
ANALGESIC BENEFITS OF MULTIPLE NERVE BLOCKS IN HIP ARTHROPLASTY. PRELIMINARY RESULTS OF A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED STUDY

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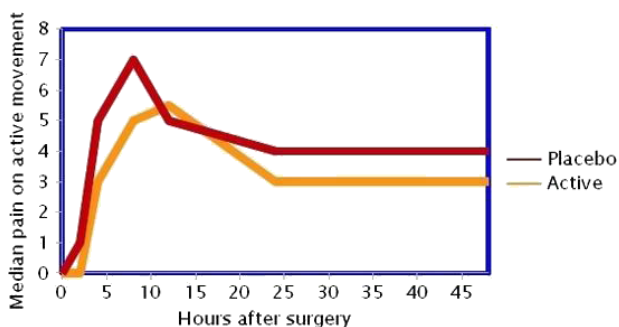
Background and aims: Postoperative pain is frequent after total hip arthroplasty. However, the literature is equivocal about the value of peripheral nerve blocks (femoral, obturator, anterior branch (ONA), lateral femoral cutaneous nerve (LFCN) for postoperative analgesia. We present preliminary results from an on-going clinical trial regarding this subject.

Methods: Preliminary data from a double-blind, randomized, placebo-controlled trial were extracted from 28 patients undergoing primary total hip arthroplasty, randomized to one of three groups: active blocks (ropivacaine) of the femoral, ONA and LFCN; ONA and LFCN; or placebo blocks. A standardized pain protocol consisted of morphine on demand, and pain was assessed throughout a 48-hour postoperative period.

Results: 81 patients are scheduled to participate. Preliminary results revealed: 19 patients were randomized to active nerve blocks, and 9 patients to placebo blocks. Main results are presented in fig. 1-2. Results on well-being and functional outcomes are presented elsewhere.



[Median pain at rest after hip arthroplasty]



[Pain on active movement after hip arthroplasty]

Conclusions: Although preliminary, these results suggest that peripheral nerve blocks with ropivacaine have a moderate benefit on postoperative pain after hip arthroplasty within the first 12 postoperative hours. The limited number of patients precludes any conclusions about the value of femoral nerve blocks.

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ANALGESIA AFTER INTRAARTICULAR LOCAL INFILTRATION COMBINED WITH MULTIMODAL ANALGESIA AFTER PRIMARY KNEE REPLACEMENTS. A CONSECUTIVE CASE SERIES OF 65 PATIENTS

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Background and aims: Large volume infiltration of local anaesthetics (LIA) have been shown to be effective in providing analgesia after major joint surgery. Majority of patients prior to the introduction of this technique received single shot femoral and sciatic blocks. The new protocol is described in the table. We aim to measure the quality of analgesia after LIA and compare it to the blocks.

Methods: 65 consecutive patients undergoing primary knee replacements with the LIA were prospectively surveyed at 6,12,24,48hours were asked to rate their pain on knee flexion as mild, moderate or severe. We compared this to 41 consecutive patients who had ultrasound guided femoral and stimulation guided sciatic blocks by a single operator.

Oswestry Enhanced Recovery protocol for

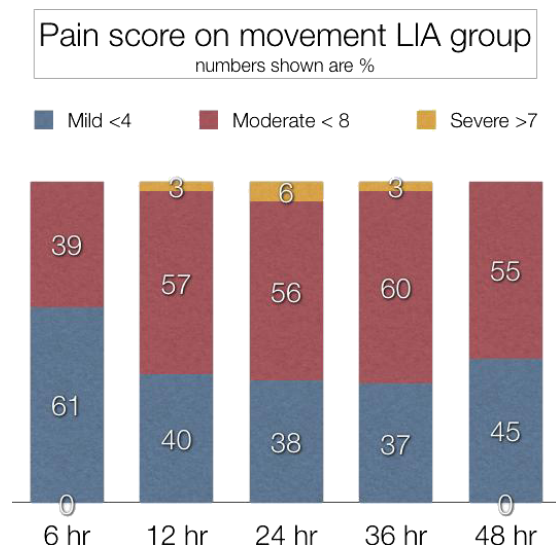
TKRs

Omeprazole 20 mg, Pregabalin 150 mg, as premed (75 mg if > 70 yrs)
Spinal with 0.5% Heavy Marcain 2ml, lying down with operated side down * 10 min
Tranexamic acid 500 mg IV at induction and 500 mg at tourniquet deflation
Sedate/ GA if needed (N2O free GA)
IV Paracetamol, Parecoxib 40 mg IV, 8mg Dexamethasone, 4mg Ondansetron, Ketamine 0.3-0.5mg/kg IV (give all drugs before tourniquet inflation)
Local infiltration by surgeon(150ml 0.2% Ropivacaine, 1 mg Adrenaline)
Paracetamol 1 gm Q6H, Etoricoxib 120mg OD * 5 days regular Omeprazole 20 mg OD
Pregabalin 75mg BD* 5 days (OD if > 70 yrs) regular
Oxycontin 20 mg BD * 4 doses regular, first dose in recovery before spinal wears off
Tranexamic acid 500mg IV 6hr postop single dose
Lactulose 10 ml nocte regular
Oxynorm 10 mg PRN 3h, Ondansetron 4 mg IV PRN

If unable to do a spinal, fentanyl boluses as required in theatre and 3-5 mg Diamorphine at the end. 5mg Mg will assist in controlling the hypertensive response to pain

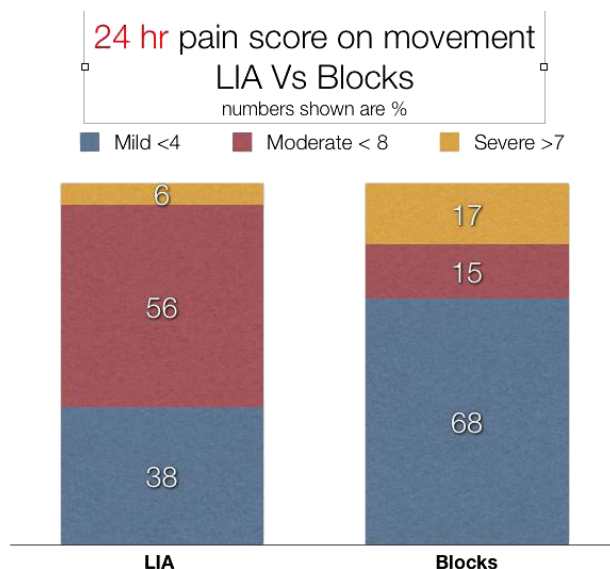
[Anaesthetic protocol]

Results:



[Pain score after LIA]

Only 6% of LIA group had severe pain at any point in the first 48hours with majority experiencing moderate pain. The data was only available for the first 24 hours in the nerve block group.



[Pain score at 24hrs LIA Vs Blocks]

Although the majority in this group had mild pain, 17% had severe pain in the first 24hrs. One would assume that this number would have been higher in the next 24 hrs when the blocks wear off.

Conclusions: LIA combined with multimodal analgesia offers high quality analgesia after TKRs. In comparison to nerve blocks the % of patients in severe pain seems to be reduced.

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POST OPERATIVE PAIN RELIEF FOR DAY CASE SHOULDER ARTHROSCOPY- AN AUDIT CYCLE

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Background and aims: Post operative pain control can be challenging after shoulder surgery. In our previous audits, nearly two thirds of our patients were in moderate to severe pain (1). We added dexamethasone 8 mg to local anaesthetic with the aim of prolonging the duration of interscalene plexus blockade.

Methods: After audit committee approval, data was collected prospectively for 3 months. All patients had a general anaesthetic and an interscalene block. Intraoperative and postoperative analgesic requirements, pain score, rescue analgesic requirement and complications were noted. On the following day, a telephonic interview was conducted to enquire about pain relief, any side effects and overall patient satisfaction.

Results: Over the audit cycle we got completed data from 121 out of 187 patients.

		1st Audit (41 pts) Interscalene block (ISB)+ Paracetamol+ Codeine+ NSAID	Reaudit (53 patients) ISB+ Paracetamol+ NSAID+ Oxycontin and PRN Oxynorm	Reaudit (27 patients) Dexamethasone in ISB+ Paracetamol+ NSAID+ Oxycontin and PRN Oxynorm
Night of surgery	Severe Pain	39%	32%	11%
	Moderate Pain	29%	24%	22%
Day 1	Severe Pain	25%	24%	8%
	Moderate Pain	33%	41%	29%
PONV		25%	32%	19%
Drowsiness		15%	40%	30%

Conclusion: Multimodal analgesia, patient and staff education are paramount in the successful management of postoperative pain in day case patients. The patients who received dexamethasone in the interscalene block had a better overall experience.

Acknowledgement: Thanks Fran, Janet and Ruth.

Reference:

1. Adequacy of postoperative pain relief after discharge: Day surgery services; RCOA - 5.3 and 11.2 - Raising the Standard.

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REDUCES THE USE OF REGIONAL ANESTHESIA IS THE RISK OF THROMBOEMBOLIC COMPLICATIONS IN ONCOGYNECOLOGY?

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Background and Goal of Study: Thromboembolic complications in the postoperative period is a serious problem oncogynecology, which reduces the safety of surgical treatment. In this study, we compared rate of thromboembolic complications between three anaesthesia technique in oncogynecology.

Methods: After obtaining written informed consent and local ethic committee approval 90 patients (ASA I-II) scheduled for elective oncogynecology were randomly allocated to the G (general anaesthesia), S (spinal) and CSE-group (combined spinal-epidural). Group G: propofol 2 mg/kg⁻¹-fentanyl 1 µg/kg⁻¹ were used for maintaining anaesthesia. In group S spinal application of 2% lidocaine (100 mg) was applied. In CSE-group was same spinal anaesthesia for maintaining anaesthesia and the epidural space was administered with 3-5 mg morphine in 10 ml NaCl 0.9 % at the end of surgery. In each was 14 patients. The primary study end point was a combination of deep vein thrombosis, nonfatal pulmonary embolism, or death from any cause during the active treatment period of up to 2 weeks, which corresponded to the time the use of LMWH in all groups.

Results: Comparative characteristics of these groups, differing characteristics of anesthetic management, showed the highest incidence of venous thromboembolism in patients operated on under general anaesthesia. Thus, the first group of patients the incidence of fatal venous thromboembolism was 10%, while the second and third groups with spinal anaesthesia, 3%.

Conclusion: The use of regional anaesthesia may influence to reduce the risk of thromboembolic complications in oncogynecology.

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AUDIT OF POSTOPERATIVE PAIN FOLLOWING SPINAL SURGERIES - ARE CERVICAL, LUMBAR AND THORACIC SPINAL SURGERIES EQUALLY PAINFUL?

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Background and aims: To audit the postoperative pain following spinal surgery and also to assess whether cervical, lumbar and thoracic spinal surgeries are equally painful.

Methods: Local audit committee approval was obtained. The following data was collected in recovery - Patient's age, sex, type of surgery, pre-op and intra-op analgesia, local anaesthetic use, pain scores (0-10) in recovery on waking and 30 minutes after waking, duration of stay in recovery, nausea, vomiting in recovery needing antiemetics.

Results: 90 patients were audited, undergoing equal number (30) of cervical, thoracic and lumbar surgeries.

Thoracic surgery: 57% male, 43% female, average age 61.5 yrs, 57% on regular analgesia, average pain score on waking (7) and 30 minutes after waking (6.7), average stay in recovery 2.4 hrs and 28.6% needed antiemetics.

Cervical Surgery: 75% male, 25% female, average age 50.5 yrs, 100% on regular analgesics, average pain score on waking (4.5) and 30 minutes after waking (8.5), average duration of stay in recovery 2.7 hrs and 25% needed antiemetics.

Lumbar Surgery: 31% male, 69% female, average age 58.2 yrs, 62.5% on regular analgesia, average pain score on waking (3.3) and 30 minutes after waking (5.6), average duration of stay in recovery 2.2 hrs and 31% needed antiemetics.

Conclusions: Average pain scores both on waking and 30 minutes after waking are high. Pain scores at 30 minutes are particularly high. Thoracic and cervical surgeries seems to be more painful than lumbar surgeries. Average stay in recovery was prolonged (2.4) hrs, more for cervical and thoracic surgeries. Majority of patients were on regular pain killers and around 25-30% needed antiemetics.

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EVALUATION OF ANALGESIA PROVIDED BY THE AXILLARY CATHETERS IN HAND SURGERY: A PROSPECTIVE AND OBSERVATIONAL STUDY

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The continuous regional analgesia by catheter (KT) is recommended when postoperative pain is considered moderate to severe for more than 24 hours. The axillary approach is easy and safe. The installation of axillary KT (KTAX) under ultrasound guidance has not yet been studied. We conducted a study to evaluate postoperative analgesia provided by this approach.

Method: Having all the approval by the Protection of Persons Committee and all the patient's consents, we conducted a prospective and observational study on all consecutive patients who need a KTAX between March and December 2011 in the service of Hand Surgery of the research hospital of Bordeaux.

The KTAX was placed preoperatively, under ultrasound, with 5 cc/h Lbupivacaine 0.125% (+/- bolus 5cc/30min). The parameters studied are median and maximal score of pain /6 h. on the first 48 h. evaluated by numerical scale (NS) (0: no pain, 10: worst pain), NS patient satisfaction (0: total dissatisfaction, 10: very satisfied), oral morphine consumption in mg/48h, and NS of the ease of the procedure (0: impossible, 10: very easy). Results are expressed as median with interquartile range 25% and 75% (IQ25-75).

Results: 34 patients were enrolled, 6 were excluded Median NS of pain/6h was always inferior to 2 within 48 hours 67.9% of patients did not need morphine. The median patient satisfaction was 10 (IQ25-75: 7-10) at H48. Ease of installation was 8 (IQ25-75: 7-10).

Conclusions: Analgesia provided by KTAX ultrasound-guided seems satisfactory in hand surgery with little risk compared to infraclavicular KT.

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EFFECTIVENESS OF EPIDURAL ANALGESIA FOR THE ACUTE POSTOPERATIVE PAIN IN UROLOGICAL SURGERY. A PROSPECTIVE COHORT STUDY

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Background and aims: To evaluate the effectiveness of the epidural analgesia for acute postoperative pain control in urological surgery.

Methods: Prospective cohort of patients submitted to urological surgery: open prostatectomy (OL), open cystectomy (OC), laparoscopic prostatectomy (LP) and laparoscopic nephrectomy (LN). Two protocols of analgesia for OL and OC were used: epidural methadone boluses and epidural PCA of Ropivacaine and Fentanyl (R+F); and two protocols for LP and LN: epidural PCA (R+F) and the association of sc methadone and iv NSAIDs. The analgesic effectiveness was evaluated as pain intensity (VAS) at 24 and 48h. Rescue analgesia (Res) and presence of nausea and vomiting (PONV) was also assessed.

Results: Between January-2009 and December-2010, 591 consecutive patients (452 males, 139 females) were included. The median (range) of age was 62 (44-82) year-old.

Surgery	Epidural methadone			Epidural PCA			Opioids+NSAIDs		
(n)	n	VAS at 24h / 48h	Res (%)	n	VAS at 24h / 48h	Res (%)	n	VAS at 24h / 48h	Res (%)
OP (67)	12	1,1(1,7) / 1,4(1,5)	8	55	1,5(1,5) / 0,8(0,7)	15			
OC (110)	35	1,4(0,7) / 1,1(1,5)	11	75	1,1(0,9) / 1,0(1,0)	13			
LP (124)				72	1,0(0,8) / 0,9(0,9)	1	52	0,8(1,1) / 1,1(1,2)	4
LN (290)				171	1,1(1,1) / 0,9(1,0)	9	119	1,2(1,2) / 1,2(1,1)	11

[pain1]

No differences were found among analgesic protocols. The overall PONV was lower than 5%.

Conclusions: Our results suggest that the analgesic effectiveness of epidural PCA and the association of sc methadone and iv NSAIDs was similar in urological laparoscopic surgery, and no differences was observed between epidural methadone and epidural PCA in open surgery.

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PROSPECTIVE AUDIT OF PATIENT CONTROLLED EPIDURAL ANALGESIA FOR POSTOPERATIVE PAIN RELIEF IN AMNCH (DUBLIN, IRELAND)

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Background and aims: Epidural Analgesia (EA) can be a very effective option for postoperative pain relief. Additional putative benefits and positive physiological effects of EA can improve surgical outcome. Advantage of Patient Controlled Epidural Analgesia (PCEA) is that it gives higher patient satisfaction, less complications and less LA consumption.

Objectives of audit:

- 1) to determine success rate of PCEA and problems and reasons for failure
- 2) to compare results with previous retrospective audit
- 3) to improve PCEA practice

Methods: Prospective analysis of information about of pain relief, side-effects and safety obtained from observational charts, anaesthetic records and pain service database.

Results: Overall failure rate was 29% and significant difference in rate of failure between urological, general, orthopaedic and vascular cases. Non-correct level of insertion of PCEA is the major reason of failed /poorly working epidural and side -effects. There was a set of common problems for all sub-specialities. Also there were problems and side- effects specific for sub-specialities.

Problematic PCEA at day 1 most likely to remain problematic at day 3 despite adequate efforts to fix problems.

Use of many PCEAs for orthopaedic and vascular cases (were used less than 24 hours) could not be justified.

Conclusions: Practical changes to be done to improve practice of PCEA in AMNCH. Most important : choice of appropriate level of insertion, protocol to prevent unauthorised disconnection/ dislodgement, consider another techniques for some categories of patients, to be more proactive to change mode of pain relief if PCEA failed.

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AN AUDIT OF ADHERENCE TO GUIDELINE BASED POST-OPERATIVE PAEDIATRIC PRESCRIPTIONS IN A DISTRICT GENERAL HOSPITAL

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Background and aims: Anaesthetists are involved with post-operative paediatric antiemetic and analgesic prescriptions but incorrect weight-based prescription could result in catastrophic consequences. Guidelines exist in our district general hospital and adherence to this and the Paediatric British National Formulary (BNF) was audited.

Methods: The notes of fifty paediatric patients, during a 3 month period between October and December 2011, were retrospectively audited for compliance to the Trust and BNF guidelines for correct antiemetic and analgesic prescriptions.

Results: The mean age of patients was 8.5 years (range 2 to 16). Overall prescription in accordance with Trust guidelines was poor at 40%, simple analgesics (Paracetamol, Ibuprofen and Codeine) were prescribed marginally less accurately than opiates (Intravenous and oral Morphine) at 28% vs. 31%. The poorest prescribed medications were Ondansetron and Ibuprofen; of the 50 cumulative prescriptions, none were guideline compliant.

On comparison Trust guidelines were on the whole concordant with the BNF, except in the dosages of Ibuprofen, Morphine and Ondansetron. Prescription was then compared with BNF dosage advice: Ondansetron and Ibuprofen prescription accuracy appeared far superior at 87% and 80% respectively; no improvement was seen with Morphine.

Conclusions: The results show poor compliance with Trust guidelines and more BNF guided prescription occurring, indicating that our guidelines are largely being overlooked. To improve adherence we have presented the audit findings and are introducing a pocket-sized quick reference card for anaesthetists to both educate and act as an aide memoir. A re-audit is planned 6-months following introduction of this change.

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USE OF EPIDURAL SUFANTANIL FOR POSTOPERATIVE PAIN RELIEF AND IT'S COMPARISON WITH EPIDURAL TRAMADOL

K.C. Pant, P.K. Singh Anaesthesiology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, India.

Background and aims: A study was conducted to evaluate the efficacy of epidural sufentanil (0.4µg/Kg) for the onset and duration of postoperative analgesia and incidences of side effects, in comparison of epidural tramadol when combined with local analgesics.

Methods: Total no. of 60 cases of ASA grade I & II undergoing major abdominal and pelvic and lower limb surgeries were selected for the study. In Group I (N=30) epidural sufentanil 0.4 µg/Kg along with local anesthetic diluted in 5ml of normal saline as 1st dose.

In Group II (N=30) epidural tramadol 1mg/Kg along with local anesthetic dilute in 5ml of normal saline as 1st dose.

Second dose of epidural drugs were given when patients complained of pain after completion of surgery during postoperative period.

Results:

1. Epidural sufentanil had rapid onset of analgesia which was potentiated by addition of local anesthetic. The mean onset of analgesia for sufentanil was 4.25 min. and for tramadol 10.70 min.
2. Epidural sufentanil and tramadol provided good analgesia. The mean duration of analgesia for sufentanil was 103 min. and for tramadol it was 76.67 min.
3. Epidural sufentanil and tramadol had no significant effect on pulse rate and blood pressure.
4. Epidural sufentanil and tramadol did not have respiratory depression which was evident from respiratory rate and oxygen saturation readings.
5. There was no sedation was observed with epidural sufentanil dose 0.4µg/Kg and epidural tramadol dose of 1mg/Kg.
6. 4% of patients in epidural sufentanil group complained of pruritus on direct questioning. No patient in tramadol group had pruritus.
7. In both groupings, no other side effect like nausea, vomiting, were observed.

Conclusions: Combination of an opioid with local anesthetic reduces local anesthetic requirements, hastens the onset of action and provides intense analgesia. it also reduces side effect including systemic toxicity.

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PERINEURAL SCIATIC CATHETER AT HOME FOR ANALGESIA AFTER AMBULATORY FOOT SURGERY: PATIENTS' FEEDBACK

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Background and aims: We brought to knowledge some problems rarely reported but met with sciatic nerve block extended into the patient's home for ambulatory foot surgeries.

Methods: We reported the feedback from 21 patients who had ambulatory foot surgeries using regional techniques in accord with the SFAR ¹ recommendations. All patients got an ultrasound guided block of the sciatic and saphenous nerves at mid thigh performed by one anesthesiologist. For sciatic block, 30-35 mL 1.5% mepivacaine were injected via needle before a catheter (Stimulung Sono, Pajunk) was inserted for postoperative analgesia. For saphenous block, 5 mL of the same solution were injected via needle. Post-operatively, at motor and sensory block recovery and before patient's discharge, 30 mL of 0.2% ropivacaine were injected via the catheter followed by infusion with 5mL/h using an elastomeric pump (EasyPump, B Braun). Complaints, pain scores, oral analgesic doses and untoward events were collected by

the daily telephonic assistance for three days, the liberal nurse's twice a day visit and the patients' written feedback.

Results: One patient was readmitted (early surgical wound infection). Anxiety was expressed by five patients: concerns with mild wound bleeding in two, pump functioning in one and return home in two. The anxiety was dissipated by telephonic assistance. Regional techniques were effective and uneventful with substantial reduction in oral analgesics.

Conclusions: Sciatic catheter at home was not a problem. However, it bound the anesthesiologist to the worry with the telephonic management of surgical complications.

1. Ann Fr Anesth Reanim 2010;29:67-72.

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COMPARISON OF POSTOPERATIVE ANALGESIC EFFECTS OF THORACIC EPIDURAL MORPHINE AND FENTANYL IN THORACIC SURGERY

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Background and aims: In our study, we aimed to compare epidural morphine and fentanyl analgesia and side effects in post-thoracotomy pain management.

Methods: Forty patients, planned for elective thoracotomy were included. Bupivacaine-morphine was administered through an epidural catheter to the patients in Group-M while bupivacaine-fentanyl in Group-F. Pain assessment was done by Visual Analogue Scale (VAS) and VAS-I and VAS-II were assessed in 0, 4, 16 and 24th hour in postoperative unit. Adverse effects were recorded after 24th hour. Statistical analyses were performed by using Two-sample independent-t test, Mann Whitney-U test, Wilcoxon-signed ranks test, Pierson chi-squared tests.

Results: Although in Group-M, the VAS-I and VAS-II scores were lower than the Group-F, the difference was not significant statistically ($p > 0.05$). When other hours were compared with initials, beginning from 4th hour, in both groups there were statistically significant drop in VAS-I and VAS-II scores in all times ($p < 0.001$). Comparing the complications between the groups, in Group-M nausea-vomiting ($p < 0.015$) and bradycardia ($p < 0.012$) were found significantly more than in Group-F.

Conclusions: We concluded that in pain management after thoracic surgery either morphine or fentanyl may be chosen in thoracic epidural analgesia but, especially in early postoperative hours close follow-up is necessary due to risk of bradycardia development.

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COMPARISON OF INTRAVENOUS MORPHINE WITH EPIDURAL MORPHINE-BUPIVACAINE IN POST-THORACOTOMY PAIN MANAGEMENT

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Background and aims: We aimed to compare the effectiveness of intravenous morphine with epidural morphine-bupivacaine in post thoracotomy pain management.

Methods: This prospective study enrolled 50 patients between the ages of 18-88. Patients were divided randomly into two groups of 25 patients. In Group MB, epidurally of morphine-bupivacaine; in Group M, morphine was administered intravenous. Pain assessment was done by Visual Analogue Scale (VAS) and VAS I (at rest) and VAS II (during coughing) were assessed in 0, 4, 16 and 24th hour in postoperative unit. Side effects were recorded.

Results: The VAS I and VAS II values were both statistically significant lower in Group MB compared with Group M ($p < 0.0001$). Beginning by the 4th hour, VAS I and VAS II scores were significantly lower ($p < 0.0001$) compared with the initial time.

Nausea and vomiting were statistically significant ($p < 0.0001$) higher incidence in Group M, on the other hand bradycardia was statistically significant higher incidence in Groups MB ($p < 0.05$).

Conclusions: The pain management after thoracotomy with the thoracic epidural morphine-bupivacaine is superior than intravenous morphine. However, postoperative bradycardia may occur in epidural morphine-bupivacaine group which should be close monitoring.

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COMPARISON OF PATIENT-CONTROLLED ANALGESIA AND CONTINUOUS INFUSION WITH INTRAVENOUS TRAMADOL IN POST-THORACOTOMY ANALGESIA

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Background and aims: We aimed to compare the consumption, and analgesic and adverse effects of tramadol that given via continuous intravenous infusion and intravenous patient-controlled analgesia.

Methods: Forty patients who planned for elective thoracotomy were included in this study. Group I patients received 100 mg loading dose, 5 mg hour⁻¹ basal infusion, 20 mg bolus dose, 5 minutes locked out time, 4 hours limit of 300 mg tramadol. Group II patients received 100 mg loading dose followed by continuous infusion of 12 mg hour⁻¹. Visual Analogue Scale (VAS) scores and sedation scores were determined at postoperative 0,4,16,24th hours. Systolic arterial pressure, diastolic arterial pressure, mean arterial pressure, respiratory rate, heart rate, peripheral O2 saturation scores were recorded at postoperative 0,1,2,4,8,16,24th hours. After 24 hours complications and amount of used tramadol were recorded.

Results: A significant decrease was observed in VAS scores starting from the fourth hour compared to all other times in both groups ($p < 0.001$). When the beginning time and the other times in groups was compared, there was a statistically significant decreasing observed in sedation scores starting from the 4th hour to all other times ($p < 0.001$). Total tramadol consumption in group I (374.2 ± 132.5 mg) was found to be significantly higher compared with group II (292.4 ± 80.1 mg) ($p < 0.05$). Hypotension was observed in four patients in group I and this difference was statistically significant ($p < 0.05$).

Conclusions: We concluded that tramadol given both intravenous methods was effective for analgesia after postthoracotomy pain.

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COMPARISON OF THORACIC AND LUMBAR PATIENT-CONTROLLED EPIDURAL ANALGESIA METHODS AT POST-THORACOTOMY PAIN

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Background and aims: Severe postoperative pain and decrease in pulmonary functions are the major clinical problems after thoracotomy. We aimed to compare the postoperative hemodynamics and analgesic effects of thoracic or lumbar patient-controlled epidural analgesia methods during thoracic surgery in this prospective study.

Methods: One thousand-twenty patients who were scheduled to undergo thoracotomy due to lung cancer were included in the prospective study. Patients were randomized into two groups: thoracic epidural analgesia (TEA) and lumbar epidural analgesia (LEA) for postoperative analgesia. A thoracic or lumbar epidural patient-controlled analgesia infusion of 0.5% bupivacaine (1 mg mL⁻¹) with sufentanyl (0.6 µg mL⁻¹) was given 24 hours into the postoperative-period.

Results: In intragroup comparisons, a significant decrease was detected in the 1st hour ($p < 0.001$) and 2nd hour ($p = 0.008$) pulse rate values of the TEA group when compared to the basal value. In the TEA group, bradycardia (13% versus 1.7%; $p = 0.015$) and total atropine consumption (0.1 ± 0.27 mg versus 0.01 ± 0.12 mg; $p = 0.044$) were found to be significantly higher than the LEA group. The postoperative 2nd hour ($p = 0.01$) and 4th hour ($p = 0.008$) pain scores, 24-hour total analgesic consumption of the TEA group were significantly lower than the LEA group (88.28 ± 21.21 mg versus 95.01 ± 11.81 mg; $p = 0.034$).

Conclusions: Both TEA or LEA methods can be used for the treatment of post-thoracotomy pain. Although in the TEA method the postoperative pain scores were lower and the analgesic consumption was less, the bradycardia possibility was detected as higher. Thus, we are of the opinion that caution should be taken in TEA applications.

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EPIDURAL ANALGESIA FOR PAIN MANAGEMENT IN ELECTIVE PARTIAL HEPATECTOMY: A RETROSPECTIVE STUDY

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Background and aims: Major liver resection is associated with severe postoperative pain. Epidural analgesia is widely criticized due to possible changes in the postoperative coagulation profile.

Methods: Retrospective study of patient medical records undergoing elective hepatectomy performed between January 2010 to December 2010, in our hospital. Assessed clinical data were: demographic data, analgesia regimens, 4 variables at 24, 48, 72 hours (assessment of pain by anesthesiologist and patient with visual analogue scale (VAS) at rest and motion), patient satisfaction, rescue analgesia, timing and reason for analgesia suspension, anesthesia, surgery and hospitalization times, blood products and fluid administration, perioperative haemoglobin, serum aspartate aminotransferase and alanine aminotransferase levels, prothrombin time.

Results: 112 patients studied. 15 patients excluded. Of the remainder 97, 56.7% were male and 43.3% female. Mean age: 59.6. Mean anesthesia and surgery times 259 and 180 minutes, respectively. Mean hospitalization time 13.6 days. 34% of the patients submitted to epidural analgesia. Mean catheter time: 4 days. No neurologic complications or spinal haematomas recorded. Blood products administration and mean hospitalization time were higher in the group of patients without epidural analgesia ($p < 0.002$). ASA physical status and sex weren't related with VAS. VAS at motion at 24 hours was lower in patients submitted to continuous epidural regimens.

Conclusions: Epidural anesthesia promotes redistribution of blood, decreasing venous return, thus contributing to reduced hepatic congestion and surgical blood loss. This study was insufficient to draw conclusions on the best modality of analgesia regimens in matter of quality of pain relief or side effects.

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EFFICACY OF TRANSVERSUS ABDOMINUS PLANE BLOCK IN AGED PATIENTS UNDERGOING EMERGENCY INGUINAL HERNIA REPAIR

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Background and aims: Transversus abdominis plane block (TAP block) is used for pain relief after lower abdominal surgery. If performed under ultrasound guidance, the TAP block is safe and painless under general anesthesia. We evaluated the efficacy of the TAP block after emergency inguinal hernia repair in aged patients.

Methods: Thirty one aged patients (>70 years old) who underwent inguinal hernia repair on emergency basis were divided into 3 groups: general anesthesia alone (GA, n=10), general anesthesia and ultrasound-guided unilateral TAP block performed after tracheal intubation and 10 min before skin incision (G+T, n=10), and spinal anesthesia (SP, n=11). We compared the pain score using Visual Analogue Scale (VAS) 1, 2, 8 and 24 hours postoperatively, the overall analgesic consumption (IV PCA morphine, IV paracetamol), and the mobilization and patient satisfaction.

Results: In G+T group, the TAP block reduced pain intensity (3.3 ± 2.5 cm vs 0.18 ± 0.5 cm vs 2.1 ± 1 cm) and morphine consumption during the first 24 hrs after surgery (3 ± 2.3 mg vs 0.4 ± 0.3 mg vs 1.5 ± 1 mg). First mobilization was also faster with TAP block (1.5 ± 0.6 days vs 0.6 ± 0.5 days vs 1.2 ± 0.5 days). There were no differences in the duration of hospitalization, the patient satisfaction and in the incidence of postoperative complications.

Conclusion: The TAP block provided effective postoperative analgesia in aged patients after emergency hernia repair. It facilitated patient mobilization and was performed without any complications.

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AUDIT OF POST-OPERATIVE COMFORT FOLLOW HIP ARTHROSCOPY: COMPARISON OF ULTRASOUND GUIDED FASCIA ILIACA BLOCK WITH INTRAVENOUS ONLY ANALGESIA

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Background and aims: Hip arthroscopy is increasingly performed to treat a variety of hip pathology. Pain is often significant following surgery. We performed an audit assessing anaesthetic technique and patient post-operative comfort.

Methods: Anaesthetic, operative, inter-operative analgesia and demographic data was collected. Recovery nurses recorded pain scores on a 0-10 visual analogue scale (VAS) when the patient was first able to, 30 minutes later and discharge alongside rescue morphine and anti-emetics administered. Statistics were calculated using Microsoft Excel 2010. Local audit department approved the audit and did not requiring further ethical approval.

Results: Data was collected on 43 patients. 28 received IV analgesia only (Group A), 13 additionally received U/S guided fascia iliaca field blocks (Group B), 1 patient received U/S guided femoral nerve block and 1 received nerve-stimulator guided psoas block. We compared group A and B. Group A had significantly higher pain scores (table 1), required more recovery morphine and antiemetics than group B (table 2). Patients were first able to perform a VAS score was 19 and 21 min respectively (NS). Group demographics were comparable. The single patient's with femoral and psoas blocks received 3mg and 20mg morphine respectively in recovery.

	First able	30min later	At discharge
Group A	4.6 [2.8]	4.1 [2.0]	2.4 [1.0]
Group B	2.3 [1.0]	2.2 [1.2]	2.1 [0.9]
P-value (NS = non-sig)	0.007 *	0.0043 *	NS

[Table 1: Vis. Analogue Pain Scores(0-10): Mean[SD]]

	Inter-Operative				Recovery		Total Morphine (mg)
	Paracetamol (G)	Diclofenac (mg)	Fentanyl (mcg)	Morphine (mg)	Morphine (mg)	Additional anti-emetic	
Group A	0.93 [0.26]	69.6 [15.8]	100 [27]	6.2 [15.8]	8.5 [9.5]	7 (29%) patients	14.7 [10.8]
Group B	1 [0]	57.69 [32.9]	100 [0]	5.4 [5.2]	0.6 [1.6]	1 (8%) patient	6.0 [6.8]
P-value	NS	NS	NS	0.005 *	NS	NS	0.007 *

[Table 2: Medications Administered: Mean [SD]]

Conclusions: Ultrasound guided fascia iliaca field block for hip arthroscopy reduces pain, opioid and anti-emetics administered.

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MARGIN FOR ERROR DURING LANDMARK GUIDED TAP BLOCKS IN PARTURIENTS AND THE "BERMUDA" TRIANGLE OF PETIT

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Background and aims: Landmark transversus abdominis plane (TAP) block can improve analgesia following surgery [1-2]. Not all studies have replicated successes. Limitations include difficulty identifying anatomy and subtle endpoints. Inaccurate technique results in ineffective analgesia or potential organ damage [3-4]. We investigated margin for error, specifically distance between TAP and intraperitoneal cavity where landmark blocks are performed, precisely defined by various sources [1-2,5].

Methods: Ultrasounding parturients following delivery identified where anaesthetic would be deposited [1-2,5]. Within the triangle of Petit, fascial extensions of external and internal oblique were identified with transversus abdominis below. Frozen image measurements enabled calculation of distance; TAP to intraperitoneal cavity. Further measurements taken 1cm medially and laterally, compensated for intra/inter-observer differences between patients. Mean distance was calculated from these three measurements for each patient.

Results: 31 parturients were studied. Median[range(IQR)] gestations; 39[28-42 (38-40)] weeks and BMIs 25[18-42 (21-30)] kg/m². Mean (SD) distance, TAP to intraperitoneum was 0.2(0.1)cms.

Conclusions: The triangle of Petit is difficult to palpate and its anatomy variable. Landmark TAP blocks have subtle end points. Both factors are exacerbated by obesity. We demonstrate little margin for error (whose consequences include inadequate analgesia or organ damage) and we conclude that performing TAP blocks under direct vision ultrasound guidance is advisable. Needles are easily lost in the "Bermuda" triangle of Petit.

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CONTINUOUS WOUND INSTILLATION WITH ROPIVACAINE FOR PAIN RELIEF AFTER MAJOR SPINAL SURGERY

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Background and aims: We evaluated analgesic efficacy and effect on postoperative nausea and vomiting (PONV) of continuous wound instillation (CWI) with 0.2% Ropivacaine after spinal surgery.

Methods: Twenty four adolescents (12-18 years old) with juvenile idiopathic scoliosis and 24 adults (23-76 years old) with spinal tuberculosis were enrolled into an EC-approved, randomized controlled study following dorsal instrumental fixation. Ropivacaine (0.2%) was used for CWI at a rate of 0.1-0.15 ml/kg/hr (max 10 ml/h) through two fenestrated catheters above the fascia location during the first 72 postoperative hours in 12 adolescents (group-A1) and 12 adults (group-A2). Alternative analgesia included Ketoprofen (1.0 mg/kg, IV, two times/day) and Fentanyl (0.5-1.0 mcg/kg/hr, IV) in adolescents (n=12, group-B1), or Trimeperidine (0.2 mg/kg, IM, four times/day) in adults (n=12, group-B2) during the first 24hrs and Ketoprofen (max 3.0 mg/kg/day, IM) +/- Tramadol (max 4 mg/kg/day, IM) or Trimeperidine (max 1.0 mg/kg/day, IM) from 24 up to 72 hrs postoperatively if needed in all groups.

Results: Pain severity measured as visual analog scale score did not differ between the adolescents and adults ($p>0.05$). Group-A1 and group-A2 needed less analgesia: fewer doses of Trimeperidine (53.9% and 77.8% respectively), Tramadol (86.4% and 56.0% respectively) and Ketoprofen (43.7% and 65.2% respectively) compared to group-B1 and group-B2. PONV was not registered in group-A1 and group-A2 vs 16.7% and 25% patients in group-B1 and group-B2, respectively.

Conclusions: CWI with 0.2% Ropivacaine offers successful postoperative analgesia after spinal surgery, decreasing requirements for additional systemic analgesia and, therefore, decreasing the incidence of PONV.

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ANAESTHESIA FOR UPPER LIMB SURGERY. WHAT WOULD ANAESTHETISTS CHOOSE FOR THEMSELVES?

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Background and aims: The benefits of regional anaesthesia for upper limb surgery have to be balanced against rare but potentially serious complications. As anaesthetists have a full understanding of the risks and benefits of these techniques, we devised a survey to gather opinion of anaesthetists as to which anaesthetic technique they would choose for themselves if they needed upper limb surgery.

Methods: We designed a survey of eight questions using survey monkey tool. An e-mail link was sent to all the anaesthetists around Scotland via departmental secretaries. A reminder request to complete the survey was sent two weeks later.

Results: 304 anaesthetists (199 consultants) completed the survey. Anaesthetists were asked that if they needed an open reduction and internal fixation (ORIF) of forearm bones, which anaesthetic technique would they prefer? 47.8% would prefer general anaesthesia (GA) with multimodal analgesia and no brachial plexus block (BPB), 50.5% would prefer BPB with or without GA. 93.6% would choose an ultrasound-guided technique, either alone (57%) or with nerve stimulation (36.6%), 5% would choose nerve stimulation alone. There were also a range of opinions on what surgery would they like a BPB for, ranging from 8.6% for a fracture manipulation (under GA), to 78.4% for an elbow replacement under GA. 12.4% would never have a BPB (with GA), 45.4% would never have surgery under BPB alone.

Conclusions: The threshold for opting for BPB showed huge variation among anaesthetists though most would choose it for major surgery and would prefer ultrasound to be used.

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INTRODUCTION OF FAST TRACK JOINT REPLACEMENT POLICY IN MAYO GENERAL HOSPITAL AUDIT: JULY-OCTOBER 2011-A RETROSPECTIVE OBSERVATIONAL STUDY

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Background and aims: Fast track surgery involves a multidisciplinary approach to care which tries to facilitate accelerated patient recovery post-op. This in turn should result in earlier time to discharge, earlier mobilisation and early return to normal diet while reducing the cost on the health service.

Methods: The Hvidovre fast track protocol ANORAK-HH was introduced to Mayo General Hospital in July 2011. 89 consecutive patients between July 2011 and October 2011 for joint replacement were assigned to the fast track recovery programme. Revision joint replacements were excluded from the programme.

The primary measured outcomes were length of stay and time to mobilisation. Secondary outcomes were pain scores at 3, 24 hours, pre-op analgesia, anaesthesia care and post op analgesia.

Results: 31/89 patients mobilised on the same day of surgery. 51/89 mobilised the morning after surgery. Average length of stay was 5.4 days. 56% were discharged within 5 days. 19% were discharged within three days. The mean length of stay for the same operations prior to the introduction of the protocol was 9.4 days.

Anaesthesia and time to mobilise:

Of the 36 patients that received 10mg or less 19/36 (53%) mobilised that afternoon.

Of 49 patients that received >10mg of Bupivacaine 12/49 (23%) mobilised that afternoon.

Conclusions: A significant difference in length of stay was obtained from 9.4 to 5.4 days. A correlation between shorter time to mobilise and reduced length of stay was noted. $p=0.0145$.

A correlation between lower dose ITLA and shorter Time to mobilisation was also noted. $p=0.0117$.

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INFLUENCE THE CONTENT OF THE PROTOCOL OF POSTOPERATIVE ANALGESIA ON THE QUALITY OF THE LIFE IN THE OLDER PATIENTS WITH MULTIPLE TRAUMA

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Background: This leads to a slowing of its recovery and the emergence of neuropathic pain.

Aim: The aim of the study was to search a rational approach to postoperative analgesia in old patients with multiple trauma.

Methods: 196 patients treated for multiple trauma (APACHE II 18,6±3,7) were prospectively studied. Only old patients without traumatic brain injury were selected. Patients treated analgesia of NSAIDs were in first group (60 patients). Second group consisted of 64 patients. They treated analgesia of NSAIDs and agonist-antagonist of opioid receptors. 72 Patients treated analgesia of NSAIDs and anticonvulsants in the therapeutic dosages during the early period (fourteen days) of traumatic disease. We analysed parameters of pain intensity by visual analogue scale, quality of analgesia on verbal Likert scale, the SF McGill Pain Questionnaire, neuropathic pain assessment scale NPSI. We studied biopsies of the skin flap, concentration of nervous fibers in the upper layers of the skin, the effect on C-fiber pain on the 1st, 7th, 14th and 21st days of treatment.

Results: Established that the use in old patients with multiple trauma anticonvulsants improves the plasticity of the nervous tissue, significantly reduces the severity of pain. This version of analgesia in the postoperative period helps minimize the negative effects on the body's vital functions, which was confirmed by biopsy.

Conclusion: Thus, appointment anticonvulsants in the early period of traumatic disease in old patients is contributes to regeneration of nerve tissue that helps to reduce the number of complications and improve quality of life.

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THE EFFECT OF INTRAMUSCULAR PROMETHAZINE AS AN ADJUVANT ON POSTOPERATIVE PAIN AFTER INGUINAL HERNIORRHAPHY

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Background and aims: Pain is an unpleasant and undesirable sensation in response to tissue injury, nerve stimulation, physical and chemical disturbances. It causes side effects in various body systems. Therefore different analgesic with different route of administration is used. Opioids are first line of postoperative pain management. Addition of drug like phenothiazine and antihistamine can increase analgesic effect and reduce side effects of opioids. We aimed to study the effect of promethazine on postoperative pain after inguinal herniorrhaphy.

Methods: After approval of the university ethics committee in this randomized double blind clinical trial; Sixty ASA I male patients (aged 20-40yr) undergoing unilateral herniorrhaphy, were studied into two control and study groups. After induction of anesthesia 50 mg Promethazine intramuscular and 1 mg normal saline intramuscular was injected in study and control group respectively. Intensity of pain (Visual Analogue Scale) and mean meperidine consumption at 2, 4, 6, 8, 12, 24 hours were compared in the two groups postoperatively.

Results: Mean postoperative pain score and meperidine consumption were lower in study groups but these different were not statically significant ($p > 0.05$)

Conclusions: This study showed that the intramuscular administration of Promethazine has not statistically significant effect on postoperative pain and systemic opioids consumption.

Late-Breakers

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COMPARISON OF HYPERBARIC BUPIVACAINE AND HYPERBARIC LEVOBUPIVACAINE UNDERGOING PERIANAL SURGERY UNDER SADDLE SPINAL BLOCK

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Background and aims: The aim of this study was to compare the saddle spinal block durations and hemodynamic effects associated with intrathecal hyperbaric bupivacaine and hyperbaric levobupivacaine in patient undergoing perianal surgery.

Methods: After approval by the hospital ethics committee and obtaining written informed consent; 60 patients, aged 18-50 years, ASA I-II who were scheduled for elective perianal surgery were included. Patients were randomly divided into two groups receiving either (in group B) 7.5 mg hyperbaric bupivacaine 0.5% or (in group L) 7.5 mg hyperbaric levobupivacaine 0.5%. The level and duration of sensory block, degree and duration of motor block were recorded. Heart rate (HR), mean arterial pressure (MAP) were recorded throughout the study; at baseline and 2.5th, 5th, 7.5th, 10th, 12.5th, 15th min after intrathecal injection, then at 5 min intervals. A 20 % or more decrease in MAP compared to baseline was considered as hypotension, iv ephedrine 5 mgr bolus administered. Atropine 0.5 mg iv administered when HR < 50 beats/min. Statistical analysis was performed using SPSS 13 version.

Results: Demographic data were similar in both groups. No statistically significant difference between groups with MAP and HR. 3 patients (2 in group L, 1 in group B) were needed ephedrine. In group L, duration of the sensory and motor block were shorter than group B.

Conclusions: Hyperbaric bupivacaine and hyperbaric levobupivacaine both provided satisfactory saddle spinal anaesthesia with good haemodynamic stability for perianal surgery.

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TRANSVERSUS ABDOMINIS PLANE (TAP) BLOCK. A TECHNIQUE TO CONSIDER FOR TREATING CHRONIC PAIN AFTER ABDOMINAL WALL SURGERY

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Background and aims: Transversus abdominis plane (TAP) block is used for anesthesia in abdominal section surgeries by blocking afferent fibers that innervate the anterior abdominal wall.

Considering the neuropathic component in our patients and coinciding with a recently reported case of chronic abdominal pain post caesarean section which was treated with TAP block with successful results, this technique was proposed to our patients.

Methods: We report two patients with chronic postoperative abdominal pain post elective inguinal hernia surgery with mesh placement. Two months after surgery, patients were complaining of constant abdominal pain. Neuropathic pain was considered, so an oral treatment was established over a two month period. Patients showed no clinical improvement. An ultrasound guided bilateral TAP block with local anesthetics and steroids was performed. A Quincke needle was advanced in plane with the transversus abdominis muscle. Ropivacaine and Methylprednisolone was injected on both sides.

Results: Two hours after the block was placed the analgesic level achieved was from D7 to L1. After TAP block patients evidenced reduced pain level demonstrated by lower pain score and less oral medication. Pain returned with reduced intensity after 30 days in case 1 and after 40 days in case 2 which was effectively treated with nonsteroidal anti-inflammatory drugs and paracetamol.

Conclusions: Given a patient with chronic pain after abdominal wall surgery, an ultrasound guided TAP block with local anesthetics and steroids is a pain management technique to consider as it can contribute to the temporary relief of symptoms in these patients.

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PREVALENCE OF CHRONIC PAIN AMONG INDIVIDUALS WITH ALCOHOL DEPENDENCE SYNDROME

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Background and aim: Prevalence of chronic pain is reported to be more common in substance dependent population. There are studies on chronic pain in opioid dependent population but the literature on alcohol and chronic pain is limited. This study examined the prevalence and correlates of chronic pain among individuals with alcohol dependence syndrome.

Methods: Sample was chosen from patients attending outpatient services of Center for Addiction Medicine in National Institute of Mental Health and Neurosciences, Bangalore, India. Individuals who had chronic pain were evaluated in detail by a semistructured proforma and Brief pain inventory after obtaining informed consent from patients and approval from Ethics Committee.

Results: Chronic pain was prevalent in 18.3% (118) of subjects (646) with alcohol dependence syndrome with 53.8% of them reporting pain to be of severe intensity and mean duration of pain was 26.2 in months (SD= 33.7). Chronic pain was significantly more common among older patients [$t : 2.46$ (95% CI 0.2 to 4.17) $p : 0.03$]. Use of other substances (nicotine, benzodiazepines, opioids and inhalants) were found in 97.8% with nicotine use being most common. Use of alcohol to manage pain in last month was reported by 73.7% of patients while 61.5% reported pain as a reason to continue to use alcohol.

Conclusion: Use of alcohol to manage pain is common among subjects with alcohol dependence syndrome with the fact that chronic pain itself is common among this population. This study explains the need for assessing and addressing pain problems in effective way among subjects with alcohol dependence syndrome.

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THE EFFECTIVENESS OF INTRAARTICULAR STEROID THERAPY IN PATIENTS WITH DEGENERATIVE KNEE OSTEOARTHRITIS

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Background and aims: The effectiveness of intraarticular (IA) corticosteroid therapy for patients with knee osteoarthritis (OA) is investigated by

comparison of various pain and physical activity evaluation tests before and after treatment.

Methods: In a prospective, observational study, 496 patients. All patients received intraarticular injection of triamcinolone at a dose of 40 mg. Investigated parameters include; Visual analog scale (VAS) (0: no pain, 10: extreme pain), WOMAC (The Western Ontario and McMaster Universities Osteoarthritis) scores for evaluation of pain intensity, WOMAC score and Laquesne indexes for evaluation of physical activity before and at 1 week, 1, 3 and 6 months after treatment.

Results: VAS scores after treatment at repeated time measures showed decreased values in comparison to before treatment values ($p < 0.001$). In comparison to before treatment pain WOMAC pain and physical activity scores, after treatment WOMAC scores at repeated time measures showed decreased values ($p < 0.001$, $p < 0.001$) (Fiedman test). In comparison to before treatment Laquesne index values, after treatment values at repeated time measures showed decreased values ($p < 0.001$).

	Before treatment	1. week	1. month	3. month	6. month	p
VAS score	8.37±0.99	2.12±0.68	3.35±0.62	4.59±0.51	5.89±0.69	0.001
WOMAC pain score	19.20±2.43	9.63±2.02	11.76±2.07	13.49±2.33	15.36±2.69	0.001
WOMAC stiffness score	7.41±0.83	2.65±0.66	3.88±0.67	5.19±0.68	6.22±0.58	0.001
WOMAC physical activity score	65.14±4.77	43.02±3.79	47.48±3.96	52.66±4.09	57.86±4.17	0.001
Lequesne index score	13.45±1.38	3.91±0.92	6.42±0.99	8.65±1.06	10.9±1.19	0.001

[The comparison of VAS, WOMAC pain, stiffness and ph]

Conclusions: IA corticosteroid therapy for patients with knee osteoarthritis (OA) showed a decrease level of pain intensity and increased level of physical activity that was observed within one week and continued for a duration of up to six months.

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VALIDATION AND RELIABILITY OF ENHANCED, QUANTITATIVE ELASTOGRAPHY FOR UGRA

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Background and aims: Aware of the limits of B-Mode imaging, we have developed enhanced form of elastography to quantify the visibility and spread of injection. However, before conducting experiments designed to differentiate between neural and extraneural injection, we wished to validate this technology in human cadaver.

Methods: A scan engine (Zonare, Palo Alto, CA) and proprietary elastography algorithm, and MATLAB 7.9 software were used. In addition to B-Mode (B) and elastography (E), two additional 4 second video frames were created. The first was termed enhanced elastography (EE), the second a fusion of B-Mode and enhanced elastography images (BEE). Measurements of brightness and area made. Brightness defined as value from 0 (black) to 255 (white) on grayscale image of 25x 25 pixel area, corresponding to the centroid of each image. Also, area of strain was measured in elastography and enhanced elastography images using ImageJ. Ten independent interscalene and femoral blocks performed in the cadaver using 0.25, 0.5 and 1ml volumes. Validation used measurements of brightness and area. Reliability measured as variability of area measurement between raters and Bland-Altman plots.

Results: *Validity*

Concurrent: Strain response to volume using E & EE. No response with B. Predictive: Brightness of BEE predicted by area of strain in E and EE

Convergent: Brightness and area of spread for interscalene and femoral blocks similar for given volume during E, EE & BEE

Discriminant: Difference in brightness pre-injection and during injection with B, E & BEE

Conclusions: We have successfully validated enhanced, quantitative elastography in UGRA.

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A COMPARISON OF SULPHUR HEXAFLUORIDE MICROBUBBLES AND CARBON DIOXIDE NANOBUBBLE LIPOSOMES FOR ULTRASOUND GUIDED REGIONAL ANAESTHESIA

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Background and aims: Hydrolocation methods are common in ultrasound guided regional anaesthesia (UGRA) to determine needle tip position. Inadvertent intraneural injection still occurs. Sensitive and specific diagnostic tools are needed in clinical practice to help avoid such complications. A potential tool is nanovesicular drug delivery systems for use as ultrasound contrast.

Methods: Approval obtained Thiel cadaver research ethics committee, we conducted a pilot dose finding study. A single Thiel cadaver selected and ultrasound guided sciatic nerve blocks performed with the cadaver in the prone position. 1-4MHz wide angle probe (Zonare, Palo Alto, CA) with microbubble contrast software incorporated and mechanical index set to 0.09 in order to prevent microbubble rupture. Nanobubbles were prepared by a dedicated pharmacist (RM) on-site and 2ml injected at each site in serial saline dilutions of 1, 3 in 10, 1 in 10, 3 in 100, 1 in 100, 3 in 1000 and 1 in 1,000.

Results: High reflection occurred at undiluted, 3 in 10 and 1 in 10 dilutions with flashes of bright flares superficial and deep to sciatic nerve. Reflection decreased and not observed at 3 in 1000 and 1 in 1000 dilutions. Calculation of brightness and reflectivity used histogram analysis and specific contrast software (Santesoft, Spain) and will be presented as AUC_{time}.

Conclusions: We have demonstrated the features of nanobubbles used for UGRA in the Thiel embalmed human cadaver model.

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ASEPTIC PRACTISE IN SINGLE SHOT PERIPHERAL REGIONAL BLOCKS - A SURVEY OF ANAESTHETISTS AND SCREENING OF ULTRASOUND EQUIPMENT

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Background and aims: The Association of Anaesthetists of Great Britain and Ireland (AAGBI) have recommendations for aseptic practise before performing peripheral regional blocks (1). We intended to survey the practise of aseptic precautions during performance of regional blocks in our institution and also screen all our ultrasound machines for contamination.

Methods: A survey questionnaire was emailed to trainees and consultants in our hospital asking about their usual practise. The 11 ultrasound machines in our institution that are used to perform regional anaesthetic procedures were swabbed and cultured after routine cleaning.

Results: 57% of respondents (46/80) replied to the survey questionnaire. 92% did some form of hand washing, 94% wore sterile gloves, 11% wore a sterile gown and 23% wore a mask before performing single shot peripheral regional blocks. The patient's skin was cleaned in 98% of patients.

61% used a sterile drape, 31% used a probe sheath and 71% used a sterile transparent dressing to cover the transducer tip only.

10/11 machines grew bacteria (mostly in the transducer and the cable) the most common of which was non pathogenic *Staphylococcus*. The other organisms that grew were *Micrococcus luteus* and *Neisseria Macacae*.

Conclusions: The practise of majority of anaesthetists was adequate in their aseptic precautions when compared to AAGBI recommendations. Most ultrasound machines grew skin commensals and should be adequately cleaned just before use.

Reference:

- Gemmell L, Birks R, Radford P, Jeffries D, Ridgway G, McIvor D. Infection control in anaesthesia. *Anaesthesia* 2008; 63: 1027-36

572

SHOULD ULTRASONOGRAPHY BE THE GOLD STANDARD FOR DIFFICULT EPIDURAL ACCESS IN PARTURIENT?

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Background and aims: Obesity could be a problem to obtain good skin landmarks to perform epidural analgesia, and sometimes for patients without

risk factors of presumed difficult epidural procedure we couldn't achieve the procedure. We try to determine about the position of ultrasonography assessment for the difficult epidural procedure.

Methods: During 31 months one anesthesiologist performed prepuncture US and subsequent epidural procedure. If US was used as a method to visualize epidural space, after one or more failed attempts, it was decided to find criteria to use it in first intention. No or barely palpable cutaneous landmarks was the criteria. Measurements were obtained with a Sonosite Micromaxx US System, with a 2-5 MHz curved probe (Sonosite Inc. USA). Skin was marked by dermatographic pen to represent the lateral extremities and the middle of the probe once the best image of intervertebral space was visualized. Internal calliper was used to calculate the depth compared to needle depth.

Results: 26 patients accepted to have an US examination after informed consent. US was used first in 16 cases, and as second line in 10. Success rate at first attempt after US landmarks was 92,30%, and 100% with the second attempt. Epidural space depth was very close to the depth measured by needle. 57,7% have poor bony surfaces landmarks and in 42,3% we couldn't palpate any lumbar spinous processes.

Conclusions: US is safe, without risk and has to be used each time where we think about difficult procedure, or after failed attempts.

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ANAESTHETIC MANAGEMENT OF RETAINED PLACENTA-SCHOOL WIDE SURVEY

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Background and aims: To determine the preferred method of anaesthetic management of retained placenta, modalities tested in a neuraxial block, block height accepted and drugs used.

Methods: Questionnaire sent via surveymonkey.com and responses analysed.

Results: Out of a total of 60 responses, 96.2% preferred a spinal, more than half preferred a volume between 2.1-2.5 mls of heavy 0.5% bupivacaine. Fentanyl (51.8%) emerged as the preferred adjuvant. Most tested for Cold & Touch (63%) followed by Cold only (25.9%), Pin-prick (5.6%), Motor block of lower limbs (3.7%) & touch alone (1.9%). Test for cold was mainly using ethyl chloride. Only 44.2% considered a block height of T7-T8 to cold as adequate for the surgeon to proceed. 32.7% preferred a block height of T4-T6, 21.2% considered T9-T10 level adequate.

Conclusions: Spinal anaesthetic was the preferred anaesthetic in our survey. Historically a block to T10 was advocated by Crawford [2]. Currently a block to cold to T6 or above is recommended for manual removal of placenta under subarachnoid block.[3] It is remarkable that majority of the anaesthetist settled for a block height much lower than that in our survey. It is also known that after both spinal and epidural anaesthesia there exists a zone of differential block at the cranial limits with loss of cold sensation lying several dermatomes higher than touch sensation. It has also been shown that the relationship between these levels is not always constant and therefore one cannot predict the level of block to touch from that of cold. [4] Our survey demonstrated that the majority used 2 modalities to test their block. Light touch is more reliable.[5] Addition of Opioids to intrathecal solutions reduces the incidence of intraoperative discomfort.[6] We conclude that there is lack of awareness about available best practice for anaesthesia for manual removal of retained placenta.

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PROSPECTIVE STUDY REGARDING RECALL OF ANAESTHETIC RISKS DISCUSSED DURING SECOND STAGE OF LABOUR

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Background and aims: Informed consent is a controversial issue in the field of Obstetric anaesthesia. Several studies have concluded that pain and sedation levels do not affect women's ability to consent. Despite this, an Australian survey demonstrated up to 70% of anaesthetists believed active labour impairs women's ability to give informed consent. Our goal was to establish the parturient ability to recall risks of anaesthesia and explore their view on information provided.

Methods: Women who had anaesthetic intervention during the second stage of labour for analgesia or operative delivery were interviewed on the postnatal ward 24 hours later. They were categorised into two groups, with/without opioid analgesia. Questions were asked to determine their recall of anaesthetic risks explained. Questions were also asked on adequacy of information.

Results: 62 women were enrolled. They were grouped into opioid analgesia (diamorphine) n=34 Group 1 and non-opioid analgesia Group 2 (Entonox, TENS) n=28. Groups were similar for anaesthetic interventions. Group 1 recalled median of 5 risks (range 3-7) and group 2 recalled median 4 risks (3-7). 91% in group 1 thought they had sufficient information to proceed with the procedure compared to 72% in group 2. 100% of patients in both groups claimed they would have proceeded irrespective of the information provided.

Conclusion: Our findings show that pain and sedation does not impair decision-making, which correlates with previous studies. We also believe that prior information provided by antenatal clinics, media, friends and midwives play an important role in influencing women's decisions.

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A BLINDED STUDY USING CELECOXIB FOR PREVENTION OF MORPHINE INDUCED PRURITUS IN PATIENTS UNDERGOING CESAREAN SECTION

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Background and aims: we aimed to evaluate the efficacy of celecoxib in reducing Intrathecal morphine-induced pruritus in parturient undergoing cesarean section delivery under spinal anesthesia.

Methods: In a randomized double-blind placebo controlled study 126 women undergoing elective cesarean section under spinal anesthesia (0.5% bupivacaine 12mg plus 0.2 mg preservativefree morphine) were randomly allocated to receive celecoxib 400 mg or placebo, 2 hours prior to surgery. Severity of pruritus and pain score and frequency of opioid's side effects were recorded.

Results: Patients receiving celecoxib had significantly lower pruritus incidence and severity at 30 min, 2, 4 and 8 hours (40% versus 82%), but not at 12 and 24 hours postoperatively. Also there was a reduction in pain score but it was not significant (1.5±0.5 versus 1.9±0.65). Analgesic requirement was similar between two groups.

Conclusions: Oral administration of celecoxib significantly reduced Intrathecal morphine-induced pruritus in parturient undergoing cesarean section under spinal anesthesia. There were no significant difference in pain scores and analgesic requirement.

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COMPARISON OF EFFICACY OF BUPIVACAINE AND LEVOBUPIVACAINE FOR EPIDURAL LABOUR ANALGESIA

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Background and aims: Levobupivacaine is local anesthetics that have effects similar to bupivacaine with less motor blockade. The aim of this study was to compare the efficacy of bupivacaine and levobupivacaine for epidural labour analgesia.

Methods: After approval by the hospital ethics committee and obtaining written informed consent; 40 full term parturient women, with cervical dilatation 3-5 cm, ASA I-II who were scheduled for epidural labour analgesia were included. Patients were randomly divided into two groups receiving either (in group B) 10 mL bupivacaine 0.175% or (in group L) 10 mL levobupivacaine 0.175%. If analgesia was inadequate (VAPS≥40), an additional bolus of 8 mL of 0.175 % bupivacaine or levobupivacaine was supplemented after 20 min. of the initial bolus. The degree of motor block, the visual analog pain score (VAPS), heart rate (HR), systolic and diastolic arterial pressure (SAP, DAP) were recorded throughout the study; at 1st, 5th, 10th, 20th, 30th, 60th min after initial bolus dose, then at hourly intervals. Neonatal APGAR scores were recorded at 1st and 5th minutes. Statistical analysis was performed using SPSS 13 version.

Results: Demographic data and duration of labour were similar in both groups. No statistically significant difference between groups with HR. In group B, mean values of SAP, DAP were lower than in group L at 10th min. In

group B, level of the motor block were higher than group L. No statistically significant difference between groups with VAPS and APGAR.

Conclusions: Levobupivacaine is more useful for optimal hemodynamic state and less motor blockade, in epidural labour analgesia when compared with Bupivacaine.

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USE OF THROMBOELASTOGRAPHY IN A PATIENT WITH HAEMOPHILIA C UNDERGOING CAESAREAN SECTION WITH REGIONAL ANAESTHESIA

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Background and aims: Factor XI (FXI) is a serine protease and forms part of the coagulation cascade. FXI deficiency leads to Haemophilia C, the fourth most common coagulation disorder and can lead to excessive blood loss during surgical procedures¹.

Thromboelastography (TEG) allows rapid near patient testing of clotting kinetics and clot stability. FXI deficiency and its treatment have not been assessed using TEG in the pregnant population. The benefits of using a rapid near patient test are obvious.

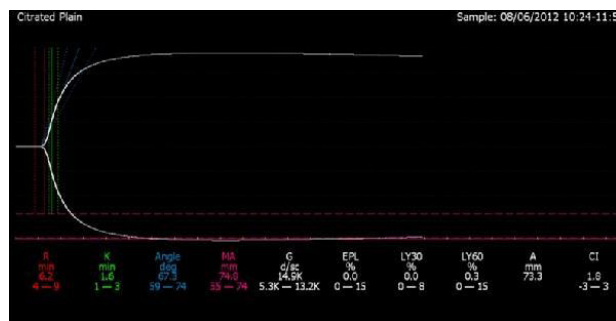
Methods: We report the comparison of citrated, kaolin activated TEG samples, to standard coagulation studies and FXI assay in a patient with partial FXI deficiency (baseline FXI level 17u/dL) having a caesarean section under combined spinal and epidural anaesthesia.

Baseline full blood count, coagulation screen, FXI levels and TEG study were performed. Then recombinant FXI (26u/kg) was infused and the above tests were repeated.

Results:

	Pre FXI Infusion	One Hour Post FXI Infusion
Prothrombin time 9.4-11.3s	9.8	10.2
Activated partial thromboplastin time 25-30.7s	30.8	26.8
FXI level 70-150 u/dL	22.4	74

[Pre and post FXI infusion coagulation studies]



[Pre FXI infusion TEG]

Conclusions: We have demonstrated that in this case TEG was not clinically useful in monitoring partial FXI and is not a substitute for measuring FXI levels in patients with Haemophilia C undergoing a caesarean section.

Reference:

1. Haemophilia. Feb 2008; 14: 1183-1189. Factor XI deficiency. Gomez, K. And P. Bolton-Maggs

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DAY CASE PEDIATRIC FLEXIBLE FLATFOOT CORRECTION: ECHO GUIDED SCIATIC NERVE BLOCK FOR INTRA AND POSTOPERATIVE ANALGESIA

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Background and aims: Day Surgery for pediatric patients is becoming an important way of managing little patients both for social and for economic

reasons. We want to study pain management of pediatric flexible flatfoot correction avoiding overnight hospitalization.

Methods: 15 little patients aged between 9 and 12 years were subjected to surgery of subtalar joint arthroereisis with Giannini endorthesis. Children were given general anesthesia with LMA and then received a sciatic nerve block with Levobupivacaine (Chirocaine ®) 0.125% at a dose of 0.625 mg/Kg and Paracetamol 15 mg/Kg ev as intraoperative analgesia. Postoperative pain was controlled with Ibuprofene (Nureflex ®) 200 mg per os every 8 hours. If the VAS exceeded the value of 4 was administrated Tramadol 1 mg/Kg per os

Results: In two cases a single dose of tramadol was given during the afternoon and only one case Tramadol was necessary the first night at home. No child has required overnight hospitalization.

Conclusions: Echo guided sciatic nerve block provide excellent analgesia for little patients undergoing pediatric flexible flatfoot correction.

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IS THERE A PLACE THORACIC PARAVERTEBRAL BLOCK FOR SHOULDER SURGERY?

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Background and aims: Proximal humeral fractures are frequently faced nosology. In general, we use US guided interscalen block to provide anesthesia and postoperative analgesia. But when we encounter fracture-dislocation, interscalen block cannot cover all of the stimulated dermatomes, myotomes or osteomes. In these cases, we also apply general anesthesia. However, in many cases where low-volume ISB is obligatory, we do not want to use general anesthesia or airway instrumentation. Is it possible to have a pain-free and complication-free patient in the operating room? The solution that we have found is US guided thoracic paravertebral block at T2. This way we have surgical anesthesia at the entire shoulder, even when posterior surgical approach is needed.

Methods: 20 patients are included in our study. Their age varied between 65-85 years. The most frequent comorbidities were diabetes mellitus, obesity, cardiovascular diseases, cerebrovascular disease, COPD. In all cases we used paravertebral block with 10 ml Lidocaine 2% at T2, and low - volume (5ml levobupivacaine 0.75%) interscalen block. We used light sedation 15 patients, and 5 patients were without sedation.

Results: All patients were pain free during entire operation. There were no need of additive sedation or local anesthesia. None of them had major respiratory or circulatory complications. Surgical team found the operative conditions and muscle relaxation excellent.

We managed the patients with ease during the operation. We have observed just minor circulatory variations.

Conclusions: The combination of these two US guided blocks provided a large pain-free surgical field, hemodynamic stability, without major or minor perioperative complications. Patient satisfaction was high especially by good postoperative pain control.

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THE EFFECTS OF CONTINUOUS ROPIVACAIN 0.3% FOR PERIPHERAL REGIONAL ANESTHESIA COMPARED TO ROPIVACAIN 0.2%

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Background and aims: Continuous regional anesthesia is clearly superior to systemic analgesia after orthopedic surgery. However, the most effective local anesthetic concentration for continuous regional anesthesia using ropivacaine is still controversial.

Methods: In a retrospective study 200 postoperative orthopedic patients with regional continuous anesthesia for 48 hours (interscalene, infraclavicular, femoral and popliteal catheters) using ropivacaine 0.2% were compared with 200 postoperative orthopedic patients using ropivacaine 0.3% for the same indications. Pain at rest and with motion, analgesia demand, motor block duration and side effects were compared.

Results: Ropivacaine 0.3% offers a better pain control reducing use of additional analgesics and improving pain with motion. Motor block duration was not significantly longer compared to ropivacaine 0.2% and side effects of the different catheters were comparable between the groups. Sensory block

in both groups were comparable and the incidence of stumbling or falling was not higher in the ropivacaine 0.3% group.

Conclusions: Continuous regional anesthesia using ropivacaine 0.3% offers better analgesia with movement compared with ropivacaine 0.2% without increasing motor and sensory block duration or side effects. These results must be verified in further prospective randomized studies.

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THE USE OF ULTRASOUND-GUIDED PERIPHERAL NERVE BLOCKS FOR ORTHOPAEDIC SURGERY BEFORE AND AFTER IMPLEMENTATION OF A DEPARTMENTAL TRAINING SESSION

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Background and aims: The National Institute for Clinical Excellence (NICE)¹ acknowledges that performing peripheral nerve blocks under ultrasound guidance may increase their safety and efficacy.

ASRA/ ESRA Joint Committee Recommendations² state that those performing blocks require adequate knowledge and skills. This can be achieved through training, overseen by an ?Ultrasound-Guided Regional Anaesthesia (UGRA) Coordinator?.

This project aimed to:

1. Assess current departmental practice
2. Increase awareness of the NICE guidelines
3. Implement a teaching session, overseen by a UGRA Coordinator
4. Assess the impact this had on practice within our department.

Methods:

1. a) Initial audit of nerve blocks over a two week period
b) Questionnaire regarding current departmental practice
2. Training session
a) Ultrasound theory
b) Live scanning and anatomy
c) Phantom scanning and needling
3. Follow-up audit of practice

Results:

- 88% of anaesthetists wanted training
- Initial audit: 45% of nerve blocks performed under ultrasound
- This increased to 95% after the training session

This represents a significant increase in the use of ultrasound blocks ($p=0.005$, Fisher Exact test)

Conclusions: Analysis of current practice identified the need for training within our department.

Following formal training, the number of blocks performed under ultrasound increased significantly.

References:

1. IPG285 Ultrasound-guided regional nerve block: NICE guidance 28 January 2009 <http://www.nice.org.uk/nicemedia/live/11931/42876/42876.pdf>. Accessed 25th June 2012
2. The American Society of Regional Anesthesia and Pain Medicine and the European Society of Regional Anaesthesia and Pain Therapy Joint Committee Recommendations for Education and Training in Ultrasound-Guided Regional Anesthesia. *Reg Anesth Pain Med* 2009;34:40-4

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IS ULTRASOUND-GUIDED POPLITEAL BLOCK IN THE POINT OF SCIATIC NERVE DIVISION AN INTRANEURAL INJECTION?

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Background: Intraneural vs extraneural needle placement remains controversial in sciatic popliteal block at point of nerve division. Otherwise, nerve

swelling (NS) is considered a sign of intraneural injection. The aim of this study was to determine the incidence of NS, proximal and distal to site of puncture.

Methods: After written informed consent, out-of-plane ultrasound-guided sciatic popliteal block at point of nerve division was performed in 23 patients, using a linear transducer connected to a M-Turbo-Sonosite ultrasound. 30 ml of LA were administered. Images were recorded before and after the block at 3 cm proximal and distal to the site of puncture. Presence of NS was defined and assessed by two blinded independent experts. Nerve area and surrounding LA-halo were measure. Fisher exact test and t-Student test was used for statistical analysis.

Results: Proximal-NS was observed in 17 patients (74%). Sciatic nerve area significantly increase ($>35\%$) in patient with NS ($77\pm38\%$ vs $-4\pm12\%$; $p<0.001$). Only 13% of patients presented distal-NS (peroneal and tibial nerves), all of them with proximal-NS. Area of LA-halo around the nerve was more than double nerve size (2 ± 0.5 vs 0.7 ± 0.2 cm², $p<0.001$).

Conclusions: US-guided popliteal block at point of sciatic nerve division frequently produce proximal-NS, but is rarely related to distal-NS (tibial and peroneal nerves). This suggest that connective tissue at the site of puncture surrounds distal nerves, but is involved in proximal inner nerve structure that produces sciatic nerve expansion. Nerve swelling must be considered intraneural spread of LA, but not an intraneural injection.

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TARGET-CONTROLLED TOTAL INTRAVENOUS ANESTHESIA VERSUS THE COMBINATION OF TCI WITH INTERSCALENE BLOCK FOR ARTHROSCOPIC SHOULDER SURGERY UNDER BISPECTRAL INDEX MONITORING

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Background and aims: The primary objective of this study was to compare two anesthetic techniques in patients for arthroscopic shoulder surgery under bispectral index (BIS) monitoring on perioperative outcomes.

Methods: Patients who were scheduled for arthroscopic shoulder surgery were randomized to either target-controlled total intravenous anesthesia (TCI) or combination of TCI and ultrasound/nerve-guided interscalene block under BIS monitoring to keep the BIS between 40–60 during operation. In control group, anesthesia was maintained with fentanyl and propofol target-controlled infusions (TCI). In study group, ultrasound and nerve-guided ISB was performed before conducting TCI using a needle-in-of-plane approach, and then general anesthesia was underwent standardized to include induction with fentanyl and propofol TCI. Effect-site concentrations (Ce) of propofol, perioperative anesthetic variables in two groups were recorded. Analgesic effects were evaluated for 24 h after surgery using visual analog scale (VAS) pain scores, time to first opioids request for pain relief and time to first physical therapy.

Results: The target effect site propofol concentration at loss of consciousness, maintenance period and at return of consciousness in study group is significant less than propofol TCI group. The study group had lower VAS pain scores at 2h, 4h and 24 h and longer time to first trigger of opioids postoperation.

Conclusions: We conclude that the combination of TCI and ultrasound/nerve-guided interscalene block (ISB) under BIS monitoring has lower Ce of propofol at loss of consciousness, maintenance period and at return of consciousness as well as better postoperative outcomes than propofol TCI group.

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2D-3D ULTRASONOGRAPHIC ASSESSMENT OF SUBEPINEURIAL LOCAL ANESTHETIC SPREAD VOLUME DURING SCIATIC POPLITEAL BLOCK AT NERVE DIVISION POINT

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Background: High success rate and rapid onset block have been observed after injection of local anesthetic (LA) at the point of sciatic nerve division due to well distribution of LA surrounding tibial and peroneal nerves. The

aim of this study was to quantify the area of the echogenic halo around the nerve and estimate the volume content in 5 cm length.

Methods: After written informed consent, twenty patients scheduled for hallux valgus repair were included. An out-of-plane ultrasound-guided sciatic popliteal block was performed, with following administration of 30 ml of LA at an infusion rate of 20 ml/min. Real time 2D images and 3D reconstruction were recorded, before and after the block, by a linear transducer connected to a M7 Mindray ultrasound machine. Dual screen mode was used to assess LA spread. Nerve area and surrounding halo were measured at the point of injection. Volume corresponding to both measures was estimated for a 5 cm length. Pared-t-student test was used for statistical analysis.

Results: Ratio of nerve area increase 1.7 ± 0.6 after the block ($0.67 \pm 0.17 \text{ cm}^2$ to $0.99 \pm 0.34 \text{ cm}^2$; $p < 0.001$). Ratio of halo/nerve area was 3.1 ± 1 ($0.67 \pm 0.17 \text{ cm}^2$ to $1.72 \pm 0.5 \text{ cm}^2$; $p < 0.001$). Estimated volume of LA spread in 5 cm length was estimated in $5.2 \pm 2.1 \text{ cm}^3$ (95%CI -4.25-6.2 cm^3).

Conclusions: Volume needed for surrounding popliteal sciatic nerve in a length of 5 cm was estimated around 6 cm^3 . This data suggest that LA volume needed for sciatic popliteal nerve block could be significantly reduce in the future.

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ANALGESIA FOR DAY CASE SHOULDER SURGERY: THE EFFECT OF ADDING DEXAMETHASONE TO LEVO-BUPIVACAINE ON THE DURATION OF INTER-SCALENE BRACHIAL PLEXUS BLOCK

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Background and aims: Shoulder surgery is well recognized as having the potential to cause severe postoperative pain. We add dexamethasone to levo-bupivacaine to prolong the duration of inter-scalene block for shoulder surgery at our hospital which has been shown in a number of studies(1). We conducted this audit to report the modalities of analgesia used for intra and post-operative pain for up-to 48 hours after shoulder surgery and patient satisfaction with the analgesia. We looked at the effect of addition of dexamethasone to the duration of block.

Methods: 20 patients who were having day case shoulder surgery were included in the audit, who were verbally consented pre-operatively. We looked at the mode of analgesia, VAS scores and analgesic consumption. Telephonic interviews were done on the first and second post-operative-day (POD).

Results: All the patients received inter-scalene block. Eleven patients had dexamethasone 8 mg as an adjunct to the local anesthetic (0.5% L-bupivacaine) and nine had plain 0.5% L-bupivacaine. None of the patients required any additional pain relief prior to discharge. The duration of block in the plain L-bupivacaine group varied from 12 to 37 hours (mean= 20.88 hours) as compared to 22 to 48 hours in the dexamethasone group (mean= 27 hours).

Conclusions: Inter-scalene block with L-bupivacaine+dexamethasone mixture provided excellent analgesia in the immediate post post-operative period and good analgesia for as long as 48 hours.

Reference:

1. Effect of **dexamethasone** on the duration of **interscalene** nerve blocks with ropivacaine or bupivacaine.
Cummings KC. Br J Anaesth. 2011 Sep; 107(3): 446-53

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THE EFFICACY OF INTRATHECAL MORPHINE WITH BUPIVACAINE FOR POSTOPERATIVE ANALGESIA AFTER TUR-B

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Background and aims: In this randomized study, we evaluated two different doses of intrathecal (IT) morphine with bupivacaine for analgesia after transurethral resection of bladder (TUR-B).

Methods: Seventy-five patients were randomly divided into three groups. They were allocated to receive IT morphine (100 μg) with 12.5 mg 0.5% bupivacaine (Group I), IT morphine (200 μg) with 12.5 mg 0.5% bupivacaine (Group II), and IT 12.5 mg 0.5% bupivacaine without morphine (Group III). Postoperative pain was evaluated by VAS during 24 h and each patient was given intravenous paracetamol and Dextetoprophren trometamol if pain

severity was moderate. The first requests for analgesia, adverse effects (pruritus, postoperative nausea and vomiting, respiratory depression) were recorded.

Results: Groups were comparable with respect to demographic data. VAS scores were significantly lower in Groups I and II than Group III at 1h, 2h, 4h, 6h, 12h ($p < 0.05$). The request for analgesia was significantly higher in Group III than the other two groups ($p < 0.05$). More patients reported postoperative nausea in Group II than the other two groups ($p < 0.05$).

Conclusions: IT morphine (100 μg and 200 μg) with 12.5 mg 0.5% provided a significant reduction in postoperative pain scores compared to IT 12.5 mg 0.5% bupivacaine alone. IT morphine 100 μg provided comparable postoperative pain control with significantly lower side effects than IT morphine 200 μg after TUR-B.

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ENHANCED RECOVERY PROGRAM FOR HIP AND KNEE ARTHROPLASTY - OUR EXPERIENCE

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Background and aims: Enhanced recovery protocols led by multi-disciplinary teams do improve the quality of care for the joint replacement patients. The aim of this study was to evaluate the impact of our fast track recovery program in terms of pain management, early mobilisation and discharge from the hospital.

Methods: 100 patient were included (50 THR and 50 TKR), Asa 1,2 and stable 3, age was not an exclusion criteria. The anaesthetic was standardised, so was the peri and post operative drug and fluid management.

The parameters considered were patient's time of first mobilisation, average pain score, postoperative nausea/vomiting, knee and hip range of movement, wound oozing, hospital length of stay. All patients received our enhanced recovery protocol involving pharmacological, physiotherapeutic and procedural modifications.

Results: 50% of patients were male, average age was 69.26.

66% of the patients was mobilised on same day of surgery, 31% on day 1, 2% on day 2 and 1% on the day 3.

23% of the patients were discharged on day 2, 47% on day 3, 22% on the day 4 and 8% on the day 5. The average pain score (VAS) was 0.895.

2 patients experienced nausea on mobilisation and 2 patients fainted. One patient had a blood transfusion.

Conclusions: Enhanced Recovery pathways for joint arthroplasty patients is effective delivering modern and safe medical care. Patient satisfaction is extremely high and hospital length of stay reduced.

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COMPARISON OF 75 μg AND 150 μg DOSES OF INTRATHECAL MORPHINE FOR POSTOPERATIVE ANALGESIA AFTER TRANSURETHRAL RESECTION OF THE PROSTATE UNDER SPINAL ANESTHESIA

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Background and aims: In this randomized study, we evaluated the efficacy and safety of two different doses of intrathecal (IT) morphine (75 μg and 150 μg) with bupivacaine for postoperative analgesia after transurethral resection of prostate (TURP).

Methods: Sixty patients were randomly divided into two groups. They were allocated to receive IT morphine (75 μg) with 12.5 mg 0.5% bupivacaine heavy (Group I) and IT morphine (150 μg) with 12.5 mg 0.5% bupivacaine heavy (Group II). Postoperative pain was evaluated by VAS during 24 h and each patient was given intravenous paracetamol and dextetoprophren trometamol if pain severity was moderate. The need for rescue analgesic, adverse effects (pruritus, postoperative nausea and vomiting, respiratory depression), and patient satisfaction were recorded.

Results: Groups were comparable with respect to demographic data. VAS scores were similarly low in both groups. However the request for analgesia was significantly higher in Group I (27%) than Group II (7%) ($p=0.04$). The incidence of postoperative nausea was similarly low in both groups. No patients reported pruritus in Group I where as 6 patients (20%) reported mild pruritus not necessitating treatment in Group II ($p=0.036$). Patients satisfaction was similarly high in both groups.

Conclusions: IT morphine 150 µg reduced the need for rescue analgesia compared to IT morphine 75 µg in patients undergoing TURP under spinal anesthesia. Since the incidence of pruritis was low with no treatment, intrathecal (IT) morphine 150 µg may be a suitable dose for postoperative analgesia for patients undergoing TURP under spinal anesthesia.

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EFFECTS OF PRE-OPERATIVE CELEBREX ON POST-OPERATIVE PAIN MANAGEMENT IN PATIENTS UNDERGOING PRIMARY PTERYGIUM EXCISION AND AMNIOTIC MEMBRANE TRANSPLANTATION: A PROSPECTIVE STUDY

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Background and aims: To investigate clinical effects of pre-operative celebrex administration on post-operative pain management in patients undergoing primary pterygium excision and amniotic membrane transplantation.

Methods: This prospective, randomised, one-blinded trial was approved by the institutional Ethics' Committee. Seventy-two patients undergoing selective primary pterygium excision and amniotic membrane transplantation were assigned randomly to pre-op and post-op groups. Patients in pre-op group ($n=36$) received a pill of celebrex 200 mg pre-operatively and a pill of vitamin E 200 mg post-operatively, whereas patients in post-op group ($n=36$) took pre-operative vitamin E and post-operative celebrex at the exact dosage. Visual analog score (VAS, 0-10) was monitored at 4, 8, 12 and 24 hr post-operatively. A pethidine dose of 50 mg was prescribed intra-muscularly on patients' demand or when the VAS reached or exceeded 5.

Results: The VASs and ratios of $VAS \geq 3$ were similar between the groups except that at 8 h time-point the pre-op patients had a lower VAS (1.8 ± 0.1 vs. 2.9 ± 0.3) and lower ratio of $VAS \geq 3$ (19.4% vs. 36.1%). Three patients in post-op group but none in pre-op group required pethidine analgesia rescue. There were 2 vomiting cases because of rescue analgesics. The over-all satisfactory with analgesia was higher in pre-op group than post-op group (87% vs. 62%).

Conclusions: A celebrex dose of 200 mg administered pre-operatively may provide more beneficial effects in reducing early surgical pain and improving patients' satisfaction when compared with post-operative administration in patients undergoing primary pterygium excision and amniotic membrane transplantation.

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NURSES KNOWLEDGE, ATTITUDE AND TRAINING REGARDING POSTOPERATIVE PAIN MANAGEMENT AT WESTERN GENERAL HOSPITAL, EDINBURGH, UK

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Background and aims: The key component of effective pain management is nurse's adequate knowledge about pain and appropriate attitude in assessing the pain. (Chung et al 2003).

The aims of the survey were

- 1) To explore the nurses knowledge and attitude towards postoperative pain management
- 2) To assess the need of training component

Methods: This is descriptive and cross sectional study design (Survey during January-February 2012). All Registered nurses on the surgical wards in Western General Hospital which included colorectal wards / SHDU / Urology & Recovery. We selected nurses randomly and sample size of 125 nurses who were asked to fill a validated paper format questionnaire.

Results: Total Actual Response Rate - 70 % ($n = 78/111$) was noted.

It showed that 5% nurses has excellent knowledge and attitude and 63 % nurses has average knowledge and attitude and 32% nurses has a poor knowledge towards postoperative pain management.

Training questionnaire showed that 55% nurses did not have pain education in previous 3 years , 45% nurses in the study looks after epidural and 60% of them had a recent training. Total of 65% nurses did not had opportunity to attend pain training due to various reasons.

Conclusions: We found that, Nurses in WGH have Moderate knowledge of postoperative pain management and positive attitude towards pain management. The findings also suggests on-going training is crucial for nurses to ensure adequate knowledge and skills and on-going pain management courses and study days for nurses particularly on ward is required.

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PAIN FOLLOWING ARTHROSCOPIC SHOULDER SURGERY PERFORMED SOLELY UNDER REGIONAL ANAESTHESIA

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Background and aims: Up to one third of patients report severe pain following arthroscopic shoulder surgery [1]. Continuous interscalene brachial plexus block has been promoted as the most effective analgesic technique after major and minor shoulder surgery [2].

Methods: Prospective re-audit of patients undergoing arthroscopic shoulder surgery under regional anaesthesia examining postoperative pain, satisfaction and analgesia compliance.

Results: We questioned 108 patients (ASA 1-3). All patients were satisfied with the regional anaesthesia technique (96% > 8/10; 4% = 7/10). 3 (2.7%) patients reported average pain scores as severe (≥ 8 on a VAS scale of 0-10) on day 1, 4 (3.7%) on day 2 and 2 (1.85%) on day 3. Of the 34 patients who had either rotator cuff repairs or stabilisations, only 1 (2.9%) patient had severe pain on day 1, 4 (11.7%) patients on day 2 and 1 (2.9%) patient on day 3. Patient compliance with post operative analgesia was improved compared to our audit in 2010.

Conclusions: Our survey suggests that a combination of regional analgesia and good compliance with oral analgesia leads to acceptable pain scores and a high level of patient satisfaction following arthroscopic shoulder surgery under plexus blockade. Routine use of post-operative interscalene catheter infusions is not necessary for most arthroscopic shoulder surgery in our practice.

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USE OF HYPERBARIC PRILOCAINE IN AMBULATORY SURGERY

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Background and aims: Data on prilocaine use for ambulatory intrathecal anaesthesia are limited. In this randomized study we compared 2% hyperbaric prilocaine and sufentanil with 2% hyperbaric bupivacaine and sufentanil for spinal anesthesia in outpatients undergoing elective anorectal surgery without increasing side - effects or delaying.

Methods: Patients ASA I-III were randomly allocated to receive 30mg hyperbaric prilocaine plus 5 microg sufentanil (group PS, $n=20$) or 10 mg hyperbaric bupivacaine plus 5 microg sufentanil (group BS, $n=20$) in sitting position. After sitting for 3 min (group PS) and 10 min (group BS), patients were positioned for surgery. Written informed consent was obtained from all subjects.

Results: There were no significant differences in intraoperative outcomes (hypotension, bradycardia, respirator depression) but mean recovery, discharge time, postoperative pain and urinary retention were significantly shorter in group PS.

Conclusions: This study demonstrates the superiority of the combination of low-dose hyperbaric prilocaine and sufentanil for spinal anaesthesia in ambulatory anorectal surgery. It is an excellent alternative to bupivacaine because of faster attainment and resolution block, greater haemodynamic stability, earlier deambulation, reduced risk of urinary retention and early patients discharge.