Safety of Epidural Anaesthesia

THE EUROPEAN SOCIETY
OF REGIONAL ANAESTHESIA

ESRA

30th Annual ESRA Congress 2011

Building Knowledge and Science in Regional Anaesthesia

Dresden, Germany
September 7-10, 2011

Epidural Anaesthesia Safety

- Interesting Topic
- Broad Subject
- Numerous Literature Reports

What is Safe Regional Anaesthesia?

according to the patient

- free from risk
- not involving danger / mishap
- guaranteed against failure

according to the anaesthesiologist

- satisfactory clinical outcome
- minimal complications
- no deviations from the ideal
- trivial deviations / easily corrected
- patients' outcome

McIntyre JWR. Regional Anaesthesia Safety
In: Finnucane BT. Complications of Regional Anaesthesia, 2007

Safe Regional Anaesthetic Technique
Characteristics

- avoidance of complications
- minimal associated risks
- primary / secondary beneficial endpoints
- few method – related dangers
- **reliable evidence**
- **benefit – and – risk equation**

Gilbert HC. Complications and Controversies in Regional Anaesthesia. ASA Refresher Courses, 2003
Fischer B. Benefits, Risks, and Best Practice in Regional Anaesthesia. Reg Anesth Pain Med, 2010; 35: 545 – 548

Epidural Anaesthesia – Analgesia (EAA)

- long / distinguished history
- leading anaesthetic modality
- advantages in certain settings
- acute postoperative pain control
- minimal side – effects
- ↓ morbidity, ↑ recovery
- ↑ patient satisfaction

Kehlet H, Holte K. Epidural Anaesthesia and Analgesia in Major Surgery. Lancet, 2002; 360: 568 – 569

Schug S, Pfluger E. Epidural Anaesthesia and Analgesia for Surgery. Curr Opin Anaesthesiol, 2003; 16: 487 – 492

Hanna MN, et al. Regional Techniques and Outcome: What is the Evidence? Curr Opin Anaesthesiol, 2009; 22: 672 – 677

Do benefits outweigh the risks?

Gilbert HC. Complications and Controversies in Regional Anaesthesia. ASA Refresher Courses, 2003
Fischer B. Benefits, Risks, and Best Practice in Regional Anaesthesia. Reg Anesth Pain Med, 2010; 35: 545 – 548

Yet …

The ongoing discussion on the merits of **EAA** continues to be controversial

- safety
- impact on morbidity / mortality
- outcome

Rodgers A, et al. ***BMJ, 2000; 321: 1493 – 1497***
Rigg JR, et al. ***Lancet, 2002; 359: 1276 – 1282***
Peyton PJ, et al. ***Anesth Analg, 2003; 96: 548 – 554***
Fischer B. ***Reg Anesth Pain Med, 2010; 35: 545 – 548***

Epidural Anaesthesia Risk ???

- Unfortunately …

- catastrophic complications: still a reality
- evidence on outcome: elusive
- reasonable **risk – benefit analysis** → difficult

Rodgers A, et al. ***BMJ, 2000; 321: 1493 – 1497***
Rigg JR, et al. ***Lancet, 2002; 359: 1276 – 1282***
Peyton PJ, et al. ***Anesth Analg, 2003; 96: 548 – 554***
Schug S, Pfluger E. Curr Opin Anaesthesiol, 2003; 16: 487 – 492
Fischer B. ***Reg Anesth Pain Med, 2010; 35: 545 – 548***
Benhamou D, et al. Reg Anesth Pain Med, 2010; 35: 1 – 3

Epidural Anaesthesia – Analgesia Safety

Need for Reappraisal

Invasive Method

- → benefit / risk ratio
- → clarification of complications issues
- → estimation of technique safety
- → alternative opportunities
- → appropriate choice
- → unbiased / rational judging
- → optimum clinical – decision making
- → objective information to patients
- → written informed consent

Schug S, Pfluger E. Curr Opin Anaesthesiol, 2003; 16: 487 – 492
Cook TM, et al. Br J Anaesth, 2009; 102: 179 – 190
Buggy DJ. Br J Anaesth, 2009; 102: 151 – 153

Epidural Anaesthesia – Analgesia

Safety – Complications – Risks

- → risks recognized > 100 y
- → large but confusing database
- → evidence on outcome elusive
- → research
- → scientific / emotive debates
- → EAA safety reappraisal
- → current medico – legal environment

Schug S, Pfluger E. Curr Opin Anaesthesiol, 2003; 16: 487 – 492
Davies MJ. Anaesth Intensive Care, 2007; 35: 593 – 600
Buggy DJ. Br J Anaesth, 2009; 102: 151 – 153
Fischer B. Reg Anesth Pain Med, 2010; 35: 545 – 548
Benhamou D, et al. Reg Anesth Pain Med, 2010; 35: 1 – 3

1 Regional Anesthesia Safety

John W.R. McIntyre†

Complications of Regional Anesthesia

Second Edition (2007)

Brendan T. Finucane, MB, BCh, BAO, FRCA, FRCPC
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Editor

Epidural Anaesthesia – Analgesia
Complications

Unexpected / Untoward Events

→ **technique** application
exposure to **anaesthetic agents**

→ simple adverse effects
common / uncommon / rare

→ insignificant
life – threatening

→ immediate
delayed

→ **minor side – effects**
- easy to prevent – manage
- no safety concerns

→ **unexpected outcomes**
- major concern
- neurological damage
- long – term disability
- permanent disability

→ **whole perioperative period**

Benhamou D, et al. Reg Anesth Pain Med, 2010; 35: 1 – 3
Buggy DJ. Br J Anaesth, 2009; 102: 151 – 153
Wheatley RG, et al. Br J Anaesth, 2001; 87: 47 – 61

EAA Complications: Aetiology

Direct / Indirect Result

- → **technique (trauma)**
  needle / catheter insertion
  indwelling catheter
- → **LAs, adjuvants**
  untoward events
  toxicity
- → **epidural blockade**
  physiologic effects
  anticipated / uananticipated
  poor / late / no management
- → **fatal drug errors**
- → **technical problems**
- → **equipment failure**
- → **ignorance**
  complications
  precipitating factors
  preventive measures
- → **delayed complications' diagnosis**
- → **lack of monitoring**
- → **experience / education / audit**
- → **human / operator factors**
- → **patient / behavioral factors**

Wheatley RG, et al. Br J Anaesth, 2001; 87: 47 – 61

Twomey C, Tsui BCH. Complications of Epidural Blockade
In: Finnucane BT. Complications of Regional Anaesthesia, 2007

What is the Evidence???

EAA is a very safe procedure ……

Severe / Permanent Disability after EAA (some studies with large cohorts)

0.52 : 10.000	*Aromaa U, et al. Acta Anaesthesiol Scand, 1997*
0.32 : 10.000	*Auroy Y, et al. Anesthesiology, 1997*
1.3 : 10.000	*Moen V, et al. Anesthesiology, 2004*
0.8 – 1.7 : 10.000	*Cook TM, et al. Br J Anaesth, 2009*
Predicted max risk: 0.07%	*Giebler RM, et al. Anesthesiology, 1997*
(upper bound of 95% CI)	

But ……

Mortality Related to General Anaesthesia

→ **0.5 – 1.0 : 100.000**

Lienhart A, et al. Anesthesiology, 2006

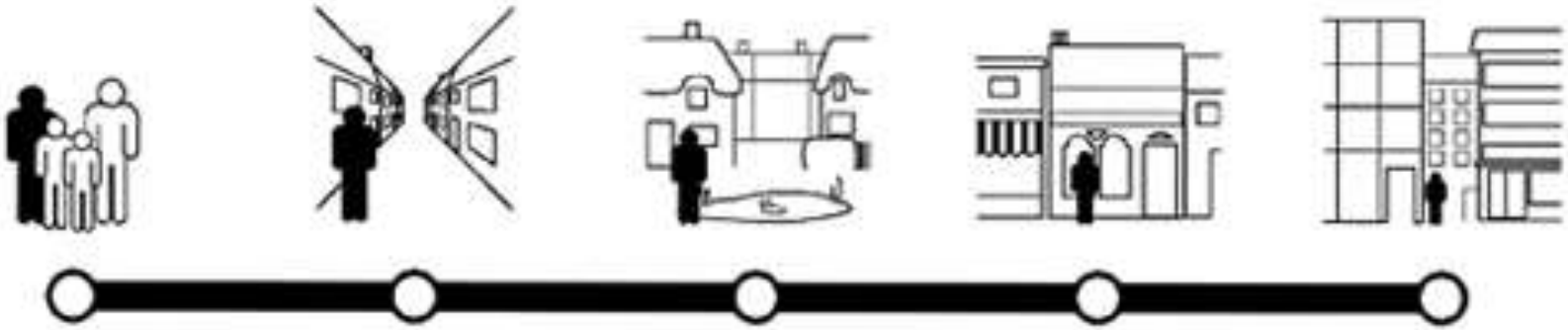
Li G, et al. Anesthesiology, 2009

Haller G, et al. Best Pract Res Clin Anesthesiol, 2011

The Royal College of Anaesthetists

Educating, Training and Setting Standards in Anaesthesia, Critical Care and Pain Medicine

Risk Stratification – Risk Incidence



1 in 10	1 in 100	1 in 1.000	1 in 10.000	1 in 100.000
someone in your family	someone in a street	someone in a village	someone in a small town	someone in a large town

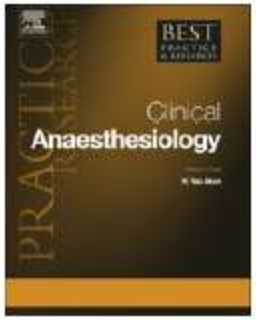
Very Common	Common	Uncommon	Rare	Very Rare
1 : 10	1 : 100	1 : 1.000	1 : 10.000	1 : 100.000

ASA Closed Claims Project Analysis:
Lessons Learned

Contents lists available at ScienceDirect

Best Practice & Research Clinical Anaesthesiology

journal homepage: www.elsevier.com/locate/bean



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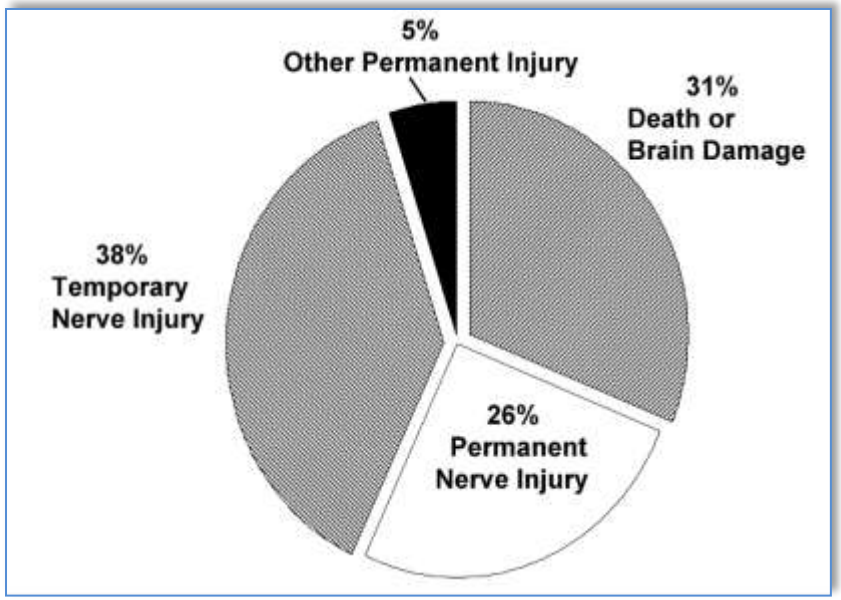
Closed claims' analysis

Julia Metzner, MD, Assistant Professor [a], Karen L. Posner, PhD, Research Professor [b], Michelle S. Lam, BS, Research Study Assistant [c], Karen B. Domino, MD, MPH, Professor *

Department of Anesthesiology & Pain Medicine, Box 356540, University of Washington, Seattle, WA 98195-6540, USA

Best Practice & Research Clinical Anaesthesiology 25 (2011) 263–276

ASA Closed Claims: Lessons Learned

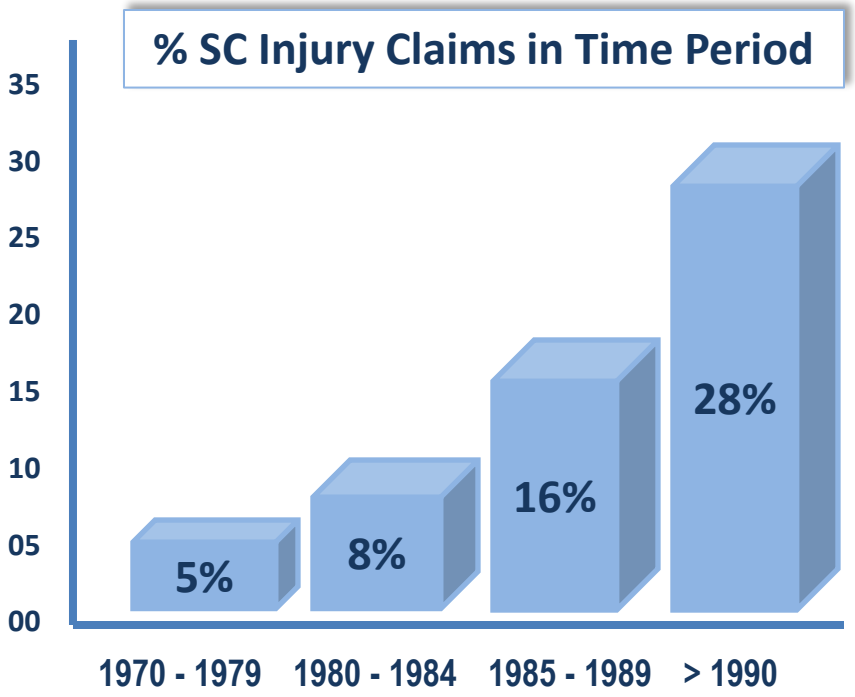


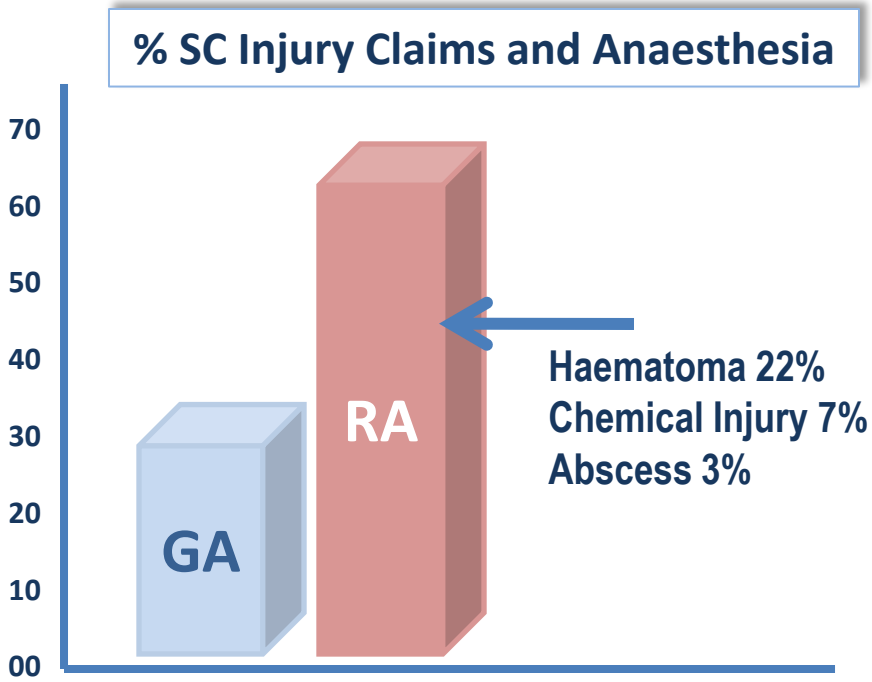
ASA Closed Claims Project Database

- 8.954 claims: 1970 – 2007
- 5.230 claims: 1990 – 2007
- RA: 20 – 25% each decade
- 74% of RA events: associated with CNBs
- Epidurals comprised 42%
- Severe Injury (death, brain damage): 31%
- Permanent Nerve Injury: 26%

Lee LA, et al. Anesthesiology, 2004; 101: 143 – 152
Metzner J, et al. Best Pract Res Clin Anesthesiol, 2011; 25: 263 – 276

Spinal Cord (SC) Injury
Lessons form the ASA Closed Claims Analysis





Associated Factors

- Paraesthesia during needle insertion
- Paraesthesia during drug injection
- Multiple attempts

Chaney FW, et al. Anesthesiology, 1999; 90: 1062 – 1069
Lee LA, et al. Anesthesiology, 2004; 101: 143 – 152

EAA Complications – Major Surveys

- **Kane RE.** *Anesth Analg, 1981; 60: 150 – 161*
- **Reinstrup P.** *Ugeskr Laeger, 1987; 149: 777 – 778*
- **Scott DB, Hibbard BM.** *Br J Anaesth, 1990; 64: 537 – 541*
- **Dahlgren N, Tornebrandt K.** *Acta Anaesthesiol Scand, 1995; 39: 872 – 880*
- **Aromaa U, et al.** *Acta Anaesthesiol Scand, 1997; 41: 445 – 452*
- **Pleym H, et al.** *Acta Anaesthesiol Scand, 1997; 41: 453 – 460*
- **Giebler RM, et al.** *Anesthesiology, 1997; 86: 55 – 63*
- **Auroy Y, et al.** *Anesthesiology, 1997; 87: 479 – 486*
- **Auroy Y, et al.** *Anesthesiology, 2002; 97: 1274 – 1280*
- **Moen V, et al.** *Anesthesiology, 2004; 101: 950 – 959*
- **Ruppen W, et al.** *BMC Anesthesiology, 2006; 6: 10*
- **Christie IW, et al.** *Anaesthesia, 2007; 62: 335 – 341*
- **Cameron CM, et al.** *Anesthesiology, 2007; 106: 997 – 1002*
- **Popping DM, et al.** *Br J Anaesth, 2008; 101: 832 – 840*
- **Katircioglu K, et al.** *Anesth Analg, 2008; 107: 1742 – 1745*
- **Cook TM, et al.** *Br J Anaesth, 2009; 102: 179 – 190*

EAA Complications / Safety: Major Surveys

	Country	Study Period	Year of Publication	No of Centres	Study Modality	Subgroups
Aromaa U	Finland	May 1987 – Dec 1993	1997	NR	R	A, O, ChP
Auroy Y	France	Jan 1994 – May 1994	1997	NR	P	A
Giebler RM	Germany	Jan 1983 – Aug 1988 (R) Sep 1988 – Dec 1994 (P)	1997	1	R & P (TEA)	A
Auroy Y	France	Aug 1998 – May 1999	2002	NR	P	A, O, P
Moen V	Sweden	Jan 1990 – Dec 1999	2004	85	R	A, O
Christie IW	UK	Jan 2000 – Dec 2005	2007	1	R	A
Cameron CM	Australia	Feb 1990 – Dec 2005	2007	1	P	A
Popping DM	Germany	Jan 1998 – Mar 2006	2008	1	R (LEA, TEA)	A, O
Katircioglu K	Turkey	Jan 1993 – Dec 2006	2008	1	R	O, G
Cook TM	UK	Sep 2006 – Mar 2008	2009	309	P	A, P, O, G

R: Retrospective **TEA:** Thoracic EAA **A:** Adults Perioperatively **ChP:** Chronic Pain **NR:** Not Reported
P: Prospective **No:** Number **O:** Obstetrics **P:** Paediatric **G:** Gynaecological

	EAA No	Overall Complications	Major Complications	Minor Complications
Aromaa U	170.000	28 cases 1.65 : 10.000 (1 : 6.072)	9 cases 0.52 : 10.000 1 : 18.904	19 cases 1.12 : 10.000 (1 : 8.947)
Auroy Y	30.413	NR	13 cases 4.27 : 10.000 1 : 2.340	NR
Giebler RM	4.185 (TEA)	129 cases 1 : 32 (3.1%)	55 cases 1 : 76 - 1.31%	29 cases (0.69%) 1 : 144
Auroy Y	35.379	NR	7 cases 1.98 : 10.000 1 : 5.054	NR
Moen V	450.000	NR	71 cases 1.58 : 10.000 1 : 6.338	NR
Christie IW	8.100	NR	12 cases 1 : 675	NR
Cameron CM	8.210	NR	8 cases 1 : 1.026	NR
Popping DM	14.223	5.334 cases (37.5%)	298 cases 2.1%	5.036 cases (35.4%)
Katircioglu K	34.285	NR	62 cases 1 : 553	NR
Cook TM	293.050	NR	23 cases 0.78 : 10.000 1 : 12.741	NR

	Haematoma	Abscess	Meningitis	Neurological Damage
Aromaa U	3 cases 0.17 : 10.000	2 cases 0.12 : 10.000	NR	4 cases 0.23 : 10.000
Auroy Y	none	none	none	6 cases – 1 permanent 1.97 : 10.000 95% CI: 0.4 – 3.6
Giebler RM	none	none	none	24 cases – all transient 0.57% max risk (%) at 95% CI: 0.8
Auroy Y	none	none	1 case 1.8 : 10.000 95% CI: 0.0 – 9.0	0 cases 95% CI: 0.0 – 0.5
Moen V	25 cases 0.55 : 10.000	12 cases 0.26 : 10.000	6 cases 0.13 : 10.000	8 cases – all permanent 0.17 : 10.000
Christie IW	3 cases 3.7 : 10.000	6 cases 7.4 : 10.000	3 cases 3.7 : 10.000	NR
Cameron CM	2 cases 2.4 : 10.000 95% CI: 0 – 6	6 cases 7.3: 10.000 95% CI: 1.5 – 13.5	NR	NR
Popping DM	3 cases 2.1 : 10.000	2 cases 1.4 : 10.000	1 case 0.7 : 10.000	66 cases – all transient 0.46%
Katircioglu K	none	none	none	7 cases – all transient 0.02%
Cook TM	5 cases 0.17 : 10.000	5 cases 0.17 : 10.000	none	8 cases – all permanent 0.28 : 10.000

Major complications of central neuraxial block: report on the Third National Audit Project of the Royal College of Anaesthetists†

T. M. Cook[1]*, D. Counsell[2] and J. A. W. Wildsmith[3] on behalf of The Royal College of Anaesthetists Third National Audit Project

NAP 3
Report and findings of the 3rd National Audit Project of the Royal College of Anaesthetists

Br J Anaesth 2009; **102**: 179–90

Prospective Survey: 293.050 cases, 1y, 309 NHS hospitals

Take Home Message from NAP3

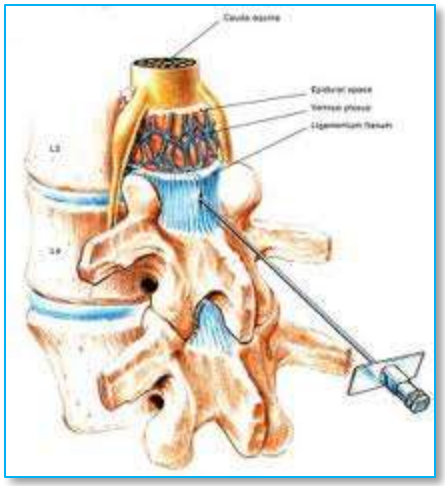
Pessimistic calculation values in events per 100.000 pts with 95% CI

- **permanent injury**
  - **after EAA (total) → 4.2 : 100.000 [2.9 – 6.1]**
  - **after EAA perioperatively → 17.4 : 100.000 [7.2 – 27.8]**
  - **after EAA in obstetrics → 0.6 : 100.000 [0 – 3.4]**
- **female, elderly → more exposed to danger**
- **CV collapse, wrong route injection error → still to be considered**

Epidural Anaesthesia – Analgesia Safety
complications' incidence in general

- **Epidural Haematoma**
  0.17 – 3.70 : 10.000
- **Epidural Abscess**
  0.12 – 7.40 : 10.000
- **Meningitis**
  0.13 – 3.70 : 10.000
- **Severe Neurologic Injury**
  0.17 – 1.97 : 10.000

- **Permanent Disability**
  0.82 – 1.7 : 10.000



Horlocker TT. Anesthesiol Clin North Am, 2000; 19: 461 – 485
Sorensen EJ. Reg Anesth Pain Med, 2008; 33: 442 – 448

EAA Safety – Complications:
Confusing Data & Discrepancy in Results

methodological aspects

- observation period: change in practice
- study type
  PR / RETRO / observational / case reports
- sample size
- general population / subpopulations of pts

differences in definition of severe complications

causation: uncertain

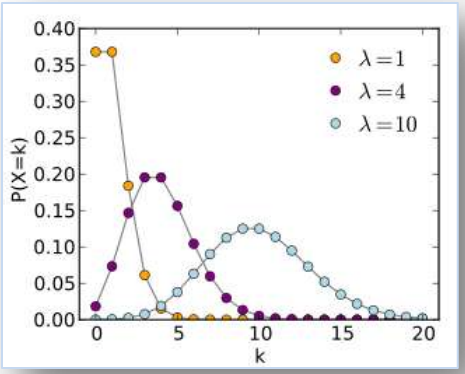
temporary / permanent disability: no clear distinction

underreporting / wrong case exclusion: risk underestimation

Horlocker TT. Anesthesiol Clin North Am, 2000; 19: 461 – 485
Sorensen EJ. Reg Anesth Pain Med, 2008; 33: 442 – 448
Fischer B. Reg Anesth Pain Med, 2010; 35: 545 – 548

Poisson's Law: Distribution of Rare Events

Statistical Model
In situations where the **Probability** of an event to occur is very low.
Opportunity for such occurrence is very high.



p = probability to observe «λ» events in a population of similar size

k = number of expected events

What does the Poisson's Law tell us?

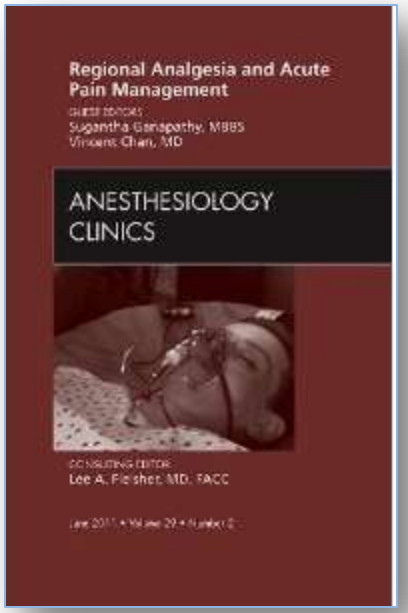
When an event has occurred in a sample size of «n» patients, the sample size associated with a 95% probability to have a new occurrence is «3n»

If no adverse event occurred in a population of «n» patients, it can only be concluded that the real incidence does not exceed «3 / n»

Beaussier M. ESRA Highlights 2010

Complications of Regional Anesthesia and Acute Pain Management

Terese T. Horlocker, MD



Anesthesiology Clin 29 (2011) 257–278
doi:10.1016/j.anclin.2011.04.006

anesthesiology.theclinics.com

EAA Complications

Exaggerated Physiologic Response

Drug Actions

- total spinal → 3 – 10 : 10.000
- severe hypotension (high block) → 0.9 – 3%
- respiratory depression → 0.13 – 0.4%
- cardiac arrest → 0.9 : 10.000
- allergic reactions
- inadvertent intrathecal or iv LAs
- drug errors
- LAs systemic toxicity → 0.01%

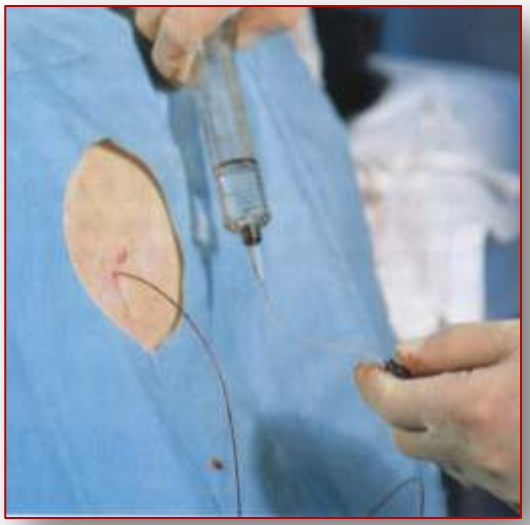
Twomey C, Tsui BCH. Complications of Epidural Blockade, 2007
Horlocker TT. Anesthesiology Clinics, 2011; 29: 257 – 278

EAA Complications

Inadvertent Injections – Drug Errors

How to Prevent

- aspiration
- test – dose
- incremental dosing
- vigilance
- skillful personnel
- dedicated team / block corner
- drug labeling
- specific epidural connectors
- specific locking adapters



withdraw catheter
go to another interspace

Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475
Horlocker TT. Anesthesiology Clinics, 2011; 29: 257 – 278

EAA Complications

Inadvertent Injections – Drug Errors

How to Prevent

NHS National Patient Safety Agency

- **Smiths Medical (Portex): Correct Inject©**
- **BBRAUN: Safe Connect©**
- **BD: ?**
- **Pajunk: ?**
- **Arrow: ?**

NAP 3
Report and findings of the 3rd National Audit Project of the Royal College of Anaesthetists

From 1 April 2013 all epidural, spinal (intrathecal) and regional anaesthesia infusions and bolus doses should be performed with devices with connectors that **will not** also connect with intravenous equipment.

EAA Complications

Insertion of Needle / Catheter in the Epidural Space (ES)

Presence of Catheter in the Epidural Space (ES)

- backache (2 – 30%)
- dural puncture (1 : 200, 0.32 – 1.23%)
- inadequate anaesthesia / bock failure (up to 1 : 2)
  catheter kinking, knotting, migration, shearing – off
- subdural block → 0.1 – 0.8%

- epidural haematoma
- infectious complications
  - meningitis
  - epidural abscess
- direct SC trauma

Horlocker TT. Eur J Pain Supplements, 2010; 4: 227 – 234
Horlocker TT. Anesthesiology Clinics, 2011; 29: 257 – 278
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

Backache

- common complaint: 2 – 30% pts
  multifactorial aetiology
- local inflammatory reaction
- posture / muscle spasm
- exaggerated lordosis / labour
- drug use, chloroprocaine – EDTA
- younger age / obesity
- pre – existing low back pain / relation to EAA ???
- alarming symptom!!!

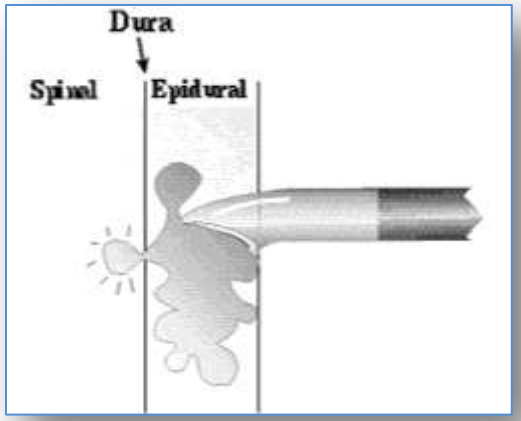
Twomey C, Tsui BCH. Complications of Epidural Blockade
In: Finnucane BT. Complications of Regional Anaesthesia, 2007

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

Accidental Dural Puncture

- 0.32 – 1.23%, PDPH ≥ 50% pts, subdural haematoma
  - younger ages, obstetrics



- in cervical – upper thoracic region
  - thinner ligamentum flavum
  - narrower ES
- no correlation with
  - needle design, identification technique
- correlation with needle diameter
- treatment: conservative, ITH catheter, morphine, blood patch

Rupasinghe M et al. Anaesth Int Care Med, 2004; 5: 273 – 274
Apfel CC et al. Br J Anaesth, 2010; 105: 255 – 263
Baysinger CL et al. J Clin Anaesth, 2011; 23: 349 – 360

Identification of epidural space (ES)

- hanging drop technique
- loss – of – resistance technique
- ultrasonography:

  better in description of dura matter
- fluoroscopy
- MRI, CT ES depth prediction
- electrical stimulation (paediatrics)
- ? learning curve
- ? cost

Tsui BC et al. Anesth Analg, 2001; 93: 1152 – 1155
Hayatsu K et al. Anesth Analg, 2001; 93: 1035 – 1039
Grau T et al. Anesthesist, 2003; 52: 68 – 73

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

Localization of Epidural Space

- **loss – of – resistance technique**
- **air versus saline**
- **evidence suggests liquid use**
- **air**
  - pneumoencephalus
  - SC root compression
  - post – epidural paraesthesia
  - venous air embolism

Shemonda PE et al. Reg Anesth Pain Med, 2003; 28: 48 – 53
Van de Valde M. Acta Anaesthesiol Belg, 2006; 57: 51 – 54
Schier R et al. Anesth Analg, 2009; 109: 2012 – 2021

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

Localization of Epidural Space

Loss – of – Resistance (LOR) technique

- In TEA: 50% no negative pressure
- classic «soccorex» glass syringe
- plastic, glass syringes
- «membrane – in – syringe»
- visual – audible confirmation
- «compass epidural assist»
- «episure» autodetect syringe
  - visual confirmation
  - precise force

Lin BC et al. Acta Anaesthesiol Sin, 2002; 40: 55 – 60
Lechner TJ et al. Anaesthesia, 2002; 57: 768 – 772

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

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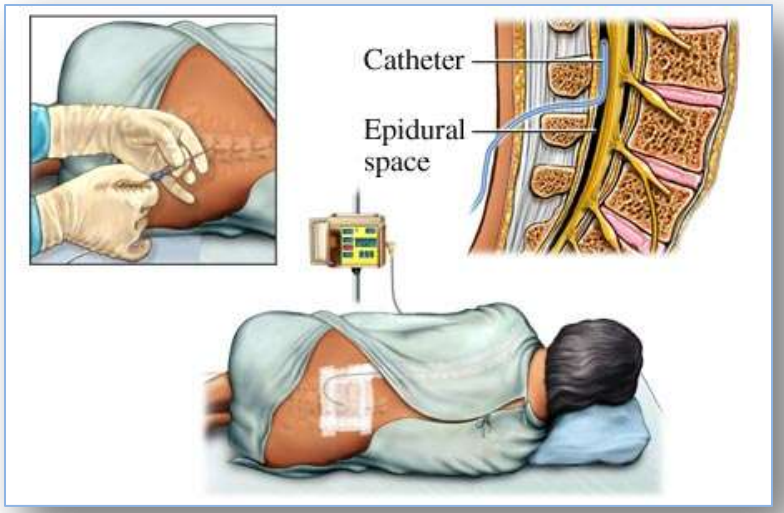
Lechner TJ et al. Anaesthesia, 2002; 57: 768 – 772

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

Block Failure

- failure rates
  - lumbar 27%
  - thoracic 2.5%, 6.9%, 32 – 50%
- catheter problems: 15%
  - migration 17%
  - not in epidural space 11%
  - infusate leakage 7%
  - unilateral block 7%
  - others ? 58%

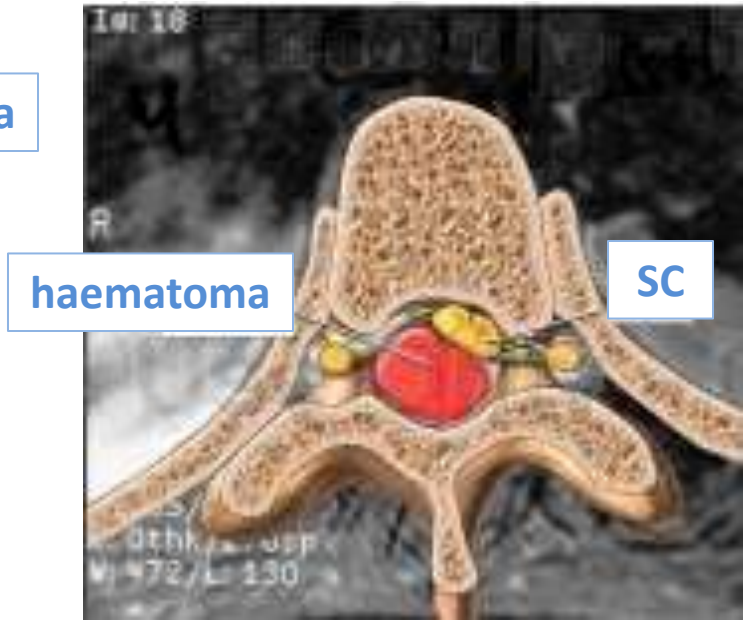


Ready LB et al. Reg Anesth Pain Med, 1999; 24: 499 – 505
Salvi L et al. Eur J Anaesthesiol, 2005; 22: 732 – 732
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475
Horlocker TT. Anesthesiology Clinics, 2011; 29: 257 – 278

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

Epidural Haematoma



Brief Review

Epidural anaesthesia and spinal haematoma

Hinnerk Wulf MD

CAN J ANAESTH 1996 / 43: 12 / pp 1260–71

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

Epidural Haematoma

- epidural vessels puncture → 3 – 12 % of attempts
- bleeding from epidural vein: usually self – limiting
- subsequent epidural haematoma: very rare
- may occur spontaneously
- atypical neurological signs – symptoms
- delay in diagnosis / treatment: paraplegia !!!
- true incidence: unknown

Vandermueler EP t al. Anesth Analg, 1994; 79: 1165 – 1177
Wulf H. Can J Anaesth, 1996; 43: 1260 – 1271
Horlocker TT et al. Reg Anesth Pain Med, 2010; 23: 95 – 116

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

Epidural Haematoma

- **13 : 850.000** [Tryba M, 1993, 1997, 1998]

  calculated incidence

- **1 : 143.000** [Vandermueler EP, 1994]
- **1 : 190.000** [Wolf H, 1996]
- **less than 1 : 150.000** [Horlocker TT, 2003]
- **? overestimated risk: based on upper limit of 95% CI**
- **? calculations before routine thromboprophylaxis**
- **recent data: ↑ risk, 15 – fold if precautions are not taken**
- **better reporting, new antithrombotics, ↑ EAA application**
- **at catheter removal**

Gogarten W et al. Eur J Anaesthesiol, 2010; 27: 999 – 1015
Horlocker TT et al. Reg Anesth Pain Med, 2010; 23: 95 – 116

EAA Complications

Insertion – Presence of Needle or Catheter in the Epidural Space

Epidural Haematoma – Incidence

- calculated incidence

  1 : 2.700 to 1 : 19.505 pts [Moen V, 2004]
  [Cameron CM, 2007]
  [Christie IW, 2007]
  [Popping DM, 2008]
  [Cook T, 2009]

- under LMWH [Schroeder DR, 1998]

  1 : 6.600 → single – shot epidural

  1 : 3.100 → epidural catheter

- lumbar versus thoracic EAA [Popping DM, 2008]

  lumbar EAA → 1 : 1.341

  thoracic EAA → 1 : 10.199

Choi S, Brull R. Anesth Analg, 2009; 109: 648 – 660
Gogarten W et al. Eur J Anaesthesiol, 2010; 27: 999 – 1015
Horlocker TT et al. Reg Anesth Pain Med, 2010; 23: 95 – 116

Severe Neurological Complications after Central Neuraxial Blockades in Sweden 1990–1999

Vibeke Moen, M.D., Nils Dahlgren, M.D., Ph.D.,† Lars Irestedt, M.D., Ph.D.‡*

Anesthesiology 2004; 101:950–9

- **retrospective analysis – serious complications – 10y period**
- **85 anaesthesia departments**
- **450.000 epidurals, including 200.000 for labour**
- **25 cases after EAA**

	EB	CSE
Spinal hematoma	21 (7/14)	4 (1/3)
Cauda equina syndrome	8 (4/4)	4 (0/4)
Purulent meningitis	5 (1/4)	1 (0/1)
Epidural abscess	12 (5/7)	
Traumatic cord lesion	8 (3/5)	
Cranial subdural hematoma	3 (1/2)	
Paraparesis	3 (1/2)	
Other	2 (0/2)	
Total	62 (22/40)	9 (1/8)

The number of males/females is in parentheses.
CSE = combined spinal epidural blockade; EB = epidural blockade; SB = spinal blockade.
Spinal hematoma followed thoracic EB in eight cases and lumbar EB or CSE in 17 cases.

Haematoma Incidence

1 : 18.000 [0.55 : 10.000]
in general

BUT

1 – 2 : 200.000
in obstetrics (labour)
1 : 10.300
in non – obstetric population

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Anesthesiology 2004; 101:950–9

- **older patients > 70 years of age**
- **at greater risk**

Table 5. Spinal Hematoma, Spinal Stenosis, and Cauda Equina Syndrome Related to Age

	Patient age					
	≤50	50–59	60–69	70–79	≥80	All
Spinal hematoma	**4 (1/3)***	**4 (3/1)**	**4 (2/2)**	**11 (3/8)**	**10 (0/10)**	**33 (9/24)**
Paraparesis and spinal stenosis	**1 (0/1)†**	**1 (0/1)‡**	**–**	**1 (1/0)**	**1 (1/0)**	**4 (2/2)**
Cauda equina syndrome, all cases	**8 (4/4)**	**8 (7/1)**	**3 (2/1)**	**7 (2/5)**	**6 (3/3)**	**32 (18/14)**
Pre-existing spinal stenosis	–	–	2 (1/1)	5 (0/5)	2 (1/1)	9 (2/7)
Local anesthetic neuronal toxicity	8 (4/4)	8 (7/1)	1 (1/0)	2 (2/0)	4 (2/2)	23 (16/7)
Total	**13**	**13**	**7**	**19**	**17**	**69**

Severe Neurological Complications after Central Neuraxial Blockades in Sweden 1990–1999

Vibeke Moen, M.D., Nils Dahlgren, M.D., Ph.D.,† Lars Irestedt, M.D., Ph.D.‡*

Anesthesiology 2004; 101:950–9

- highest percentages
- female, orthopaedic surgery → 1 : 3.600 pts
- ? intense thromboprophylaxis

Table 8. Cases and Incidences of Spinal Hematoma

	Epidural Blockade Including CSE			
	Patients (× 1000)		Cases and Incidence	
	M	F	M	F
Knee arthroplasty	9	18	1 **[0–6]** 1:9 000	5* **[2–12]** 1:3 600
Hip arthroplasty	14	29	–	1 **[0–6]** 1:29 000
Total (M/F)	450		25 (8/17)	

Major complications of epidural analgesia after surgery: results of a six-year survey

I. W. Christie[1] and S. McCabe[2]

Anaesthesia, 2007, **62**, pages 335–341

Table 1 Details of surgical procedures and epidural techniques. Values are number of patients.

	Abscess/ meningitis $n = 9$	Haematoma $n = 3$
Laparotomy, thoracic epidural	6	3
Joint replacement, lumbar epidural	3	0
Sedated or anaesthetised for insertion		
Sedated	5	0
Anaesthetised	4	3
Loss of resistance		
Air	4	2
Saline	5	1
Difficult insertion		
Yes	2	1
No	7	2
Dressing		
Transparent	5	3
Gauze	4	0
Epidural solution		
50-ml syringe	9	2
500-ml bag	0	1

- retrospective study
- single center
- between 2000 – 2005
- 8.100 pts
- 3 cases of haematoma
  - TEA
  - 1 : 2.700 pts
- all in anaesthetized pts

Cardiothoracic Surgery – High TEA
Risk of Epidural Haematoma

- risk after full / half dose heparinization probably higher
- mathematical model
- calculated risk zero occurrence / 4.582 cases up to 1999

Minimum – Maximum Risk

- 1:1.500 (1:1.528) up to 1:150.000 (95% CI)
- 1:1.000 up to 1:250.000 (99% CI)

Chaney MA. Anesth Analg, 1997; 84: 1211 – 1221
Ho AMH et al. Chest, 2000; 117: 551 – 555
Castellano JM, Durbin CG. Chest, 2000; 117: 305 – 307
Ho AMH et al. Anesth Analg, 2006; 103: 1327 – 1328

If Nothing Goes Wrong, Is Everything All Right? Interpreting Zero Numerators

James A Hanley, Abby Lippman – Hand

JAMA, 1983; 249 (13): 1743 – 1745

- some case reports of EH
- after 2000
- with or without epidural instrumentation

Rosen DA et al. Anesth Analg, 2004; 98: 966 – 969
UK Medical Protection Society. Case Book, 2004
Imanaka K et al. Intensive Care Med, 2000; 26: 826
Yoshinaga A et al. Masui, 2004; 53: 551 – 554
Sharma S et al. J Cardiothorac Vasc Anesth, 2004; 18: 759 – 762
Li PTY, Ho AMH. SCA Newsletter, 2005; Vol 4, No 5
Ho AMO, Li PTY, Karmakar MJ. Anesth Analg, 2006; 103: 1327
Epidural Emergency. South East Asia Case Book, Medical Protection Society, 2004: 19 – 20
Nakaya M et al. Nippon Kyobu Geka Gakkai Zasshi, 1992; 40: 1764 – 1766

Risk of Epidural Haematoma – EH

- danger overestimated
- comparable to risk of non – obstetric population
- comparable to risk of receiving wrong blood
- comparable to risk of fatal road accident
- 10 times ↓ than risk of dying by human error in ICU
- 100 times ↓ than risk of death after CEA under GA

- 12.000 published cases of High TEA in cardiac surgery
- true risk 1: 12.000
- estimated / calculated risk 1: 2.100 to 1: 68.000 (95% CI)

Bracco D, Hemmerling T. Heart Surg Forum, 2007; 10: E334 – E 337
Scott NB et al. Anesthesiology, 2006; 105: 853
Ruppen W et al. BMC Anesthesiology, 2006; 6: 10
Jack ES, Scott NB. Acta Anaesthesiol Scand, 2007; 51: 722 – 725

Royse CF et al. Anesth Intensive Care, 2007; 35: 374 – 377
Bracco D et al. Heart Surg Forum, 2007; 10: E499 – E458
Chaney MA. Annals of Cardiac Anaesthesia, 2009; 12:1
Royse CF. Curr Opin Anaesthesiol, 2009; 22: 84 – 87

Table 1 Risk factors associated with spinal hematoma

Procedure related	Hemorrhagic puncture
	Multiple punctures
	Catheter removal
	Catheter insertion during general anesthesia
Patient related	Advanced age (>75 years)
	Female sex
	Ankylosing spondylitis (Morbus Bechterew)
	Spinal column abnormalities
	Renal insufficiency
	Known or unknown coagulopathy (including thrombocytopenia)
Drug related[a]	Anticoagulant therapy
	Antiplatelet agents: clopidogrel, ticlopidine
	Aspirin dose >300 mg/day
	Dual anticoagulant/antiplatelet therapy
	Fibrinolytic therapy

Llau JV, Ferrandis R. Curr Opin Anaesthesiol, 2009; 22: 661 – 666

TABLE 8. Patient, Anesthetic, and LMWH Dosing Variables Associated With Spinal Hematoma

Patient factors
Female sex
Increased age
Ankylosing spondylitis or spinal stenosis
Renal insufficiency
Anesthetic factors
Traumatic needle/catheter placement
Epidural (compared with spinal) technique
Indwelling epidural catheter during LMWH administration
LMWH dosing factors
Immediate preoperative (or intraoperative) LMWH administration
Early postoperative LMWH administration
Concomitant antiplatelet or anticoagulant medications
Twice-daily LMWH administration

Horlocker TT, et al. Reg Anesth Pain Med, 2010; 35: 64 – 101

EAA and Anti – Thrombotic Drugs

First Recommendations – Practice Guidelines

Gogarten W et al, 1997

Horlocker TT et al, 1998

Anonymous, 2000

Llaou JV et al, 2001

EAA and Anti – Thrombotic Drugs

ASRA Recommendations – Practice Guidelines

Regional Anesthesia in the Anticoagulated Patient: Defining the Risks (The Second ASRA Consensus Conference on Neuraxial Anesthesia and Anticoagulation)

Terese T. Horlocker, M.D., Denise J. Wedel, M.D., Honorio Benzon, M.D., David L. Brown, M.D., F. Kayser Enneking, M.D., John A. Heit, M.D., Michael F. Mulroy, M.D., Richard W. Rosenquist, M.D., John Rowlingson, M.D., Michael Tryba, M.D., and Chun-Su Yuan, M.D., Ph.D.

2003

ASRA Practice Advisory

Regional Anesthesia in the Patient Receiving Antithrombotic or Thrombolytic Therapy

American Society of Regional Anesthesia and Pain Medicine Evidence-Based Guidelines (Third Edition)

Terese T. Horlocker, MD, Denise J. Wedel, MD,* John C. Rowlingson, MD,† F. Kayser Enneking, MD,‡ Sandra L. Kopp, MD,* Honorio T. Benzon, MD,§ David L. Brown, MD,|| John A. Heit, MD,* Michael F. Mulroy, MD,¶ Richard W. Rosenquist, MD,# Michael Tryba, MD,** and Chun-Su Yuan, MD, PhD††*

2010

EAA and Anti – Thrombotic Drugs

ASRA Practice Advisory – Practice Guidelines

- consensus statements
- collective experience of recognized experts
- recommendations on EAA and each drug separately
- differences in practice between countries
- issue complexity
- «cookbook» approach: not appropriate
- decisions individualized
- complete elimination of haematoma risk: impossible
- 13% of pts: no identifiable risk factors
- prevention
- neurologic monitoring / early evaluation / vigilance
- diagnosis / treatment

Vandermueler EP t al. Anesth Analg, 1994; 79: 1165 – 1177
Horlocker TT et al. Reg Anesth Pain Med, 2010; 23: 64 – 101

EAA and Anti – Thrombotic Drugs

ASRA Practice Advisory – Practice Guidelines

Practice Differences among Countries – Continents

- fibrinolytics, UFH, anti-PLTs: similar attitude
- LMWH: ASRA more conservative
  - epidural catheter + single-day dose: safe in Europe, ACCP
  - EAA at least 12h after (20h France, 10h US)
  - subsequent LMWH after catheter removal: 4h (Europe), 2h (US)
  - subsequent LMWH dose: 6h after surgery (France)
  - anti-PLT co-administration (Europe):
    last LMWH 24h before puncture or catheter removal
- fondaparinux
  - Germany: allows indwelling epidural catheter
  - ASRA, Belgium: contrindication
- direct thrombin inhibitors
  - Europe: support continuous EAA
  - ASRA: relative contraindication

Samama CM et al. Eur J Anaesthesiol, 2006; 23: 95 – 116
Rosencher N et al. Anaesthesia, 2007; 62: 1154 – 1160
Horlocker TT et al. Reg Anesth Pain Med, 2010; 23: 95 – 116

EAA and Anti – Thrombotic Drugs

ESA Recommendations – Practice Guidelines

GUIDELINES

Regional anaesthesia and antithrombotic agents: recommendations of the European Society of Anaesthesiology

Wiebke Gogarten, Erik Vandermeulen, Hugo Van Aken, Sibylle Kozek, Juan V. Llau and Charles M. Samama

Eur J Anaesthesiol 2010;27:999–1015

- National / International Societies Guidelines do not always have universal acceptance
- To overcome deficiencies and applicability, ESA has taken the initiative to provide current and comprehensive Guidelines for the continent as a whole

GUIDELINES

Regional anaesthesia and antithrombotic agents: recommendations of the European Society of Anaesthesiology

Wiebke Gogarten, Erik Vandermeulen, Hugo Van Aken, Sibylle Kozek, Juan V. Llau and Charles M. Samama

Eur J Anaesthesiol 2010;27:999–1015

- optimize safety and efficacy of thromboprophylaxis during EAA
- drug – specific recommendations
- based on pharmacokinetics – pharmacodynamics
- time to reach maximal concentration
- time to reach maximal antithrombotic activity
- half – life
- dose regimen
- thrombosis prophylaxis rather than therapeutic anticoagulation

Table 2 Recommended time intervals before and after neuraxial puncture or catheter removal[a]

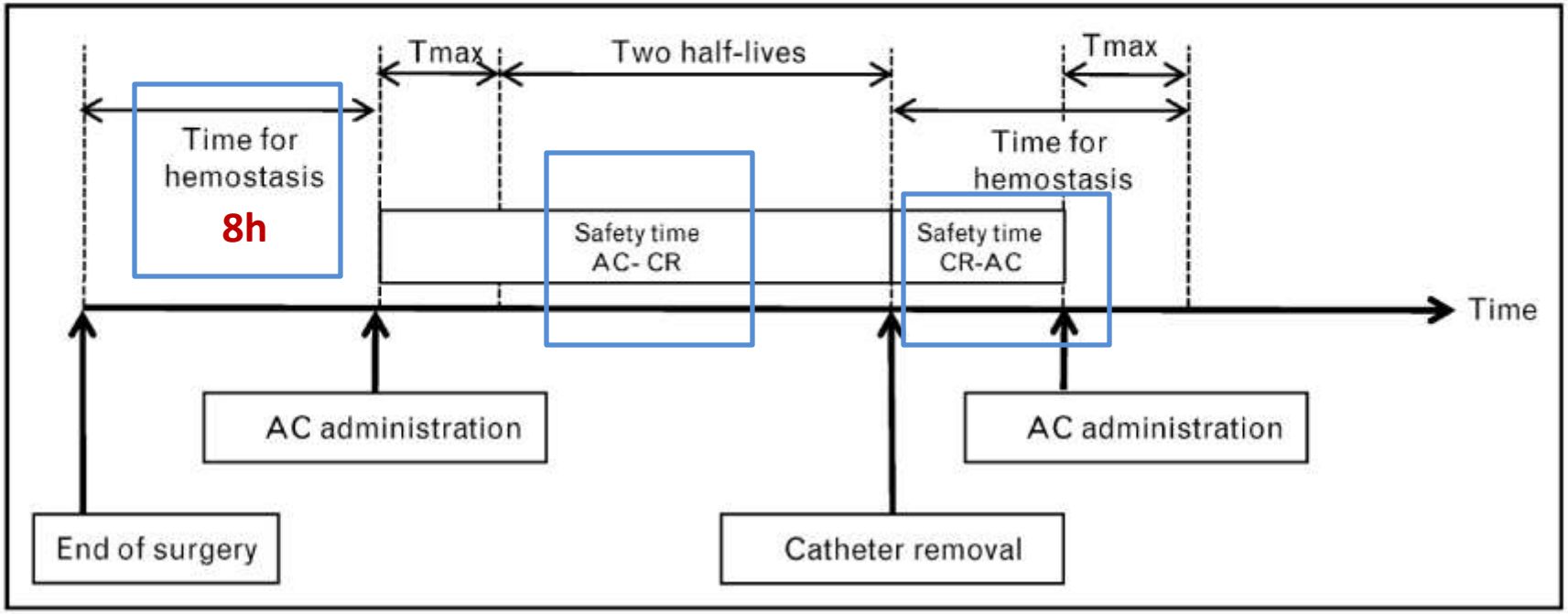
Time Intervals:
for normal renal and hepatic function

	Time before puncture/catheter manipulation or removal	Time after puncture/catheter manipulation or removal
Unfractionated heparins (for prophylaxis, ≤15 000 IU per day)	4-6 h	1 h
Unfractionated heparins (for treatment)	i.v. 4–6 h	1 h
	s.c. 8–12 h	1 h
Low-molecular-weight heparins (for prophylaxis[b])	12 h	4 h
Low-molecular-weight heparins (for treatment)	24 h	4 h
Fondaparinux (for prophylaxis, 2.5 mg per day)	36–42 h	6–12 h
Rivaroxaban (for prophylaxis, 10 mg q.d.)	22–26 h	4–6 h
Apixaban (for prophylaxis, 2.5 mg b.i.d.)	26–30 h	4–6 h
Dabigatran (for prophylaxis, 150–220 mg)	Contraindicated according to the manufacturer	6 h
Coumarins	INR ≤1.4	After catheter removal
Hirudins (lepirudin, desirudin)	8–10 h	2–4 h
Argatroban[c]	4 h	2 h
Acetylsalicylic acid	None	None
Clopidogrel	7 days	After catheter removal
Ticlopidine	10 days	After catheter removal
Prasugrel	7–10 days	6 h after catheter removal
Ticagrelor	5 days	6 h after catheter removal
Cilostazol[c]	42 h	5 h after catheter removal
NSAIDs	None	None

Gogarten W, et al. Eur J Anaesthesiol, 2010; 27: 999 – 1015

VanderMueler E. Best Pract Res Clin Anaesthesiol, 2010; 24: 121 – 131

Figure 2 Recommendations for managing the catheter based on the pharmacokinetics of the anticoagulant (see text)



AC: anticoagulant
CR: catheter removal

Llaou JV, Ferrandis R. Curr Opin Anaesthesiol, 2009; 22: 661 – 666

Table 2 Recommended time intervals before and after neuraxial puncture or catheter removal[a]

	Laboratory tests
Unfractionated heparins (for prophylaxis, ≤15 000 IU per day)	Platelets during treatment for more than 5 days
Unfractionated heparins (for treatment)	aPTT, ACT, platelets
Low-molecular-weight heparins (for prophylaxis[b])	Platelets during treatment for more than 5 days
Low-molecular-weight heparins (for treatment)	Platelets during treatment for more than 5 days
Fondaparinux (for prophylaxis, 2.5 mg per day)	(anti-Xa, standardised for specific agent)
Rivaroxaban (for prophylaxis, 10 mg q.d.)	(PT, standardised for specific agent)
Apixaban (for prophylaxis, 2.5 mg b.i.d.)	?
Dabigatran (for prophylaxis, 150–220 mg)	?
Coumarins	INR
Hirudins (lepirudin, desirudin)	aPTT, ECT
Argatroban[c]	aPTT, ECT, ACT
Acetylsalicylic acid	
Clopidogrel	
Ticlopidine	
Prasugrel	
Ticagrelor	
Cilostazol[c]	
NSAIDs	

Gogarten W, et al. Eur J Anaesthesiol, 2010; 27: 999 – 1015

VanderMueler E. Best Pract Res Clin Anaesthesiol, 2010; 24: 121 – 131

Table 1
Summary of recommended minimum time intervals or clotting times before and after central neuraxial needle/catheter insertion and withdrawal of catheters (only valid for patients with normal renal function).

	Before insertion/withdrawal	After insertion/withdrawal
LMWH (prophylactic)	12 h Platelet count if LMWH > 5 days	2–4 h
LMWH (therapeutic)	24 h Platelet count if LMWH > 5 days	2–4 h
UH (therapeutic)	aPTT or ACT within normal range Platelet count if LMWH > 5 days	1 h
Danaparoid	Neuraxial anaesthesia not to be used	Neuraxial anaesthesia not to be used
Fondaparinux	36 h	12 h
Rivaroxaban[a]	At least 20 h	6 h
Vitamine K antagonists	4–10 days[b] and PT ≥ 50% or INR ≤ 1.4	Immediately
Ticlopidine	10 days	Immediately
Clopidogrel	7 days	Immediately
Prasugrel[a]	At least 7 days	8 h
Eptifibatide/tirofiban	8–10 h and platelet count aPTT or ACT within normal range	2 – 4 h
Abciximab	24–48 hours and platelet count aPTT or ACT within normal range	2 – 4 h
Lepirudine	8–10 h aPTT or ECT within normal range	2 – 4 h
Bivalirudine	8–10 h aPTT or ECT within normal range	2–4 h
Argatroban	4 h PiCT, aPTT, ACT or ECT within normal range	2 h
Dabigatran[a]	Neuraxial anaesthesia contraindicated	Neuraxial anaesthesia contraindicated

VanderMueler E. Best Pract Res Clin Anaesthesiol, 2010; 24: 121 – 131

Table 2
Laboratory investigations and neuraxial techniques.

	Without problems	After individual evaluation
Prothrombin Time (PT) Activated Partial Thromboplastin Time (aPTT)	> 50% (INR ≤ 1.4) upper limit of normal[b]	40–50% (INR 1.41–1.7) exceeding upper limit of normal by 1–4 sec[b]
Platelet count	>80,000/μl	50,000–80,000/μl

[b] Normal values depend on assay used locally in each hospital

VanderMueler E. Best Pract Res Clin Anaesthesiol, 2010; 24: 121 – 131

GUIDELINES

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Eur J Anaesthesiol 2010;27:999–1015

- avoid traumatic puncture
- presence of blood during needle puncture / catheter threading: does not necessitate postponement of surgery
- if blood tap occurs when intraoperative anticoagulation is planned: postponing surgery should be considered
- alternatively, catheter placement the night before
- anticoagulant therapy: delayed 24h if bleeding is observed

GUIDELINES

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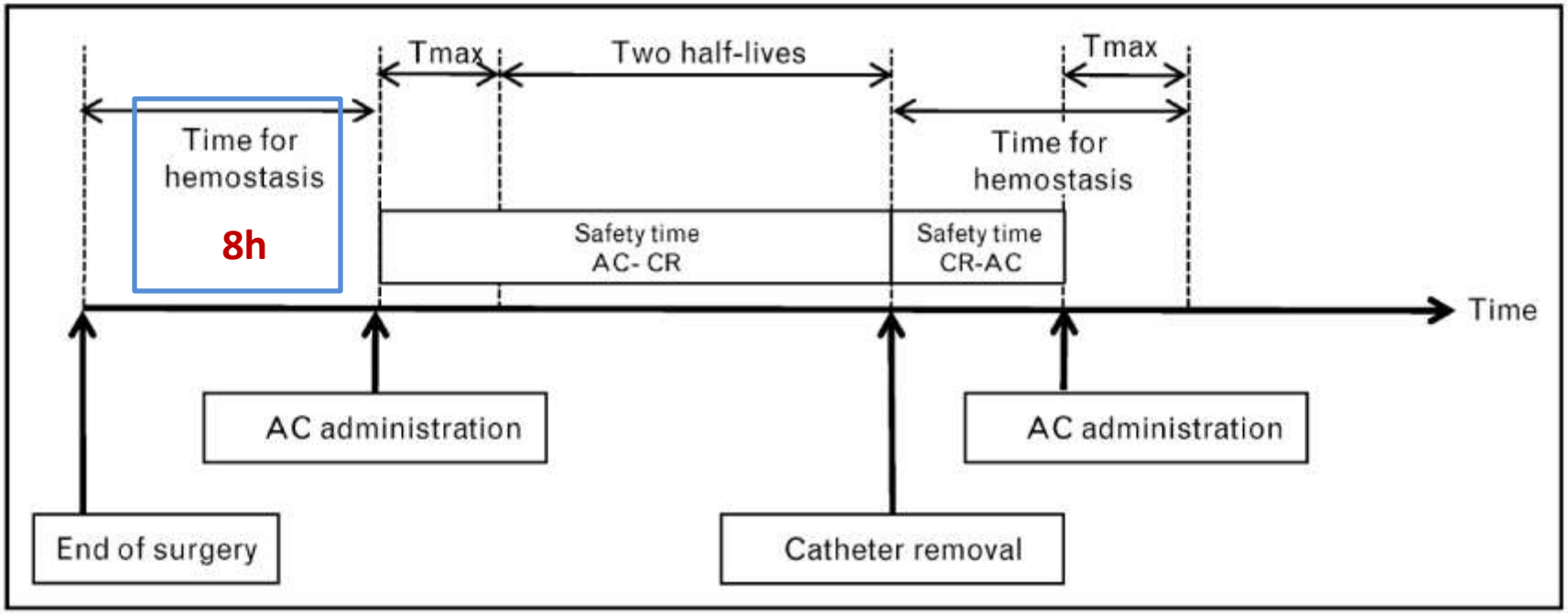
Eur J Anaesthesiol 2010;27:999–1015

- no «cookbook» approach
- complete elimination of haematoma risk: impossible
- 13% of cases: no identifiable risk factors
- preoperative anticoagulation: not always required for efficacy
- EAA: relative contraindication during full anticoagulation
- concomitant administration of drugs altering haemostasis: ↑ risk
- neurologic monitoring perioperatively: mandatory
- strict adherence to time intervals: ↓ risk of haematoma

Figure 2 Recommendations for managing the catheter based on the pharmacokinetics of the anticoagulant (see text)

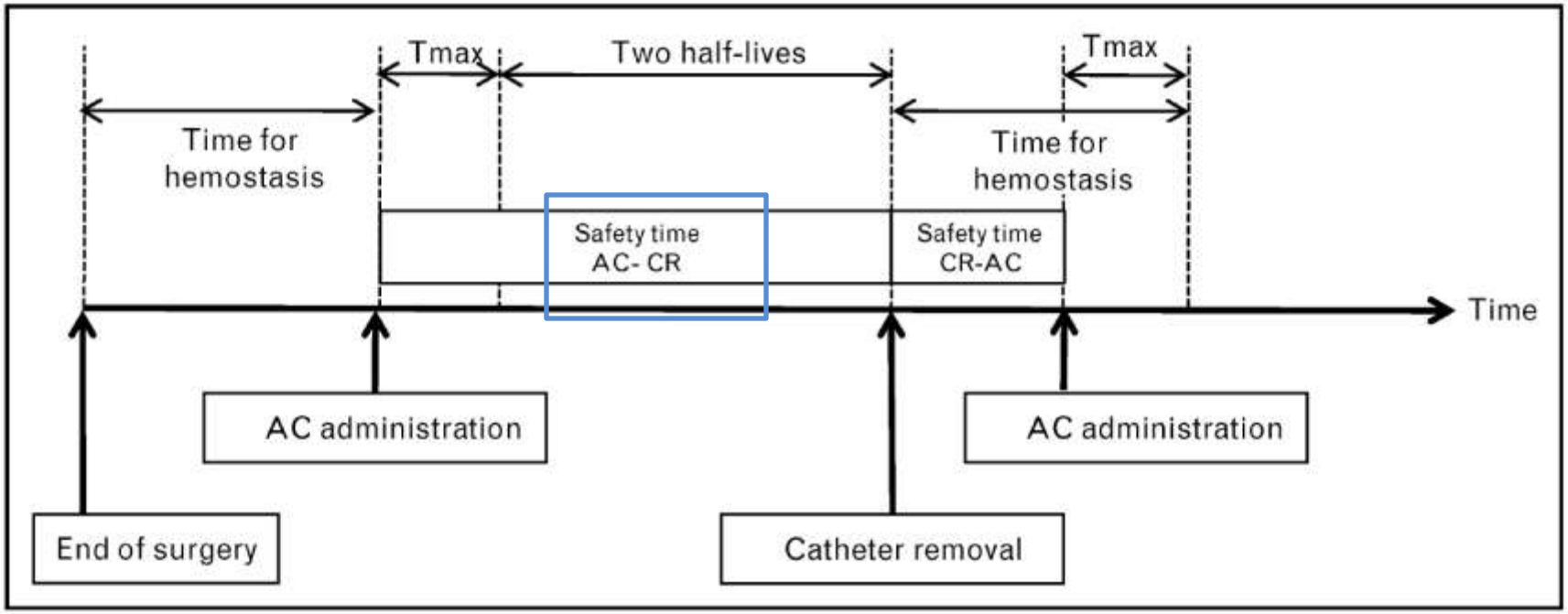


AC: anticoagulant
CR: catheter removal

Haemostasis Time
The 1st dose of AC after EAA must be administered so as to ensure an interval of at least 8h between end of surgery and AC peak plasma level

Llaou JV, Ferrandis R. Curr Opin Anaesthesiol, 2009; 22: 661 – 666

Figure 2 Recommendations for managing the catheter based on the pharmacokinetics of the anticoagulant (see text)

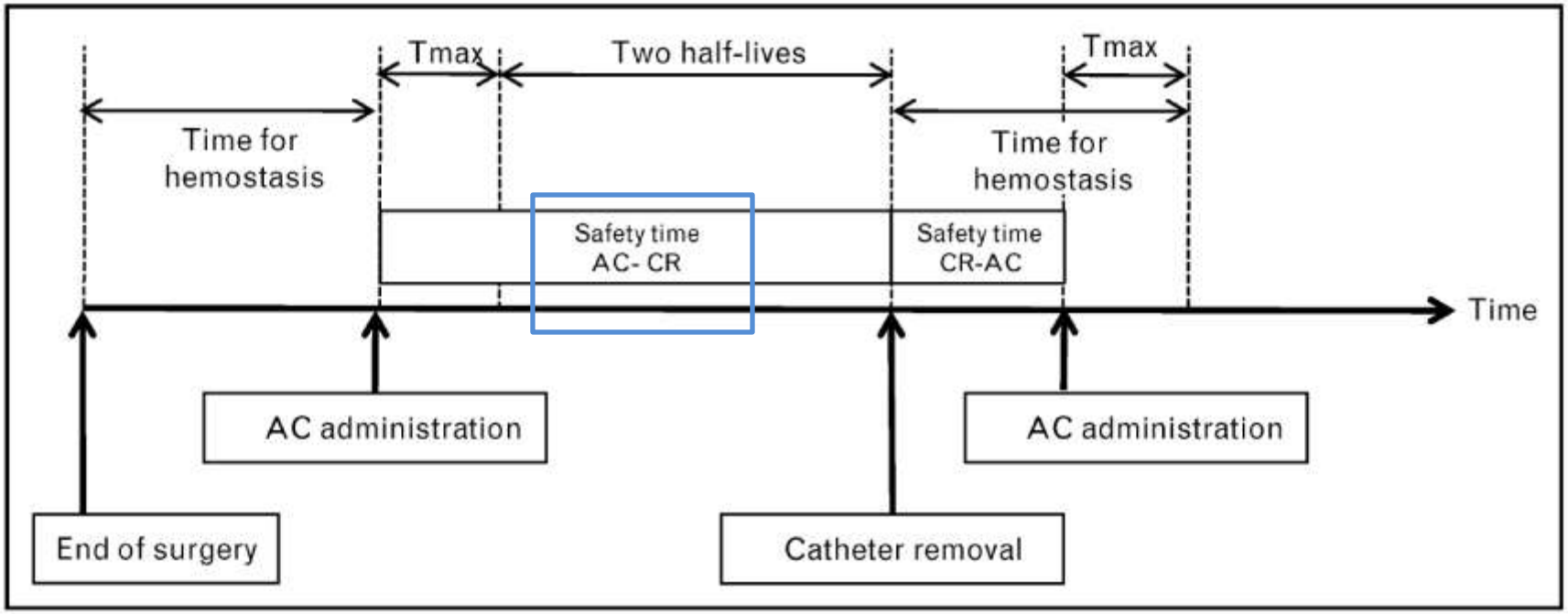


AC: anticoagulant
CR: catheter removal

Safety Time AC – CR
Catheter removal / manipulation must be delayed by an interval of at least two half – lives of AC following the last peak plasma level. At this time, only 25% of circulating AC remains, offering optimal risk – benefit ratio.

Llaou JV, Ferrandis R. Curr Opin Anaesthesiol, 2009; 22: 661 – 666

Figure 2 Recommendations for managing the catheter based on the pharmacokinetics of the anticoagulant (see text)

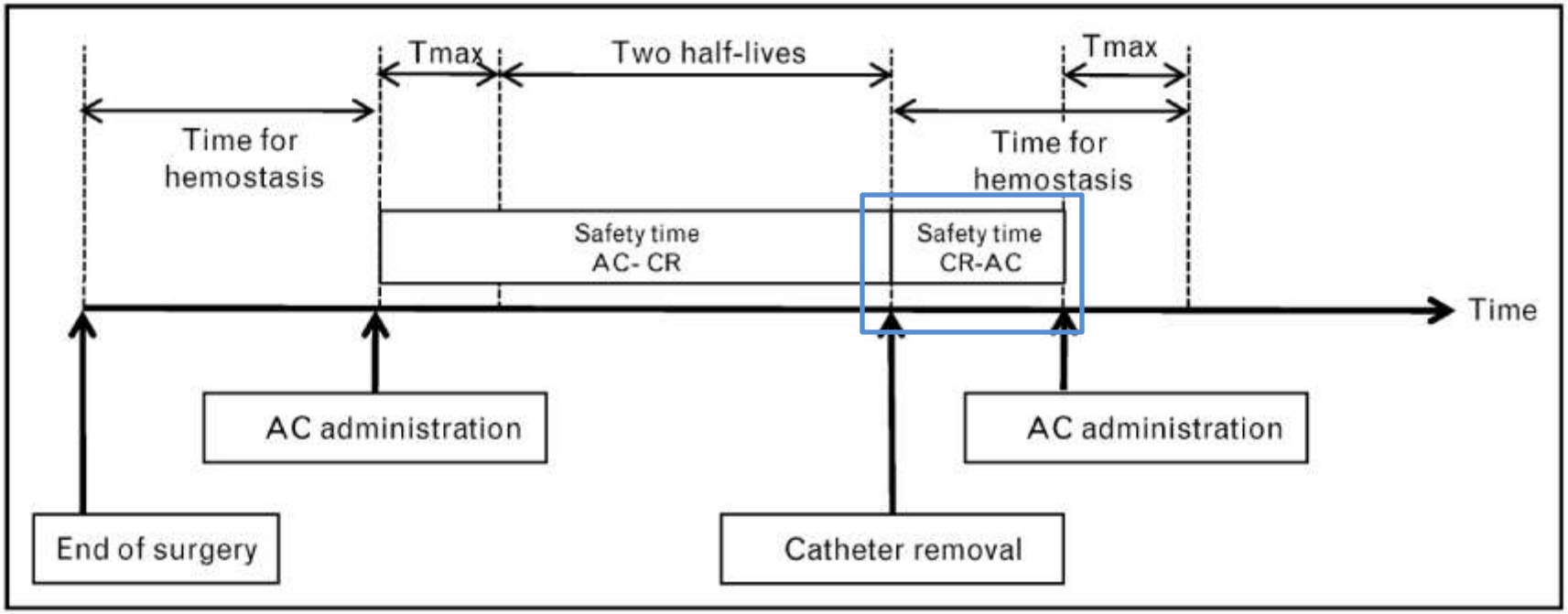


AC: anticoagulant
CR: catheter removal

Safety Time AC – CR
Elimination slows considerably and waiting longer decreases residual AC concentration only slightly. An obvious limitation is the slight residual AC activity, but it seems a reasonable compromise between risk of haematoma / thrombosis

Llaou JV, Ferrandis R. Curr Opin Anaesthesiol, 2009; 22: 661 – 666

Figure 2 Recommendations for managing the catheter based on the pharmacokinetics of the anticoagulant (see text)



AC: anticoagulant
CR: catheter removal

Safety Time CR – AC
Next AC administration must be delayed by a period calculated from haemostasis time minus peak plasma level of the drug.
The longer the peak level, the shorter the time delay.

Llaou JV, Ferrandis R. Curr Opin Anaesthesiol, 2009; 22: 661 – 666

Cardiothoracic Surgery – High TEA
Epidural Haematoma

- Epidurals: Excessive harm?
  - 477 pts need to be treated to save a life
  - 5000 pts need to be treated to harm

- **Incidents underreported???**
- **Paraplegia:** still catastrophic complication

Li PTY, Ho AMH. SCA Newsletter, October, 2005
Wijeysundera DN et al. Lancet, 2008; 372: 562 – 569
Royse CF. Curr Opin Anaesthesiol, 2009; 22: 84 – 87

Cardiothoracic Surgery – High TEA
Epidural Haematoma

Minimizing Risk of Epidural Haematoma – EH
Guidelines Adherence for Application

- catheter removal: reasonable haemostatic conditions
- laboratory evidence
- bloody tap (3 – 4%): 24h delay of surgery

Li PTY, Ho AMH. SCA Newsletter, October, 2005
Wijeysundera DN et al. Lancet, 2008; 372: 562 – 569
Royse CF. Curr Opin Anaesthesiol, 2009; 22: 84 – 87

EAA and Epidural Haematoma

Lessons learned from large Cohort studies & Reviews

Take Home Message

- **Follow Guidelines – Recommendations in pts submitted to EAA**
- **Consider the risk of doing EAA in surgery associated with perioperative blood disorders (vascular, cardiac, orthopaedics)**
- **Consider the particular risk in elderly who will need aggressive thromboembolic prevention perioperatively**

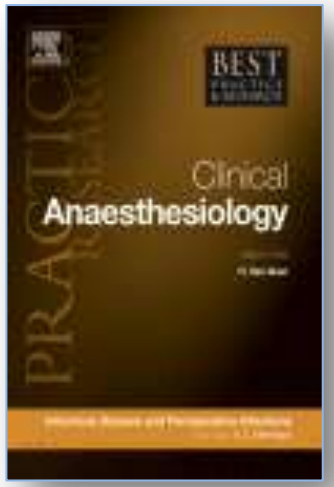
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

Gogarten W, et al. Eur J Anaesthesiol, 2010; 27: 999 – 1015

VanderMueler E. Best Pract Res Clin Anaesthesiol, 2010; 24: 121 – 131

ELSEVIER

Best Practice & Research Clinical Anaesthesiology
Vol. 22, No. 3, pp. 451–475, 2008



4

Infectious complications of regional anesthesia☆

Terese T. Horlocker* M.D.
Professor of Anesthesiology and Orthopedics

Denise J. Wedel M.D.
Professor of Anesthesiology
College of Medicine, Mayo Clinic, Rochester, MN 55905, USA

- meningitis
- arachnoiditis
- epidural abscess

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

Infectious Complications

- **<u>in the past:</u> extremely low frequency**
- **<u>nowadays:</u> recent epidemiological data are alarming**
- **usually bacterial infection**
- **endogenous source**
  - distant colonization / local infection
  - haematogenous spread / CNS invasion
- **exogenous source**
  - contaminated equipment – drugs
  - break in aseptic technique / skin flora
  - ascending infection to ES

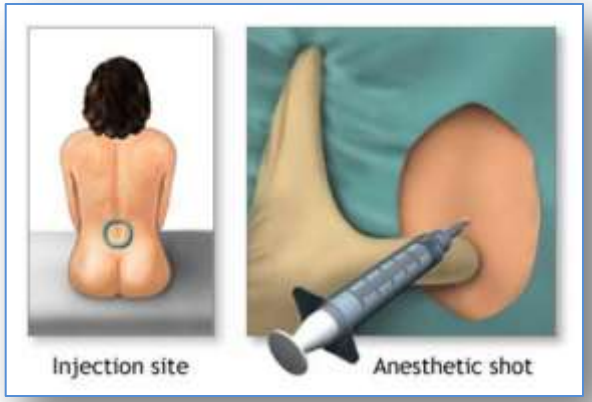
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475
Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

Infectious Complications

- meningitis (if dura is breached)
- arachnoiditis
- epidural abscess → SC compression



- common cause of neuraxial injury claims
- especially in obstetric population
- our own actions may affect occurrence
- idiosyncratic nature

Cameron CM, et al. Anestehsiology, 2007; 106: 997 – 1002
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475
Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52

EAA Infectious Complications

Meningitis

- very rare but serious complication (mortality 30%) !!!

1 : 14.223	0.70 : 10.000	Popping DM et al, 2009
6 : 450.000	0.13 : 10.000	Moen V et al, 2004
1 : 5.561	1.80 : 10.000	Auroy Y et al, 2002
3 : 8.100	3.70 : 10.000	Christie IW et al, 2007

- healthy pts / uncomplicated technique
- with – without localized epidural abscess
- **dural puncture:** important risk factor
- **puncture site contamination:** aerosolized mouth particles

  a – haemolytic streptococcus: dominant microorganism (nosocomial origin)
- **skin bacteria:** contribution to a lesser extent
- presentation similar to PDPH / no postural component / ± fever, rigidity

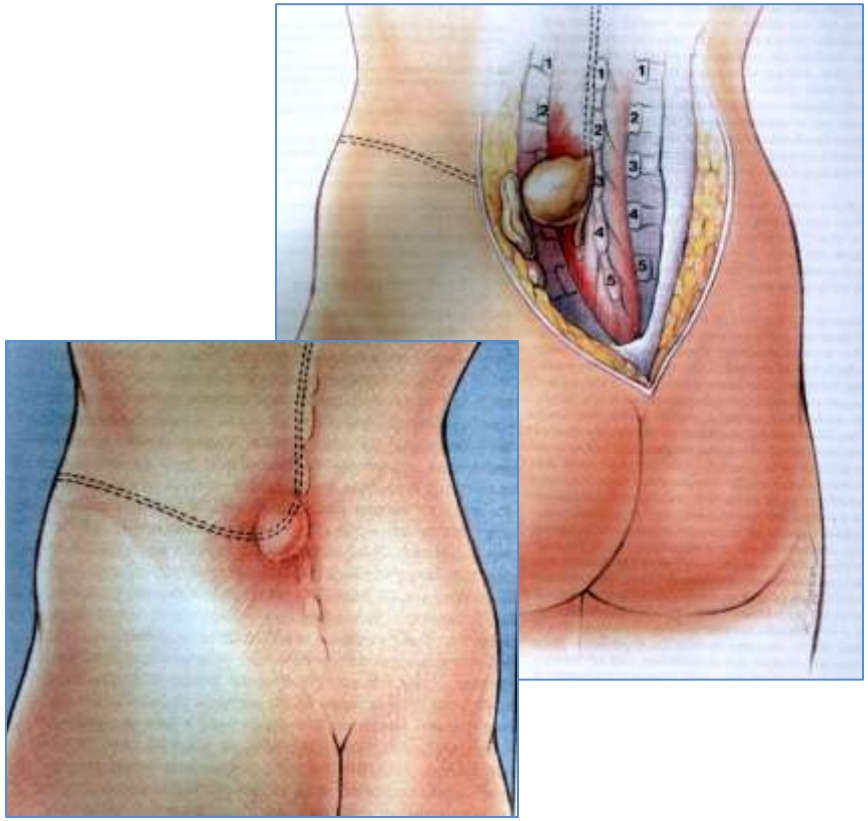
Baer ET. Anesthesiology, 2006; 105: 381 – 393

Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52

Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

EAA Infectious Complications

Epidural Abscess



EAA Infectious Complications

Epidural Abscess

uncommon, serious complication → persistent neurologic deficit

9 : 17.372	1 : 1.930 (0.052%)	Wang LP et al, 1999
2 : 170.000	1 : 85.000 (0.0012%)	Aromaa U et al, 1997
12 : 450.000	1 : 37.500 (0.0027%)	Moen V et al, 2004
6 : 8.210	1 : 1.369 (0.073%)	Cameron CM et al, 2007
5 : 293.050	1: 58.610 (0.0017%)	Cook TM et al, 2009

- **1 : 800 if catheter > 2 days (Philips, Br J Anaesth 2002)**
- **Permanent Harm → 1.3 : 100.000 (1: 88.000)**
- **Paraplegia → 0.42 : 100.000 (1 : 236.000)**

Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475
Cook TM et al. Br J Anesth, 2009; 102: 179 – 190
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88

EAA Infectious Complications

Epidural Abscess

- may develop independently of EAA (spontaneously)
  0.2 – 1.2 : 10.000
- not always related to indwelling catheter placement
- infections of skin, soft tissue, spine, haematogenous spread to ES
- infective sources: osteomyelitis, bacteraemia, postop infection
- pathogenesis
  colonization / subsequent infection from normal skin flora
- staphylococcus aureous: commonest causative organism

Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475
Cook TM et al. Br J Anesth, 2009; 102: 179 – 190
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88

EAA Infectious Complications

Epidural Abscess – Diagnosis, Prognosis, Treatment

first symptoms: 2 days (median 5 days) to 5 weeks or months

Stage 1 → back / vertebral pain intensified by precussion, fever, ↑ WBC
Stage 2 → progress to nerve roots, radicular pain
Stage 3 → motor, sensory and / or sphincter dysfunction
Stage 4 → paraparesis, paralysis and / or paraplegia

- radiologic evidence of mass in ES: diagnostic
- gadolinium – enhanced MRI: most sensitive imaging modality
- prognosis dependent on diagnosis: the earlier the better
- immediate catheter removal / inspection of epidural site for infection
- tip / blood cultures
- antibiotics / surgical drainage
- neuroconsultation – possible decompression

Bluman EM et al. J Am Acad Orthop Surg, 2004; 12: 155 – 163
Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

EAA Infectious Complications

Epidural Abscess – Risk Factors

- bacteraemia, febrile pts
- sepsis
- catheterization time
- immune compromised pts
  - malignancy
  - diabetes mellitus
  - alcoholism
  - iv drug abuse
  - steroid therapy
  - COPD
  - chronic renal failure
  - herpes / HIV
- untreated infection
  - localized / systemic
- transient bacteraemia?
  - urological procedures
  - gynaecological procedures
- lack of antibiotic prophylaxis
- multiple catheter placement
- anticoagulants perioperatively
- localized haemorrhage
- multiple trauma
- back trauma

Baer ET. Anesthesiology, 2006; 105: 381 – 393
Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

Epidural Anaesthesia – Analgesia
Infectious Complications

- **no reports of abscess formation:** catheters in situ ≤ 2 days
- difficulty at catheter insertion: **no ↑ of bacterial infection**
- **risk of persistent deficit:** almost 50% - delay in diagnosis
- **Regional Anaesthesia in the Febrile or Infected Patient.**

  Wedel DJ et al Reg Anesth Pain Med, 2006; 31: 324 – 333
- **Regional Anaesthesia in the Immunocompromised Patient.**

  Horlocker TT et al. Reg Anesth Pain Med, 2006; 31: 334 – 345
- **decision on an individual basis**

EAA Infectious Complications

immune – compromised patients

- attenuated inflammatory response:
  - ↑ frequency / severity of infection
  - may ↓ clinical signs – symptoms associated with infection
  - may delay diagnosis – treatment
- range of microorganisms causing invasive infection:
  - broader than general population
  - including atypical – opportunistic pathogens
- early / effective therapy: optimized neurological outcome
- consultation with an infectious disease specialist: advised
- prolonged antibiotic therapy (weeks – months)
  - often required
  - persistent and immunologic deficiencies
- infection eradication: difficult once established
- prevention: of paramount importance

Horlocker TT, Wedel DJ.
Regional Anaesthesia in the Immune Compromised Patient
Reg Anesth Pain Med, 2006; 31: 334 – 345

EAA Infectious Complications:
Lessons learned from large Cohort studies & Reviews

- epidural catheter tip frequently colonized
- progression to ES infection rarely occurs
- major routes for microorganisms entry into ES
  - catheter hub
  - catheter insertion site / catheter track
  - haematogenous spread
  - catheter hub: 50% of sources
- factors affecting infection risk
  - site of catheterization: caudal > lumbar
  - aseptic technique, antiseptic solution
  - equipment, infusate, filter
  - catheter disconnection management / break in system
  - LAs & adjuvants

Hebl JR, Horlocker TT. Reg Anesth Pain Med, 2003; 28: 376 – 379
Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

EAA Infectious Complications:
Lessons learned from large Cohort studies & Reviews

Procedure Description

- practice varies – hospital policy
- conflicting evidence regarding precautions

Protocols

- ↓ variability in practice
- effective according to best available evidence
- easy to implement
- avoid unnecessary cost
- minimize intrinsic and extrinsic sources of infection

Benhamou D. ESRA Highlights, 2004
Hepner DL. Anesthesiology, 2006; 105: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

Methods to Reduce EAA Infectious Complications

Lessons learned from large Cohort Studies & Reviews

- careful pts selection, on an individual basis
- avoid EAA in septic pts – pts with untreated systemic infection
- consider risk in immune – compromised pts
- consider risk in diabetic pts
- administer antibiotic prophylaxis

  especially in case of indwelling long term catheters

Hebl JR. Reg Anesth Pain Med, 2006; 31: 311 – 323

Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52

Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

Methods to Reduce EAA Infectious Complications

Lessons learned from large Cohort Studies and Reviews

- **do adequate hand washing before EAA**
  - the most crucial component of asepsis
  - antimicrobial soap
  - alcohol – based antiseptic

- **do strict antiseptic skin preparation**
  - disinfect back twice, centrifugal manner
  - with alcoholic solutions
  - ? chlorhexidine + isospropyl alcohol
  - ? povidone iodine

- **wear mask, sterile powder – free gloves, probably gown**
- **in case of any doubt to contamination**

  stop and start over

Hebl JR. Reg Anesth Pain Med, 2006; 31: 311 – 323

Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

Methods to Reduce EAA Infectious Complications

Lessons learned from large Cohort Studies and Reviews

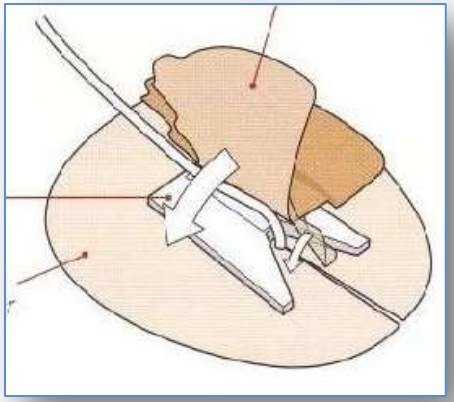
- use disposable equipment
- ↓ epidural catheter manipulation
- use antibacterial filter
- ↓ filter changes
- always maintain a closed system
- avoid use of
  repeatedly changing small volume syringes
- prefer use of
  large volume bags (sterile continuous infusion)
- apply aseptic, non – touch technique
  during the whole catheterization period

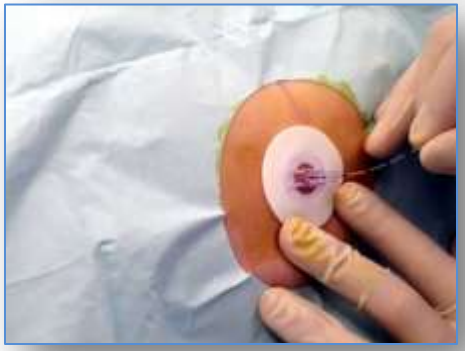
Hebl JR. Reg Anesth Pain Med, 2006; 31: 311 – 323
Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

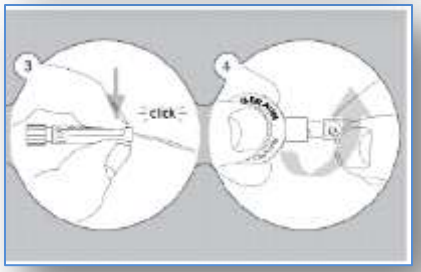
Methods to Reduce EAA Infectious Complications

Lessons learned from large Cohort Studies and Reviews

- secure epidural catheter
- try to avoid catheter disconnection
- fix epidural catheter to available fixation devices in the kit







Hebl JR. Reg Anesth Pain Med, 2006; 31: 311 – 323
Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

Methods to Reduce EAA Infectious Complications

Lessons learned from large Cohort Studies and Reviews

- use transparent sterile dressings
- have a daily look at insertion point
- close neurologic monitoring

Hebl JR. Reg Anesth Pain Med, 2006; 31: 311 – 323
Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

Methods to Reduce EAA Infectious Complications

Lessons learned from large Cohort Studies and Reviews

- remove epidural catheter at 4th postoperative day
- inspect catheter tip for completeness
- inspect insertion site for inflammation
- in case of disconnection decide to whether aseptically reattach or remove catheter

Hebl JR, Neal JM. Reg Anesth Pain Med, 2006; 31: 291 – 293
Hebl JR. Reg Anesth Pain Med, 2006; 31: 311 – 323
Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

Epidural Catheter Reconnection

Safe and Unsafe Practice

any disconnected catheter: contaminated

- **if disconnection > 8 hours**

  remove catheter

- **if disconnection < 8 hours**

  reconnection is permitted

- **if catheter is not lying in a puddle of innoculate**
- **cut catheter 15 – 20 cm with a sterile blade**
- **submerse catheter in betadine for 3 minutes and dry**
- **use new fixation device – filter during reconnection**
- **check and secure catheter with sterile transparent dressings**

Hebl JR. Reg Anesth Pain Med, 2006; 31: 311 – 323
Langenn PB. Anesthesiology, 1996; 85: 883 – 888
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475

EAA Infectious Complications:
Lessons learned from large Cohort studies & Reviews

Local Anaesthetics

- bupivacaine 0.5%, lidocaine 2%
- inhibit microorganisms' growth in culture

opioids

no ability in bacterial growth inhibition

immune compromised pts:

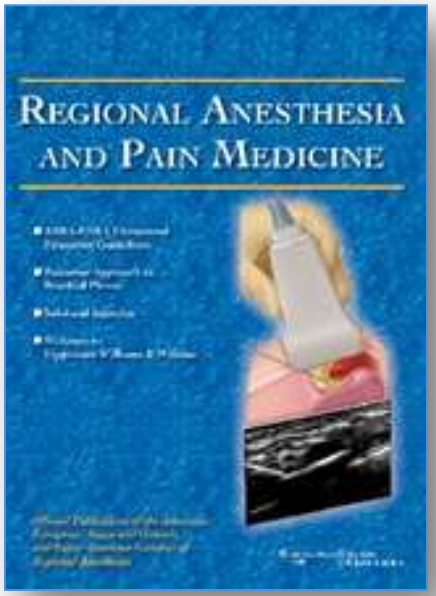
even LAs dilute solutions may have an effect

- ? in vivo bactericidal effects of dilute solutions

Reynolds F. Anesthesiol Clin, 2008; 26: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475
Wright JL. Curr Opin Anaesthesiol, 2008; 21: 651 – 656
Gupta A. Curr Opin Anaesthesiol, 2011; 23: 708 – 713

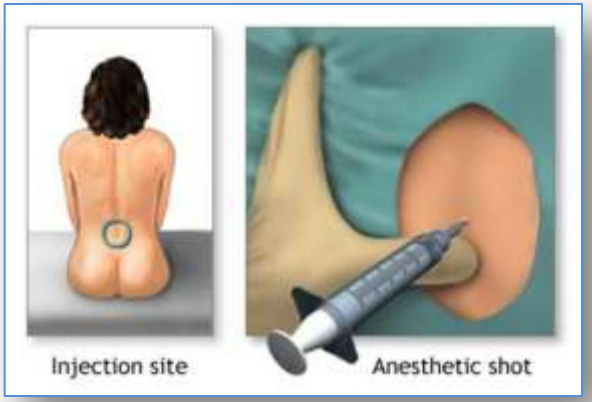
Anatomy and Pathophysiology of Spinal Cord Injury Associated With Regional Anesthesia and Pain Medicine

Joseph M. Neal, M.D.



Regional Anesthesia and Pain Medicine,

Vol 33, No 5 (September–October), 2008: pp 423–434



EAA Complications

Insertion – Presence of Needle or Catheter in the ES

Traumatic Injury – Exceedingly Rare

Where

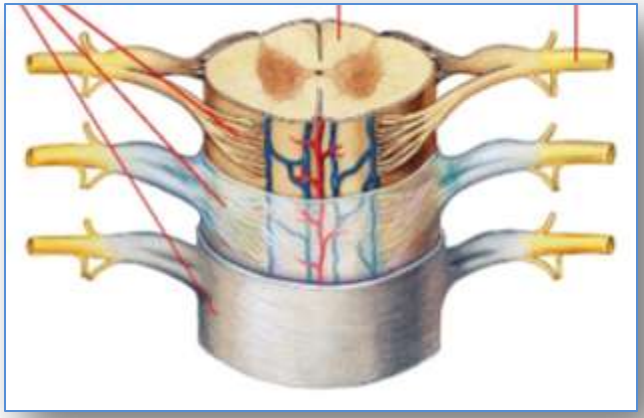
- spinal cord (SC)
- conus medullaris
- spinal nerve roots
- spinal nerves

How

- procedural SC lesions
  - by needle
  - by catheter
- localized hydromyelia
  - by fluid injection

↓

sensory loss
motor deficits

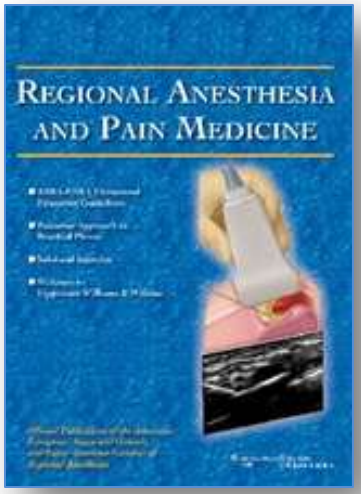


Wilkinson PA et al. J Neurol Neurosurg Psychiatry, 2002; 72: 537 – 539
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88
Horlocker TT. Anesthesiology Clin, 2011; 29: 257 – 278

▽ ASRA Practice Advisory on Neurologic Complications

ASRA Practice Advisory on Neurologic Complications in Regional Anesthesia and Pain Medicine

Joseph M. Neal, M.D., Christopher M. Bernards, M.D., Admir Hadzic, M.D., James R. Hebl, M.D., Quinn H. Hogan, M.D., Terese T. Horlocker, M.D., Lorri A. Lee, M.D., James P. Rathmell, M.D., Eric J. Sorenson, M.D., Santhanam Suresh, M.D., and Denise J. Wedel, M.D.



Regional Anesthesia and Pain Medicine,

Vol 33, No 5 (September–October), 2008: pp 404–415

- **despite recommendations**
- **vast majority of SC injuries**
- **neither predictable**
- **nor preventable**

Level of Epidural

- cervical epidural
- thoracic epidural (TEA)
  - high TEA (C7, T1 – T3)
  - central Area (T4 – T9)
  - lower TEA (T10 – T12 – L1)
- lumbar epidural
- caudal

Differences in

- indications
- level of analgesia
- procedure
- physiologic sequelae / complications

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

Traumatic Injury

Mechanisms

- transient – permanent
- anatomic – physiologic damage
  - SC, roots, nerves
  - their blood supply

Mechanical Injury

- direct needle trauma
- mass compression (haematoma, abscess)

Vascular Injury

- direct needle trauma
- SC infarction, ASA Syndrome

Stretch Injury

- excessive traction
- improper positioning

Neurotoxicity (LAs – adjuvants)

Hebl J et al. Anesth Analg, 2006; 103: 1294 – 1299
Neal JM. Reg Anesth Pain Med, 2008; 33: 423 – 434
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Horlocker TT. Anesthesiology Clin, 2011; 29: 257 – 278

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

Traumatic Neurological Injury

Mechanisms – Results

- direct needle trauma
- toxic injury (LAs, adjuvants)
- ischaemic injury
  - axonal loss / damage
  - poor prognosis
- compressive injury
- stretch injury
  - neuroapraxia
  - intact axon
  - better prognosis

Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88
Horlocker TT. Anesthesiology Clin, 2011; 29: 257 – 278

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Injury

causal link between

procedural trauma & nerve damage

<u>rarely straight forward</u>

Multimodal Aetiology

Confounding Factors

- EAA technique, puncture level
- surgical operation
- underlying pathology under treatment

Risk Factors

- diabetes
- spine pathology
- spinal stenosis
- atherosclerosis
- neuropathy
- neurological diseases
- hypotension

Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88
Horlocker TT. Anesthesiology Clin, 2011; 29: 257 – 278

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Injury

- permanent harm from nerve – SC injury
  1 : 100.000
- not always associated
  with pain / paraesthesia during procedure
- avoidance of trauma
  - accurate anatomic knowledge – landmarks
  - proper pts positioning
  - careful technique
  - pre existing neurological deficits & risk factors documentation

Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88
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EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Mechanical Injury

EAA Complications

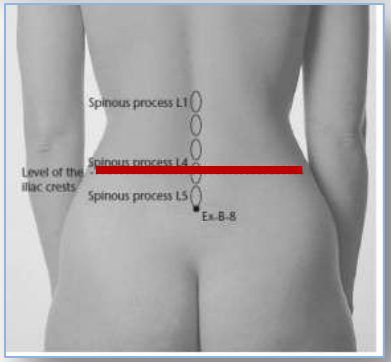
Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Mechanical Injury

Direct Needle Trauma

Case Reports – Medicolegal Review

- excessively caudal SC termination
- inaccurate determination of bony landmarks



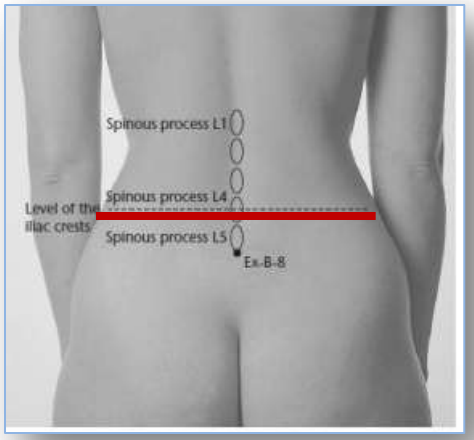
Moen V et al. Anesthesiology, 2004; 101: 950 – 959
Neal JM. Reg Anesth Pain Med, 2008; 33: 423 – 434
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Mechanical Injury

Direct Needle Trauma – Lumbar Region



Surface Anatomical Landmarks

- SC typically terminates at L1 – L2 interspace
- in some pts above or below (between T12 – L4)
- difficulties / failure in correct vertebral interspace identification
- EAA at a higher level than estimated
- conus medullaris ending lower than usual
- possible SC puncture

Moen V et al. Anesthesiology, 2004; 101: 950 – 959
Neal JM. Reg Anesth Pain Med, 2008; 33: 423 – 434
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88

EAA Complications

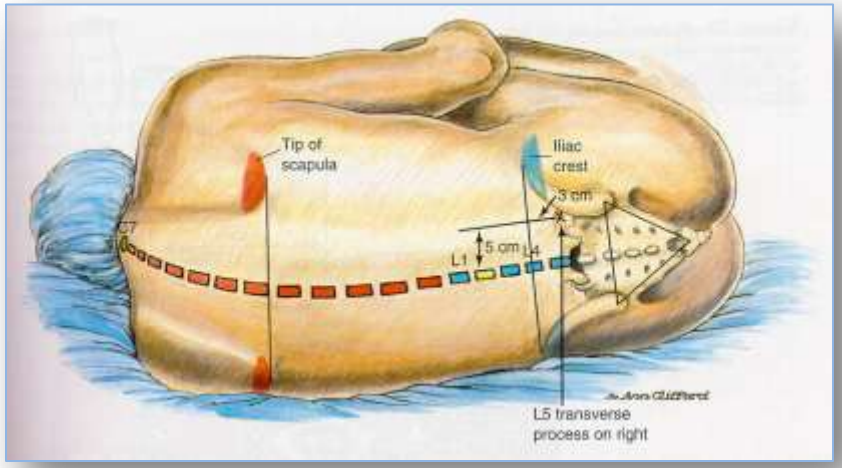
Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Mechanical Injury

Direct Needle Trauma – Lumbar Region

Surface Anatomical Landmarks

- lumbar EAA: very common
- Tuffier's line: careful use
  - L4 – L5 interspace: 31% pts
  - L5 vertebra: 58% pts
- MRI studies
  - correct interspace identification: 29%
  - at higher levels: 51%
  - SC below L1: 19% pts



Neal JM et al. Reg Anesth Pain Med, 2008; 33: 404 – 415
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88
Horlocker TT. Anesthesiology Clin, 2011; 29: 257 – 278

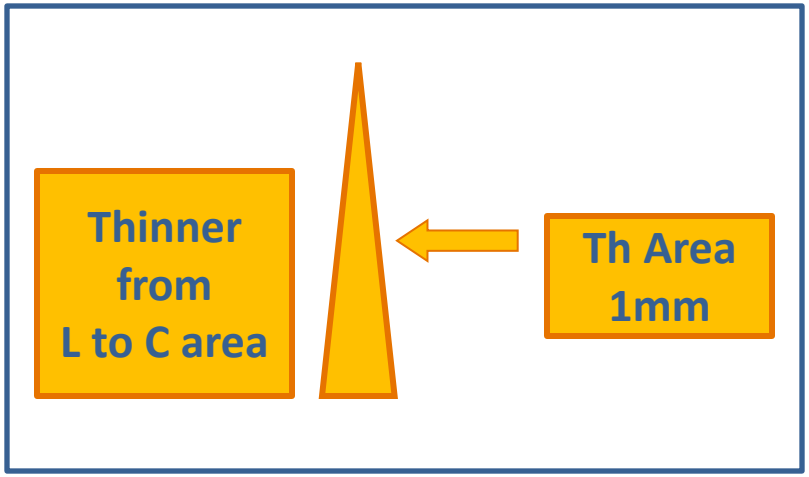
EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Mechanical Injury – Direct Needle Trauma

Ligamentum Flavum

- thinner from L to C area
- ?? fuse in midline (gaps)
- prevalent in C and upper Th region
- despite a meticulous epidural
- loss of resistance is not felt
- needle passage directly into epidural / intrathecal space



Lirk P et al. Anesthesiology, 2003; 99: 1387 – 1390
Neal JM et al. Reg Anesth Pain Med, 2008; 33: 404 – 415
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Lee RA et al. Reg Anesth Pain Med, 2010; 35: 364 – 369

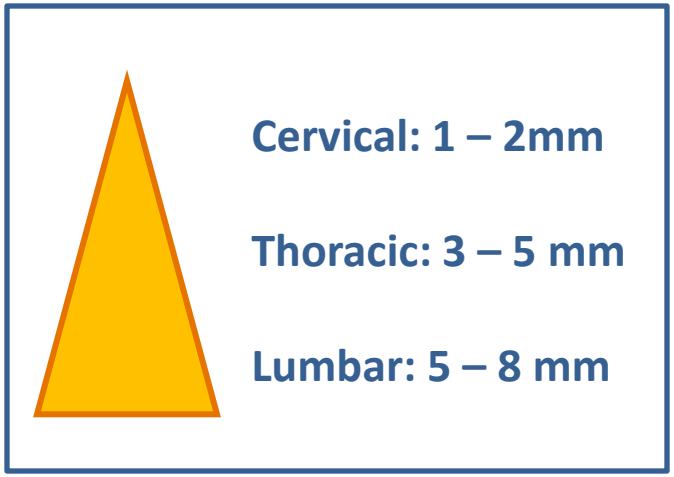
EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Mechanical Injury – Direct Needle Trauma

Epidural Space

- ↓ posterior – to – anterior dimension
- moving cephalad
- unintentional meninges penetration
- ? intramedullary Tuohy needle
- oedema, haematoma, syrinx from LAs
- simple passage without injection: not always injurious



Neal JM et al. Reg Anesth Pain Med, 2008; 33: 404 – 415
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Lee RA et al. Reg Anesth Pain Med, 2010; 35: 364 – 369

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Mechanical Injury: Direct Needle Trauma – Thoracic Region

The Anatomy of the Thoracic Spinal Canal in Different Postures

A Magnetic Resonance Imaging Investigation

Ruben A. Lee, BE (Hons), André A. J. van Zundert, MD, PhD, FRCA,†‡ Charl P. Botha, PhD,§ L. M. Arno Lataster, MSc,|| Tom C. R. V. van Zundert, BSc,† Willem G. J. M. van der Ham, MD,† and Peter A. Wieringa, PhD**

Regional Anesthesia and Pain Medicine • Volume 35, Number 4, July-August 2010

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Mechanical Injury: Direct Needle Trauma – Thoracic Region

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Mechanical Injury – Direct Needle Trauma

Thoracic versus Lumbar Spinal Canal Anatomy

- SC follows the straightest line through imposed geometry of spinal canal
- lumbar – caudal region: SC more posteriorly (dorsally)
- thoracic region: SC more anteriorly (ventrally)
- especially in the apex of thoracic kyphosis
- sitting / head down position

  ↑ posterior separation of SC and dural sheath

Neal JM et al. Reg Anesth Pain Med, 2008; 33: 404 – 415
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
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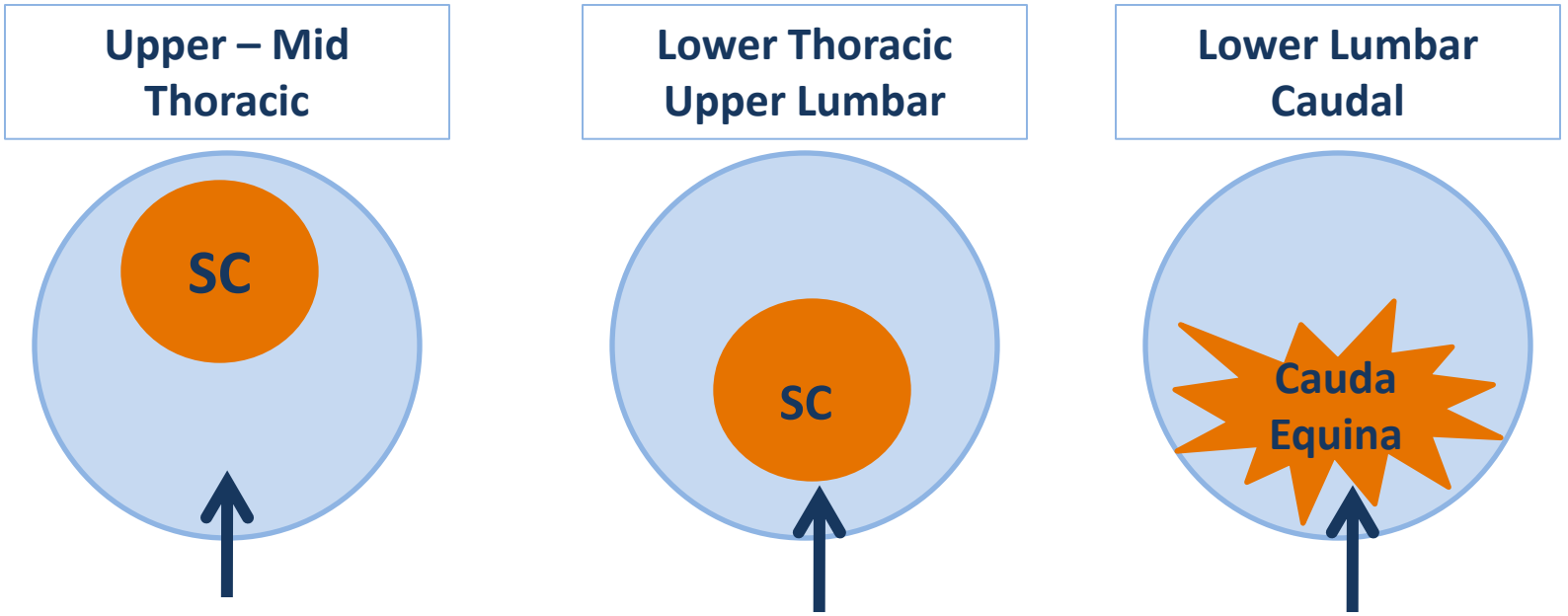
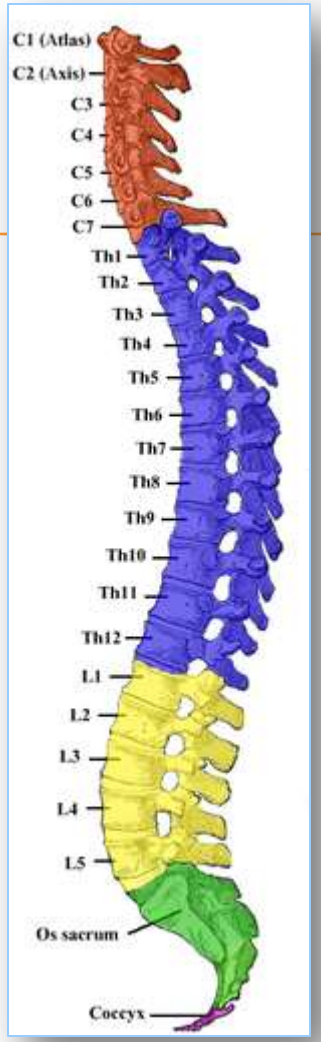


Neal JM et al. Reg Anesth Pain Med, 2008; 33: 404 – 415
Lee RA et al. Reg Anesth Pain Med, 2010; 35: 364 – 369

Epidural Technique

Angle of Inclination of Spinous Processes

- **cervical (C1 – C7), upper thoracic area (T1, T2)**
  - almost parallel to the sagital plane
  - at the same level with corresponding vertebrae
- **thoracic (T3 – T12), upper lumbar area (L1)**
  - caudal angle
  - especially T4 – T9
- **lower lumbar area (L2 – L5)**
  - almost parallel to sagital plane
- **T10 – T12**
  - shorter spinous processes

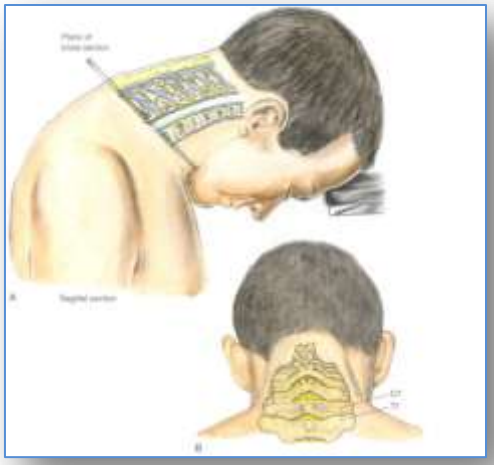


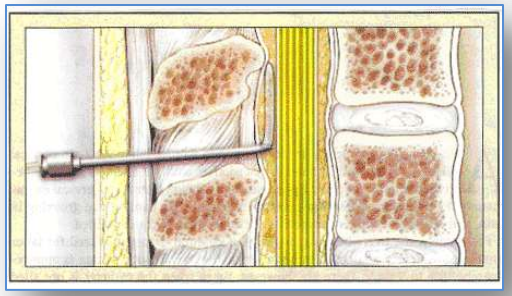
EAA Complications

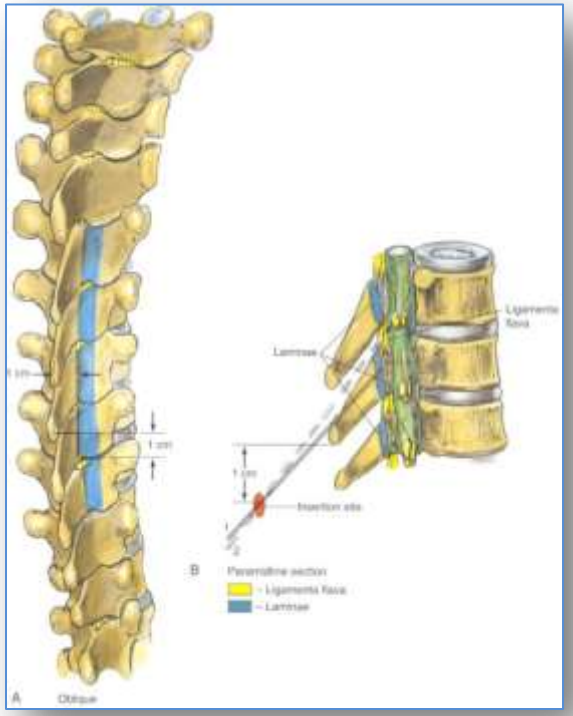
Insertion – Presence of Needle or Catheter in the ES

SC Mechanical Injury – Direct Needle Trauma

Thoracic versus Lumbar Spinal Canal Anatomy – Needle Direction





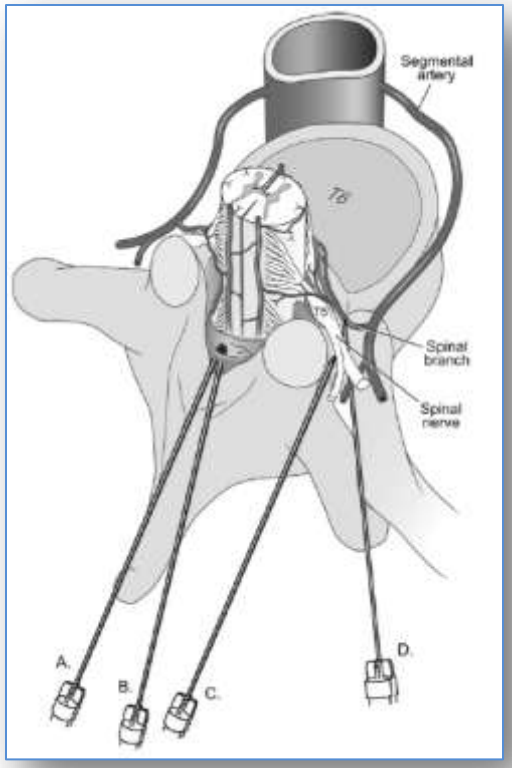


EAA Complications

Insertion – Presence of Needle or Catheter in the ES

Spinal Roots – Nerves Mechanical Injury: Direct Needle Trauma

Midline – Paramedian Approach: Relatively Safe



- oblique lateral entry into ligamentum flavum
- needle directed into dural cuff region
- potential nerve – vessel trauma
- unisegmental paraesthesia
- alert
- no further needle advancement
- no catheter threading

Neal JM et al. Reg Anesth Pain Med, 2008; 33: 404 – 415
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88
Horlocker TT. Anesthesiology Clin, 2011; 29: 257 – 278

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Mechanical Injury: Direct Needle Trauma

Paraesthesia – Misperceptions

- ? SC injury → pain, paraesthesia
- SC: devoid of sensory innervation
- LAs: usually intense sensation
- rapid ↑ in intramedullary pressure
- massive afferent discharge
- up to 6.3%
- actual injury: rare
- same radicular pattern

Auroy Y et al. Anesthesiology, 1997; 87: 479 – 486
Neal JM et al. Reg Anesth Pain Med, 2008; 33: 404 – 415
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Horlocker TT. Anesthesiology Clin, 2011; 29: 257 – 278

REGIONAL ANESTHESIA
SECTION EDITOR
DENISE J. WEDEL

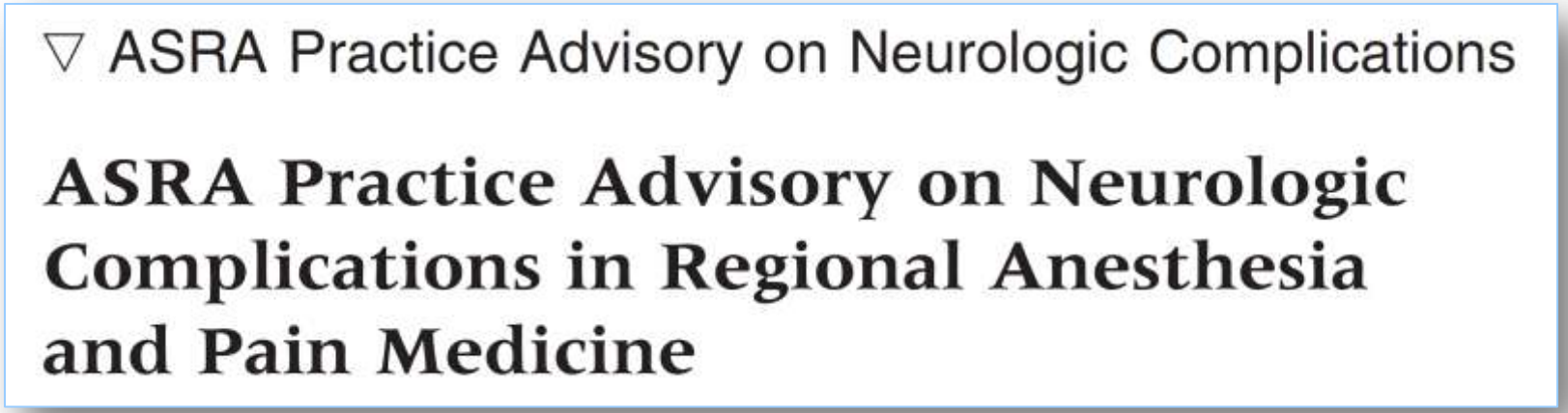
Small Risk of Serious Neurologic Complications Related to Lumbar Epidural Catheter Placement in Anesthetized Patients

Terese T. Horlocker, MD*, Martin D. Abel, MD*, Joseph M. Messick, Jr, MD*, and Darrell R. Schroeder, MS†

Departments of *Anesthesiology and †Health Sciences Research, Mayo Clinic, Rochester, Minnesota

(Anesth Analg 2003;96:1547–52)

- **actual frequency: 0 [95% CI 0% - 0.08%]**
- **based on upper limit of CI → calculated incidence 0 – 8: 10.000**



Adult Neuraxial Anaesthesia and GA – Heavy Sedation

- paraesthesia/pain on LAs injection: not always present (6.3%)
- actual frequency of SC injury under GA: 0 [95% CI 0% - 0.08%]
- based on upper limit of CI → calculated incidence 0 – 8: 10.000

- EAA should be <u>rarely</u> performed in adults whose sensorium is compromised by GA. CLASS II

Neal JM. Reg Anesth Pain Med, 2008; 33: 404 – 415
Horlocker TT. Anesth Analg, 2003; 96: 1547 – 1552

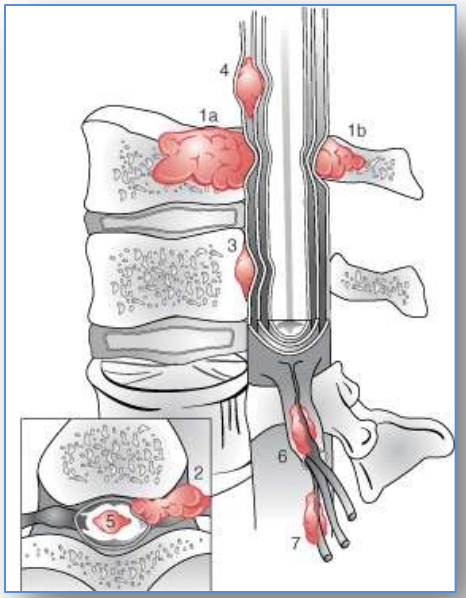
EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Mechanical Injury

Mass Lesions (compressive injury)

- ↓ available cross section area in spinal canal
- direct SC compression
- ↑ CSF pressure
- impaired blood flow
- SC ischaemia – infarction



Buffington CW, Nystrom EUM. Reg Anesth Pain Med, 2006; 31: 102 – 106
Neal JM. Reg Anesth Pain Med, 2008; 33: 423 – 434
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Mechanical Injury

Compressive Injury

reduced spinal canal cross – section area

- **degenerative**
  - osteoporosis
  - spinal stenosis
- **acquired**
  - haematoma
  - abscess
  - morphine – induced grannulomas
- **positional**

Neal JM. Reg Anesth Pain Med, 2008; 33: 423 – 434
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Mechanical Injury

Compressive Injury

reduced spinal canal cross – section area

- **Degenerative**
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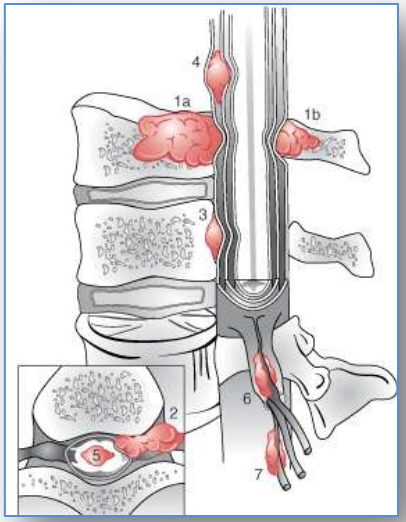

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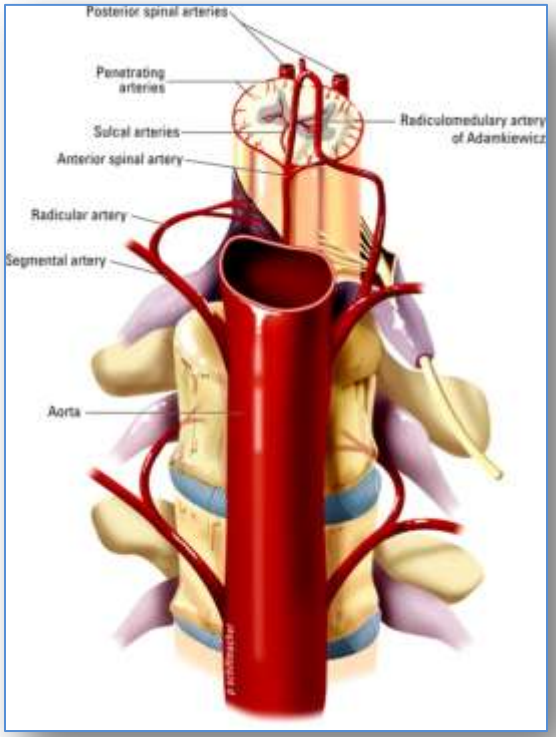
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88

EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Vascular Injury

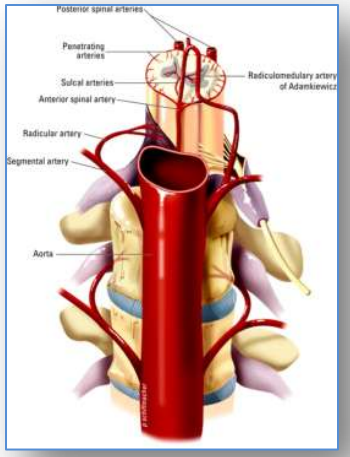


EAA Complications

Insertion – Presence of Needle or Catheter in the ES

SC Trauma – Vascular Injury

Ischaemic Injury



- direct needle vascular trauma

  oblique midline – lateral paramedian EAA approach
- SC Infarction – Anterior Spinal Artery Syndrome (ASAS)

  hypotension, atherosclerosis, diabetes, vasoactive spinal agents
- «double – crush» phenomenon

Hebl J et al. Anesth Analg, 2006; 103: 1294 – 1299
Neal JM. Reg Anesth Pain Med, 2008; 33: 423 – 434
Horlocker TT. Eur J Pain Suppl, 2010; 4: 227 – 234
Dale MC, Checketts MR. Anaesth Intensive Care Med, 2010; 11: 85 – 88

▽ ASRA Practice Advisory on Neurologic Complications

ASRA Practice Advisory on Neurologic Complications in Regional Anesthesia and Pain Medicine

Adult Neuraxial Anaesthesia: Spinal Stenosis – Spinal Masses

- **When EAA is complicated by the development of haematoma or abscess, resultant postoperative neurologic complications may be more likely or more severe in pts with pre – existing spinal stenosis or other obstructive spinal canal pathology.**

CLASS II

Neal JM. Reg Anesth Pain Med, 2008; 33: 404 – 415

▽ ASRA Practice Advisory on Neurologic Complications

ASRA Practice Advisory on Neurologic Complications in Regional Anesthesia and Pain Medicine

Adult Neuraxial Anaesthesia: Pre – existing Neurologic Diseases

- **Definite evidence indicating that EAA <u>may increase the risk</u> of new or progressive neurologic complications in pts with preexisting CNS diseases (multiple sclerosis, post – polio syndrome) is lacking.**
- **Such pts may be at increased risk of new or worsening injury, <u>regardless of anaesthetic technique</u>.**
- **A careful risk – to – benefit assessment to alternatives should be considered.**
- **When EAA is thought to be appropriate, <u>technique modification</u> may minimize potential risk.**

CLASS II

EAA and SC Trauma – Injury:
Lessons learned from large Cohort studies & Reviews

- be careful with EAA in pts with spine pathology
- ? EAA when neurologic disorders are present
- ? stop if paraestehsia / pain at injection
- ? redirect needle
- forego procedure after multiple failed attempts
- avoid EAA in adult unconscious pts
- do aspiration test and test – dose before full injection of LAs
- avoid severe hypotension concomitant to EAA
- prefer saline rather than air for loss – of – resistance technique

Benhamou D. ESRA Highlights, 2004
Hepner DL. Anesthesiology, 2006; 105: 23 – 52
Horlocker TT, Wedel DJ. Best Pract Res Clin Anaesthesiol, 2008; 22: 451 – 475
Horlocker TT et al. Anesth Analg, 2011; 111: 1511 – 1519

▽ ASRA Practice Advisory on Neurologic Complications

ASRA Practice Advisory on Neurologic Complications in Regional Anesthesia and Pain Medicine

Adult Neuraxial Anaesthesia: Previous Spinal Surgery

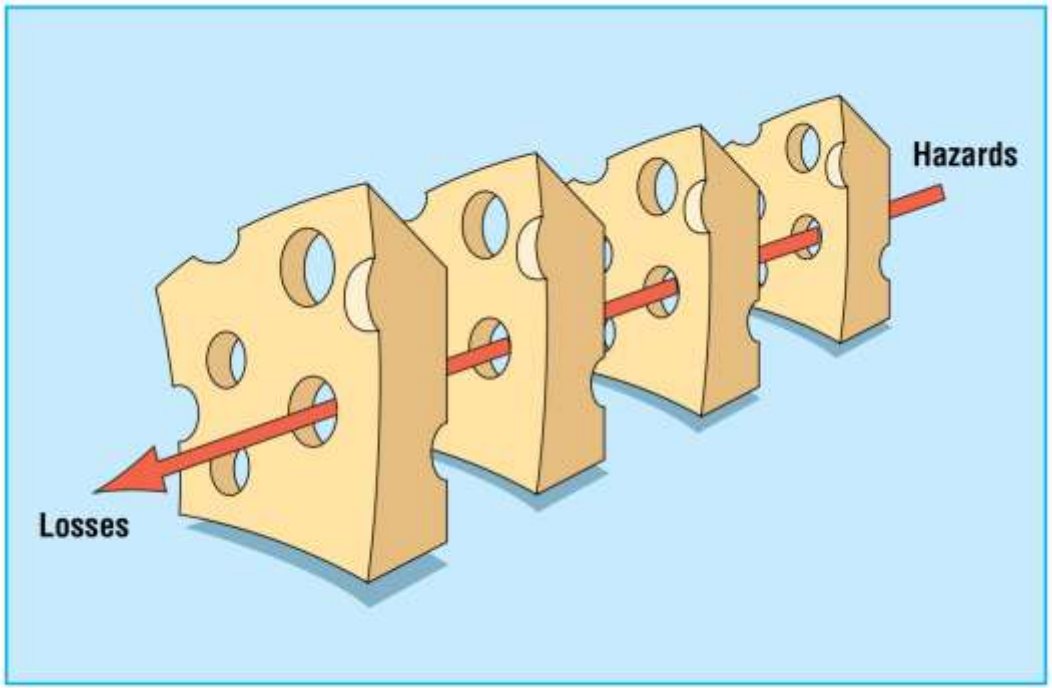
- **Previous spinal fusion or spinal corrective surgery are not a contraindication to EAA.**
- **In such pts, compared to EAA, spinal anaesthesia may be technically easier to perform and more reliable than EAA itself**
- **A review of radiologic imaging and / or the use of fluoroscopy are recommended to refine the approach to neuraxis.**

CLASS II

Human error: models and management

James Reason

BMJ 2000;320:768–70



The Swiss cheese model of how defences, barriers, and safeguards may be penetrated by an accident trajectory

EAA Safety and Education ……

Learning Curve

Residents significant improvement over baseline: after **25 EAAs**
90% success rate reached and maintained: **60 EAAs** must be performed
Manual skills improve with increased experience

Benefits of new Educational Tools

Video Technology
Ultrasound for difficult cases
Simulators

Konrand K et al. Anesth Analg, 1998
Birnbach O et al. Anesthesiology, 2002
Friedman Z et al. Reg Anesth Pain Med, 2006
Grau T et al. Can J Anaesth, 2003

1. Many questionnaire surveys suffer from a poor response rate, and potentially, therefore, a reporting bias.
2. Clinical practice has changed radically since the older surveys were conducted.
3. Small local audit may be more precise than larger multicenter surveys, but with improvement in practice, smaller studies lack power to assess incidence of rare disorders with accuracy.
4. Level of skill and training vary from place to place.
5. Denominator data are inaccurate, while numerators may lack diagnostic precision.
6. Cases arising late, in the community, may be missed.
7. Surveys that are prompted by the occurrence of a case or cluster of cases have a built-in positive reporting bias.

Safe Epidurals

… we should always know where we put our needles!!!

… not all backs are that easy !!!

… not all backs are that easy !!!


Don't
PANIC!

Take Home Message

- concentrate
- think of Guidelines – prevention
- assess pts individually
- think of alternatives
- use common sense
- realistic informed consent
- act quickly
- early diagnosis / treatment
- documentation

AUDIT:
Learn from the mistakes of others

EDITORIAL

Practice Guidelines Often Fail to Keep Pace With the Rapid Evolution of Medicine

A Call for Clinicians to Remain Vigilant and Revisit Their Own Practice Patterns

Katharine H. Fleischmann, MD, David J. Kuter, MD, DPhil,† Christopher M. Coley, MD,‡ and James P. Rathmell, MD**

Regional Anesthesia and Pain Medicine • Volume 35, Number 1, January-February 2010

EDITORIAL

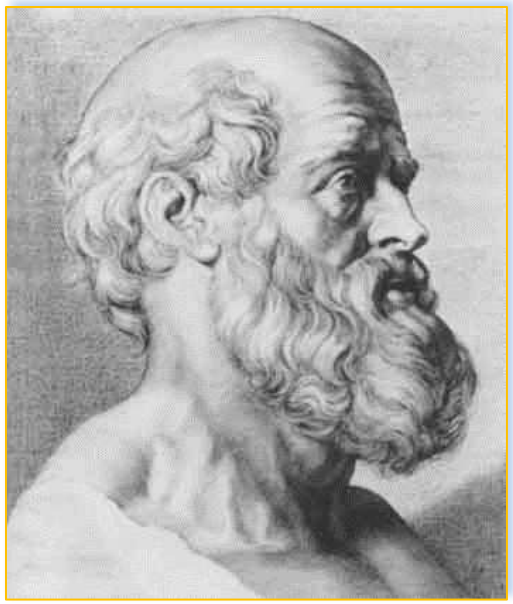
Practice Advisories by the American Society of Regional Anesthesia and Pain Medicine

Grading the Evidence and Making the Grade

Terese T. Horlocker, MD, Joseph M. Neal, MD,† and James P. Rathmell, MD‡*

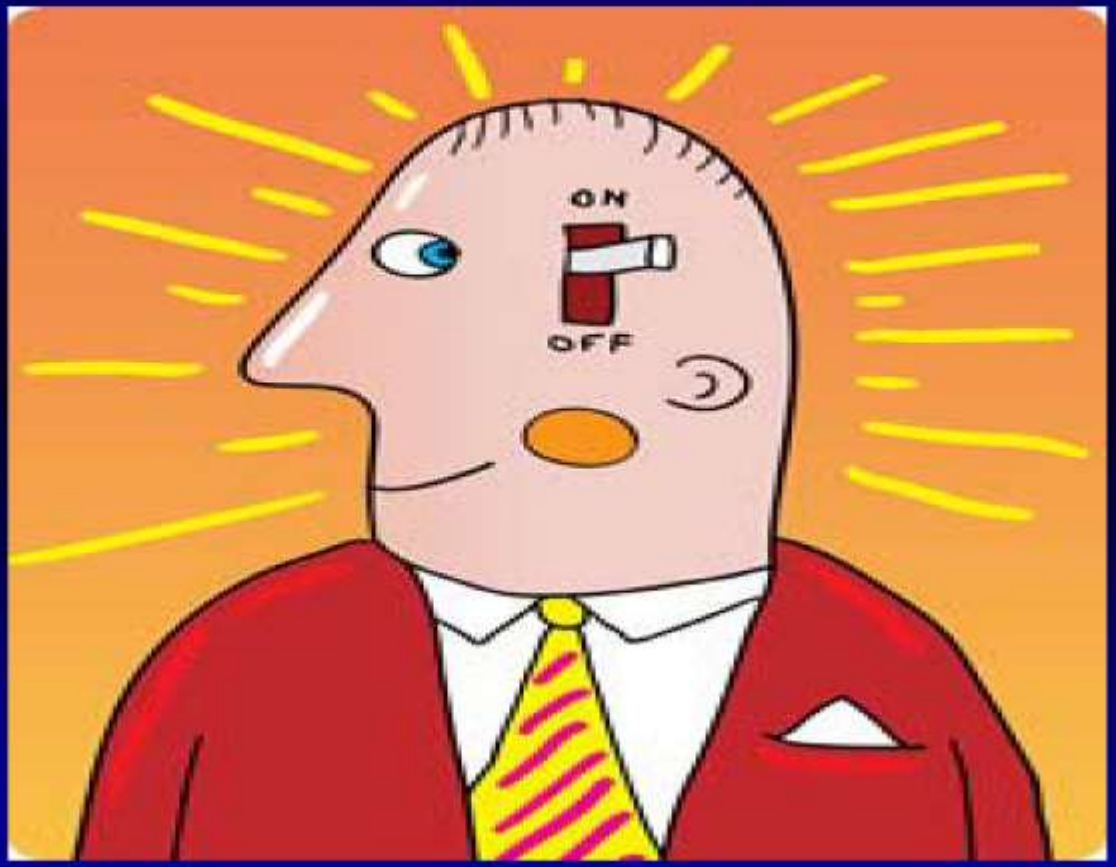
Regional Anesthesia and Pain Medicine • Volume 36, Number 1, January-February 2011

"… As to diseases,
make a habit of two things –
to help, or at least to do no harm …"



Hippocrates (460 – 370 BC)
Epidemics, BK 1, Sect XI

No MORE THINKING!!!!!
Turn it OFF!!!



Thank you!!