Epidural Technique for cardiac surgery improves outcome

Con

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Various perioperative benefits of TEA in cardiac surgery have been reported. TEA alone has even been used in awake spontaneously breathing patients during CABG or valve replacement with impressive results (NR).
Yet the ongoing discussion on the merits of TEA in heart surgery continues
WHY???

Because
results regarding the outcomes
and possible benefits
are still conflicting
Effects on major outcomes

meta-analysis of 15 prospective RCT’s
outcomes of 1178 patients (Liu SS.2004)
TEAA compared to standard management

no difference in major outcome

- postoperative mortality
  - 0.7% TEA vs. 0.3% GA
- major morbidity
- new myocardial infarction
  - 2.3% TEA vs. 3.4% GA
- new myocardial ischemia
- hospital discharge time
Benefits

- attenuated cardiac dysrhythmias
- shorter time to extubation
- reduced pulmonary morbidity
- lower postoperative pain scores

## RCT’S TEA outcomes in CBAG

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Nr of Pants</th>
<th>Dosing</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scott</td>
<td>2001</td>
<td>408</td>
<td>TEA T2-T4 GA</td>
<td>Analgesia morbidity</td>
</tr>
<tr>
<td>De Vries</td>
<td>2002</td>
<td>90</td>
<td>GA/TEA+GA</td>
<td>Early extubation</td>
</tr>
<tr>
<td>Priestly</td>
<td>2002</td>
<td>100</td>
<td>TEA T1-T4 GA</td>
<td>Analgesia</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>~~ hospital stay chest XR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>spirometry</td>
</tr>
<tr>
<td>Royce</td>
<td>2003</td>
<td>76</td>
<td>TEA T1-T3</td>
<td>Analgesia Postop. stress</td>
</tr>
</tbody>
</table>
Is TEA cardioprotective?

In animal studies, has been shown that TEA

- may redistribute myocardial blood flow in favor of subendocardial layers
- may reduce the size of experimentally induced myocardial infarction. [i] [ii]


Hemodynamic effects

investigated extensively and reproducibly is reported

- diminished cardiac work
- enhanced cardiac output
- improved coronary blood flow and distribution

should benefit patients with CAD
HTEA? Better cardiac performance !!!

- Left ventricular diastolic function (but not systolic) is improved in CAD patients
  
  Schmidt C. Anesth Analg. 2005
arrythmogenesis

**protective effect** of TEA in animal [i]
in human studies [ii]


Scott et al. assessed postoperative impact of TEA

- 400 patients undergoing CABG, unblinded analysis
- 0.5% bupivacaine and clonidine epidurally during surgery / postoperatively

Results

- Reduction of supraventricular arrhythmias
- Lower catecholamine levels
- Slower heart rates

Anesth Analg 2001;93:528-35
# Atrial fibrillation (AF)

## Lower incidence with TEA??

<table>
<thead>
<tr>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3. Royse 2003</td>
</tr>
<tr>
<td></td>
<td>4. Jideus 2001</td>
</tr>
</tbody>
</table>
Dysrythmias: can we treat otherwise?

- b blockers

Reduction by TEA (30% vs 39% GA) compares favorably with results from placebo controlled trials examining efficacy of b-blockers (31% vs 39%)

Conolly SJ Am Heart J 2003;145:226
Dysrhythmias can we treat otherwise?

amiodarone

TEA or amiodarone or both in AF prophylaxis
Amiodarone was more protective
(12% vs 25%)

Yazigi 2002 Nygard 2004
Effect of HTEA on biochemical or ECG markers of myocardial ischemia or infraction: not clear

- In a prospective RCT for elective CABG surgery [i] HTEA had no effect on the release of troponin I, but infusion of ropivacaine 0.2% might not maintain a dense sympathetic block.
- PCTEA ropivacaine 1% no effect on troponine levels [ii].

Effect of HTEA on biochemical or ECG markers of myocardial ischemia or infraction: not clear

- reduced troponine T release with HTEA with bupivacaine 0.75% [iii]

Other factors?

Despite the theoretical advantages of HTEA, factors such as technical difficulty in grafting and myocardial protection during the ischemic period may have a more significant effect than HTEA on troponine release.
Adverse effects in HTEA

- Countering the potential cardioprotective effect of TEA is the possible risk of hypotension secondary to bradycardia and reduced sympathetic tone.\[i\]

Adverse effects in HTEA

- Studies in CADG patients have shown larger intraoperative vassopressor requirements in TEA treated patients compared to controls.[ii]

Bradycardia and myocardial depression may also result from extensive sympathetic blockade (Reiz S et al, Br J Anaesth 1986; 58: 778-782).

...may increase the requirement for postoperative pacing with its attendant risks.
Adverse effects in HTEA

The impact of hypotension on the incidence of myocardial ischemia in patients with critical coronary stenosis cannot be ignored

This aspect of the application of TEA during CABG requires further consideration

Consider!

- **Hypotension** from excessive sympathetic blockade is relatively common
  
  *Moore CM et al, Br J Anaesth 1995*

- Coronary, spinal cord and cerebral perfusion pressure may be compromised
  
  *Kirno K et al, Anesth Analg 1994*

- Volume replacement and vasoconstrictors are required in 50-90% of patients
  
  *Stenseth R. et al, 1995*
Consider!

- Vasoconstrictor dependence may delay discharge to ward.
- Persistent hypotension increased fluid loading may be detrimental in congestive cardiac failure.
Myocardial ischemia

Epidural analgesia and intravenous patient-controlled analgesia result in similar rates of postoperative myocardial ischemia after aortic surgery.

  Anesth Analg. 1998
Myocardial ischemia postop.

RCT 124 patients PCA or TEA, Holter monitoring

- TEA: T6-7 or T7-8 epidural Bup. 0.125% + fent. 10 μg/mL
- PCA: bolus morphine, 0.05 mg/kg, on demand 0.02 mg/kg every 10 min
- maintain VAS < or = 3.
- Postop. pain control superior with TEA
- Postop. TEA did not result in lower incidence of early myocardial ischemia compared with intravenous PCA with morphine (Bois S, 1997)
HTEA? Better cardiac performance !!!

What is the clinical impact???
RCT 60 patients
TEA: T3-T10 preop. analgesia documented versus GA
<table>
<thead>
<tr>
<th></th>
<th>GA</th>
<th>TEAA</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-CPB</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vasodilator*</td>
<td>14</td>
<td>4</td>
<td>0.01</td>
</tr>
<tr>
<td>Catecholamine†</td>
<td>1</td>
<td>5</td>
<td>0.19</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>2</td>
<td>11</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Post-CPB</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vasodilator*</td>
<td>7</td>
<td>2</td>
<td>0.15</td>
</tr>
<tr>
<td>Catecholamine†</td>
<td>20</td>
<td>30</td>
<td>0.00005</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>19</td>
<td>21</td>
<td>0.78</td>
</tr>
<tr>
<td><strong>CTICU</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vasodilator*</td>
<td>10</td>
<td>2</td>
<td>0.02</td>
</tr>
<tr>
<td>Catecholamine†</td>
<td>16</td>
<td>26</td>
<td>0.005</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>13</td>
<td>23</td>
<td>0.008</td>
</tr>
</tbody>
</table>

**NOTE.** n = 30 for both groups.

Abbreviations: GA, general anesthesia; TEAA, thoracic epidural anesthesia and analgesia; CPB, cardiopulmonary bypass; CTICU, cardiothoracic intensive care unit.

*Vasodilator = nitroglycerin or nitroprusside.
†Catecholamine = dopamine or epinephrine.
<table>
<thead>
<tr>
<th></th>
<th>GA</th>
<th>TEAA</th>
<th>( p ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical ventilation (h)</td>
<td>9.5 ± 0.8</td>
<td>10.7 ± 1.4</td>
<td>0.49</td>
</tr>
<tr>
<td>Duration of ICU stay (h)</td>
<td>30.0 ± 44.0</td>
<td>31.7 ± 21.3</td>
<td>0.84</td>
</tr>
<tr>
<td>Total complications*</td>
<td>12</td>
<td>17</td>
<td>0.28</td>
</tr>
<tr>
<td>Pain control (VAS on POD1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain intensity</td>
<td>3.5 ± 0.5</td>
<td>2.7 ± 0.5</td>
<td>0.29</td>
</tr>
<tr>
<td>Pain relief</td>
<td>6.6 ± 0.6</td>
<td>7.0 ± 0.6</td>
<td>0.62</td>
</tr>
<tr>
<td>Mood</td>
<td>5.7 ± 0.6</td>
<td>6.0 ± 0.5</td>
<td>0.78</td>
</tr>
<tr>
<td>Morphine equivalents† (mg)</td>
<td>26.7 ± 2.6</td>
<td>25.1 ± 7.3</td>
<td>0.83</td>
</tr>
<tr>
<td>Urinary free cortisol (( \mu )g/dL)</td>
<td>120 ± 70.5</td>
<td>150 ± 115.5</td>
<td>0.25</td>
</tr>
<tr>
<td>Crystalloid (mL/kg)‡</td>
<td>41.5 ± 17.9</td>
<td>40.0 ± 14.9</td>
<td>0.71</td>
</tr>
<tr>
<td>Hospitalization (h)</td>
<td>160.8 ± 91.6</td>
<td>156.0 ± 90.4</td>
<td>0.84</td>
</tr>
<tr>
<td>Total charges</td>
<td>$36,955 ± 1441</td>
<td>$40,026 ± 1908</td>
<td>0.20</td>
</tr>
</tbody>
</table>
Consider

- Use of extensive hemodynamic monitoring to **identify** and early aggressive interventions to **treat** unfavorable cardiovascular events in all patients during and after surgery.
- Cardiac arrhythmias could be treated otherwise.
- Although TEA has well-documented beneficial cardiovascular effects, they are not unique can be reproduced effectively with other agents and interventions.
decrease in pulmonary complications

- Liu SS. 2004 in his meta-analysis identified a decrease in pulmonary complications (OR 0.41; 95% CI 0.27–0.60; P=0.00001)
RCT on the incidence of hypoxemic episodes for CABG surgery utilizing extracorporeal circulation

Controls (CONs): GA + postop PCA opioids IV
"test" group GA + PCTEAA

No difference in postop hypoxemic episodes

on the 3rd postop night, hypoxemic episodes in 100% of the patients in the TEAA group and in only 76% of the subjects in the CON group (p < 0.05).

Lundstrøm, LH, et al CHEST 2005
Extubation

- Routine immediate extubation for off-pump coronary artery bypass grafting without thoracic epidural analgesia.

- Fast-track anesthesia using remifentanil, 160 patients off-pump coronary artery bypass grafting.
- Postoperative pain control by continuous remifentanil (0.0125 to 0.05 microg x kg\(^{-1}\) x min\(^{-1}\))
- RESULTS: extubation within 10 minutes of the end of operation in 150 patients (94%).
- No pulmonary complications
Immediate extubation

Immediate extubation is possible after OPCAB using either opioid-based analgesia or TEA
Hemmerling T. M. CAN J ANESTH 2004
J Cardiothorac Vasc Anesth. 2005
RCT 125 patients

Conclusions: The clinical course of elective cardiac surgical patients who receive epidural anesthesia during surgery and epidural analgesia after surgery is comparable to that of patients managed with general anesthesia alone during surgery followed by parenteral opiate analgesia after surgery
Consider

- The clinical impact of faster extubation with TEA (~ 4.5h) may be uncertain with changing cardiac anesthesia praxis.
- Recent RCT’s indicate that GA with short acting drugs results in comparable extubation times.
Thoracic Epidural versus Intravenous Patient-controlled Analgesia after Cardiac Surgery

A Randomized Controlled Trial on Length of Hospital Stay and Patient-perceived Quality of Recovery

Vigdis Hansdottir, M.D., Ph.D.,* Julia Philip, R.P.T.,§ Monika Fagevik Olsen, Ph.D., R.P.T.,† Christina Eduard, R.N.A.,|| Erik Houltz, M.D., Ph.D.,* Sven-Erik Ricksten, M.D., Ph.D.‡
Length of Hospital stay

- In elective cardiac surgery
  TEA +GA PCTEA /GA+PCA,
No major advantage
in hospital stay, recovery, morbidity
V. Hansjottir Anesthesiology 2006;104:142
There is currently no evidence to suggest that the use of TEA is associated with earlier hospital discharge
Cost?

- Hypothesized cost savings have not been clearly demonstrated.
- One report (Fillinger 2002) noted a higher total hospital cost in the TEAA group.
- Overall average patient savings of $450 in the TEAA group (Scott NB 2001).
- But consider added professional fees and hospital charges for use of an indwelling catheter in the TEAA (US) (Smith B 2005).
“Analgesia is better”

In Liu’s metaanalysis the difference was:

- at rest: TEA group 1.2 vs 2.0 opioid group
- during exercise: 1.4 TEA group vs 2.8 opioids

Effects of Preemptive TEA on Post-thoracotomy Pain

- Does preemptive thoracic epidural analgesia (TEA) initiated before surgical incision reduce the severity of acute post-thoracotomy pain and the incidence of chronic post-thoracotomy pain

Meta-analysis of 7 RCTs
Bong C. L. 2005
Acute to chronic pain

- preemptive TEA was associated with a statistically significant reduction in the severity of acute pain on coughing at 24 and 48 hours.
- Acute pain was a good predictor of chronic pain.
- no statistically significant difference in the overall incidence of chronic pain at 6 months: preemptive TEA group (39.6%) control group (48.6%).
Failure of technique

- Epidurals have failed to achieve adequate analgesia in between 33% and 50% of patients in two large studies (McLeod GA et al, *Anaesthesia* 2001; 56: 75-81, Rigg JR et al, *Lancet* 2002; 359: 1276-1278).

- not specified where catheters were placed

*L. Salvi et al Correspondence TEA EJA 2005;22:723*
Failure of technique

Salvi et all* in 677 patients reports failure rate 6.9% (C7-T7) due to:

- inabily to find the epidural space 3.8%
- Catheter not positioned properly 1%
- Block not properly functioning 2.1%
- Dural puncture 1%
- Blood tap 1%
- Vasovagal reaction 0.6%

Probable failure rate ~ 10%- 30%

* EJA 2005;22:723

This fact prompts the question of whether you would expose the patient to all of the above risks, if there is a 50% chance of the intervention being unsuccessful during the postoperative period. * *Kamming D. et all TEA for coronary artery surgery. A bridge too far? Editorial EJA 2005;22:85
question of whether you would expose the patient to all of the above risks, if there is a 10-50% chance of the intervention being unsuccessful during the postoperative period.

# Risk of epidural Haematoma after TEA in cardiac surgery

<table>
<thead>
<tr>
<th></th>
<th>95 % confidence intervals</th>
<th>99 % confidence intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidural</td>
<td>1:1,500 – 1:150,000</td>
<td>1:1000 – 1:1,500</td>
</tr>
<tr>
<td>Spinal</td>
<td>1:3,600 – 1:220,000</td>
<td>1:2,400 – 1:220,000</td>
</tr>
</tbody>
</table>

Ho A.M. Chest 2000
Danger overestimated?

- prospective audit of 2,113 cardiac surgical patients:
  - 4 temporary neurological deficits

E H reports >2000

- 2 cases of epidural hematoma in TEA for cardiac surgery. Despite surgical decompression, one of them paraplegic.
  Peggy T. Y. Li, Newsletter Soc Card Anaest. 2005

- Spontaneous E.H after cardiac surgery without epidural instrumentation: Imanaka K. 2000

- 2 E.H after epidural catheterization for cardiac surgery scheduled for the next day
  Rosen DA, Anesth Analg 2004
Consider

- No legal imperative to report occurrences. Major incidents may never be reported because of considerations of legal liability and personal reputation.
- In many out-of-court settlements there is a stipulation that neither party will publicly discuss the incident.

*Smith BE. 2005*
Little objective evidence

- For the "safe" insertion and removal of a thoracic epidural in a patient who will undergo full or partial systemic heparnization.
- Studies small uncontrolled
- Suggestions: laboratory evidence of normal coagulation prior to catheter insertion: increases cost, may delay surgery.
Little objective evidence

- If a bloody tap (3-4%) delay surgery 24 hours: increases cost and upsets surgeons
- Insert catheter the night before surgery: impractical
- TEA cannot be used in a large number of patients because of preoperative idiopathic or pharmacologic (heparin, aspirin, etc.) coagulopathy
Consider

- more than 1/2 of hematoma formation occur following **catheter removal**: care must be taken in the postoperative period
- clotting defects during and just after CABG/ECC might add to the frequency of E.H

Green, JA, 2003
Consider

- elder patients at greater risk than younger
- comorbid conditions such as diabetes mellitus and atherosclerosis might affect the ability of vessels to constrict, causing greater susceptibility to epidural hematoma
- Performing spinal decompression after CABG is daunting

Green, JA, 2003
Thoracic Epidurals in Heart Valve Surgery: Neurologic Risk Evaluation

Miguel Cantó, MD, Angeles Casas, MD, Maria J. Sánchez, MD, Ana Lorenzo MD, and Luisa Bataller

Objective: To evaluate the risk of neurologic complications resulting from epidural hematoma in a series of patients who had surgery for repair or replacement of heart valves under combined general and thoracic epidural anesthesia (TEA).

Design: Prospective observational study.

Setting: General reference hospital associated with a university.

Participants: Patients (n = 305) who had surgery for replacement or repair of heart valves.

Interventions: An epidural catheter was inserted at T1-3 as soon as the patient was in the operating room, and local anesthetic was administered as a bolus, then as a continuous infusion throughout the operation and postoperatively. A protocol for postoperative neurologic evaluation was used to rule out clinical signs of spinal lesions. A set of safety guidelines was routinely followed.

Measurements and Main Results: Preoperatively a battery of coagulation tests was systematically carried out: activated partial thromboplastin time, platelet count, and prothrombin time. Oral anticoagulants (warfarin) were stopped >60 hours before surgery, and antiplatelet drugs (aspirin) were stopped 7 days before. No patient required parenteral opiates postoperatively. Of the patients, 65% were extubated in the operating room. There were no neurologic complications resulting from epidural hematoma.

Conclusion: TEA can provide effective postoperative analgesia and assist in early tracheal extubation in cardiac valve surgery. In this series, there were no neurologic deficits detected. When certain safety measures are taken, routine TEA is feasible and helpful in cardiac valve surgery.

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KEY WORDS: thoracic epidural anesthesia (TEA), valve surgery, neurologic risk, epidural hematoma
Neurologic complications

Rare but devastating risk not known

- 4,185 patients 2,059 prospective / 2,126 retrosp.
- abdominal or abdominothoracic surgery

- puncture- and catheter-related complications less in the mid/upper than in lower thoracic region

- predicted maximum risk for permanent neurologic complications (upper bound of the 95% confidence interval) is 0.07%.

Canto M. 2002
Is TEA worth the risk?
Conclusion

- TEA results in significantly better pain relief
- There may also be a lower incidence of respiratory, cardio-vascular, and renal complications
- Length of hospital stay is not affected.
Conclusion

- The potential benefits of thoracic epidurals can be achieved via other modalities that carry less risk.
- History shows that even therapies with sound pharmacologic and physiologic rationale may prove ineffective or even harmful when evaluated by randomized clinical trials.
Conclusion

- Appropriately designed clinical studies are required prior to definitive analysis of the risk: benefit ratio of the technique
- At present time, the risk/benefit ratio of TEA in cardiac patients who will undergo full or partial heparinization is not sufficient.