


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)
TEEA 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**

Liu SS et al, *Anaesthesiology* 2004; 101:
153-161

RCT'S TEA outcomes in CBAG

Author	Year	Nr of Pants	Dosing	Results
Scott	2001	408	TEA T2-T4 GA	 Analgesia morbidity 
De Vries	2002	90	GA/TEA+GA	Early extubation
Priestly	2002	100	TEA T1-T4 GA	 Analgesia ~~ hospital stay chest XR spirometry
Royce	2003	76	TEA T1-T3	 Analgesia Postop. stress 

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. [\[i\]](#) [\[ii\]](#)

[\[i\]](#) Davis RF, et al Thoracic epidural anesthesia reduces myocardial infarct size after coronary artery occlusion in dogs. *Anesth Analg* 1986;65:711-7

[\[ii\]](#) Klassen GA, et al. Effect of acute sympathectomy by epidural anesthesia on the canine coronary circulation. *Anesthesiology* 1980;52:8-15

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 [\[ii\]](#)

- [\[i\]](#) Meissner A, Eckardt L, Kirchhof P, et al. Protective effects of Thoracic epidural anesthesia on arrhythmogenesis in chronically instrumented dogs. Anesthesiology 1998; V89:A 627
- [\[ii\]](#) Turferey DJ, Ray DA, Sutcliffe NP, et al. Thoracic epidural anaesthesia for coronary artery bypass surgery. Effects on postoperative complications. Anaesthesia 1997;52:1090-5

arrythmogenesis

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??

yes	no
<ul style="list-style-type: none">1. Scott (+Clonidine) 20012. Turfrey 1997	<ul style="list-style-type: none">1. Barrington 20032. Priestley 20023. Royse 20034. Jideus 2001

Dysrhythmias: 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 [\[ii\]](#),

[\[i\]](#) Barrington MJ, et al Anesth Analg 2005;100:921-8

[\[ii\]](#) Priestley MC et al Anesth Analg 2005;100:921-8

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% [\[iii\]](#)

[\[iiI\]](#) Loick HM, et al. Anesth Analg 1999;88:701-9

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]

^[i] Stenseth R, Bjella E, Berg O, et al. Thoracic epidural analgesia in aortocoronary bypass surgery I: Haemodynamic effects. Acta Anaesthesiol Scand 1994;38:826-33

Adverse effects in HTEA

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

^[ii] Moore CM, Cross MH, Desborough JP, et al. Hormonal effects of thoracic epidural analgesia for cardiac surgery. Br J Anaesth 1995;75:387-93

-
- **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

O'Connor CJ, Tuman KJ. Epidural anesthesia and analgesia for coronary artery bypass graft surgery: Still forbidden territory? *Anesth Analg* 2001;93:523-5

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.

- ▣ **Bois S**, Anesth Analg. 1997
- 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???



M. Fillinger et al J. Cardioth. Vasc. Anaest. 2002;16:15

RCT 60 patients
TEA: T3-T10 preop.
analgesia documented
versus GA

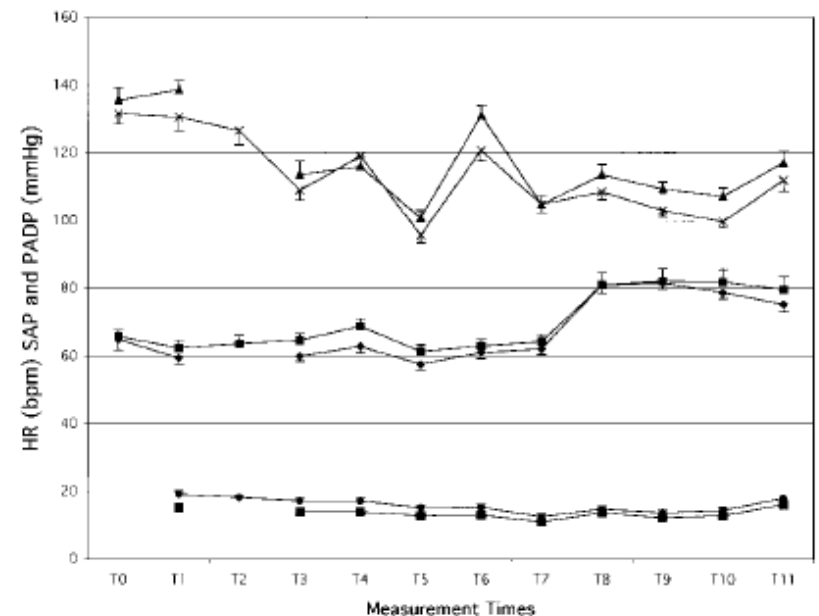


Fig 1. Hemodynamics measurements (\pm SE) at times T0 through T11 (see text) in the control and treatment groups. Abbreviations: GA, control group (general anesthesia); TEAA, treatment group (thoracic epidural anesthesia and analgesia); SAP, systolic arterial pressure; HR, heart rate; PADP, pulmonary artery diastolic pressure. ◆, HR/GA; ■, HR/TEAA; ▲, SAP/GA; X, SAP/TEAA; ■, PADP/GA; ●, PADP/TEAA.

Table 3. Perioperative Use of Vasoactive Agents

	GA	TEAA	<i>p</i> Value
Pre-CPB			
Vasodilator*	14	4	0.01
Catecholaminet	1	5	0.19
Phenylephrine	2	11	0.01
Post-CPB			
Vasodilator*	7	2	0.15
Catecholaminet	20	30	0.0005
Phenylephrine	19	21	0.78
CTICU			
Vasodilator*	10	2	0.02
Catecholaminet	16	26	0.005
Phenylephrine	13	23	0.008

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 4. Postoperative Characteristics

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

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)

hypoxemic episodes postop.

- ❑ 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.**
- ❑ [Straka Z](#), et al Ann Thorac Surg. 2002 Nov;74(5):15
- ❑ Fast-track anesthesia using remifentanyl, 160 patients off-pump coronary artery bypass grafting .
- ❑ postoperative pain control by continuous remifentanyl (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 patnts

- **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 ($\sim 4.5\text{h}$) may be uncertain with changing cardiac anesthesia praxis
- Recent RCT's indicate that GA with short acting drugs results in comparable extubation times

■ PAIN AND REGIONAL ANESTHESIA

Anesthesiology 2006; 104:142-51

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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

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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

Liu SS et al, *Anaesthesiology* 2004; 101:
153-161

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

- ❑ inability 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 al TEA for coronary artery surgery. A bridge too far? Editorial EJA 2005;22:85

Failure of technique

- ❑ 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.
- ❑ Kamming D. et al TEA for coronary artery surgery. A bridge too far? Editorial EJA 2005;22:85

Risk of epidural Haematoma after TEA in cardiac surgery

	95 % confidence intervals	99 % confidence intervals
Epidural	1:1,500 – 1:150,000	1:1000 – 1:1,500
Spinal	1:3,600 – 1:220,000	1:2,400 – 1:220,000

Ho A.M. Chest 2000

Danger overestimated?

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

Chakravarthy M, *J Cardiothorac Vasc Anesth* 2005

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 heparinization.
- 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.