

Update on Thoracic Epidurals: Are the Benefits Worth the Risks?

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INTRODUCTION

Thoracic epidural anesthesia has been established as a cornerstone in the perioperative care after thoracic and major abdominal surgery providing most effective analgesia.^{1,2} Beyond its analgesic properties, TEA's effects on the postoperative neurohumoral stress response, cardiovascular pathophysiology and intestinal dysfunction have been in the focus of both clinical and experimental investigations for years.³⁻⁶ However, as an invasive technique TEA is related to specific complications even when contraindications are properly considered. There is an ongoing debate whether these risks of TEA and its consumption of procedural resources in the perioperative period are worth the benefits with respect to outcome and organ protection.

The purpose of this lecture is to outweigh the perioperative risks related to TEA and analgesic technique and the benefits of TEA with respect to the cardiovascular system, the intestinal tract and the host immune response to the perioperative spread of malignant cells.

INCREASED SYMPATHETIC ACTIVITY AND THE STRESS RESPONSE

The term stress usually describes a state of increased sympathetic activity that is accompanied by distinct changes in the host's hormonal and immune response as well as the coagulation system.⁷ Stress is caused by a multitude of situations of physical danger or factual injury to the organism but also can be induced solely by emotional tension or fear of adverse events.⁸⁻¹⁰ The stress response, that has been highly conserved throughout evolution, can turn against the host in the case of coexisting cardiovascular disease. In these patients, even watching a soccer game lastingly increases the risk of acute coronary syndromes and significant arrhythmias.¹¹

There are different synergistic mechanisms involved in cardiac complications during stress. Increased catecholamine levels increase afterload of the left ventricle. Tachycardia further increases workload of the heart while decreasing the time for coronary perfusion.¹² While healthy coronary arteries relax to compensate for the higher need of oxygen, altered and stenotic coronary arteries are not able to relax or even constrict on sympathetic stimulation.¹³ Raised CRH-levels reduce cardiac NO-release and increase the endothelin production. This aggravates coronary endothelial dysfunction.¹⁴ Stress can induce a pro-coagulatory state in the absence of any

trauma.¹⁵ Finally, the early phase of stressful events is characterized by an proinflammatory response that may lead to plaque instability via the activation of matrix-metalloproteinases.^{16,17} This fatal triad triggers acute coronary syndromes and myocardial infarction during and after stressful events.

In the perioperative period, surgery and related interventions induce stress responses. Endotracheal intubation alone has been shown to be related to a marked increase of norepinephrine and prolactin.^{18,19} Both after minimal invasive and major open surgery increased serum levels of stress hormones were recorded.²⁰⁻²² A pro-coagulant state has been repeatedly shown after major abdominal and orthopaedic surgery and persists weeks after surgery.^{21,23,24} As a consequence of this constellation, cardiovascular mortality accounts for 63% of perioperative mortality in a high risk patient population and is still responsible for 30% of perioperative mortality in low risk patients.²⁵

TEA AND SYMPATHETIC BLOCK

TEA has been intensively investigated with respect to its effect on perioperative pathophysiology and outcome. In the scientific discussion, segmental temporary sympathetic block is assumed to be related to the beneficial effects.²⁶

However, both clinical and experimental data on sympathetic activity during TEA are scarce and needs to be interpreted carefully. Level of epidural catheter insertion, volume and concentration of local anesthetics as well as the methodological limits of sympathetic activity measurement needs to be considered.^{27,28} Microneurography is the only technique that allows direct quantitative insight into abdominal sympathetic activity. It is, however, highly limited in spatial resolution and restricted to animal experimental studies.²⁸ Many data were derived from indirect techniques relying on measurements of altered effector organ function during sympathetic block.²⁹ These parameters are, however, prone to affection by microvascular anatomy, emotional and thermoregulatory state or the presence of general anesthesia.³⁰⁻³²

TEA is supposed to induce a segmental sympathetic block covering at least the levels of sensory block. Depending on the level of insertion, this block includes cardiac sympathetic efferent fibres in high TEA and low cervical epidural anesthesia and splanchnic sympathetic nerves in the case of midthoracic TEA. The sympathetic block should be restricted to a segmental block with compensatory

increased sympathetic activity in the segments below the intended block. This concept is based on two microneurographic studies in cats and rabbits conclusively demonstrating abdominal sympathetic block when mid-thoracic sympathetic roots were covered by TEA.^{33,34}

In contrast to this, a clinical study failed to show thoracic sympathetic block within the sensory block in TEA using 4.2 ml Bupivacaine 0.75% injected at Th6-Th9.³⁵ In contrast to these negative findings, recently a thoracic sympathetic block was preoperatively demonstrated by thermography in TEA induced by low concentration and high volume of local anesthetic.²⁹ During midthoracic TEA, the decrease of skin temperature in Th4 – Th12 was significantly less pronounced compared to sham group, demonstrating reduced sympathetic vasoconstrictive activity. Similarly, in a rat model of continuous TEA an early and sustained increase in skin temperature in the dermatomes Th1, Th6 and Th12 was recorded.²⁷ In another rat model, 30µl Lidocaine 2% injected epidurally at the level of Th6 induced increase in thoracic and abdominal skin temperature as qualitatively demonstrated by thermography.³⁰

However, it is still unclear whether a limited segmental high thoracic sensoric block is accompanied by a limited sympathetic block. In experimental TEA in cats, high TEA with 0.1ml/kg Lidocaine 1% induced cardiac sympathetic block (Th1 – Th4) but increased renal sympathetic nerve activity (Th8) as recorded by microneurography. In the same study, lumbar epidural anesthesia induced renal sympathetic block and increased cardiac sympathetic block via baroreceptor-reflexes. There are no data concerning sensoric block in this model.³⁴ Clinical data on a restricted segmental block of sympathetic activity in TEA is inconclusive until today. In human, limited upper thoracic sensoric block reaching Th6 occurred during high TEA induced by 4.2 ml Bupivacaine 0.75%. In these patients, however, skin temperature in the feet also increased, suggesting unrestricted sympathetic block including splanchnic segments.³⁵ In contrast to this, 4 ml Bupivacaine 0.5% injected at Th4 induced sensory block down to Th8 but did not affect sympathetic activity in the lower legs.³² Consequently, the concentration of local anesthetic might not only determine the intensity but also extent of the sympathetic block (35,36). A higher volume of Bupivacaine 0.25% injected at a midthoracic level induced a sympathetic block including the complete sympathetic innervation of the legs.²⁹

ANTI-ISCHEMIC EFFECTS OF TEA IN CARDIAC AND NON-CARDIAC SURGERY

TEA has been repeatedly shown to decrease adverse perioperative cardiac events.^{3,37} A superior pain relief with concomitant reduction of the postoperative stress response and systemic sympathetic activity is most likely to contribute to

this effect.^{1,38,39} Furthermore, regional sympathetic block including cardiac sympathetic nerves reduces not only ischemic pain but preserves coronary perfusion during cold pressor testing. This effect was most pronounced in stenotic vessels.^{40,41} These data support findings of perioperative anti-ischemic effects of TEA both in cardiac and in non-cardiac surgery. TEA reduced diastolic dysfunction in patients with CAD undergoing operative revascularization.⁴² Diastolic dysfunction has been reported to be an early sign of cardiac ischemia. While in this study no effect on systolic function was recorded, an earlier study revealed improved systolic function and wall motion in coronary artery disease. Troponin release and long term survival after CABG underline the cardioprotective potential of TEA in that study.⁴³ In experimental myocardial ischemia TEA reduced infarct size.¹² Due to the low incidence of complications and limited study sizes, two meta-analyses failed to prove decreased myocardial infarction after TEA in cardiac surgery,^{44,45} while in non-cardiac high risk surgical patients postoperatively continued TEA prevented myocardial infarction.³⁷ However, a recent meta-analysis showed a decreased rate of combined end-points myocardial infarction and mortality after cardiac surgery in the presence of neuraxial blockade.⁴⁴

INTESTINAL PERFUSION

Safeguarding intestinal perfusion is a critical issue in the maintenance of intestinal function and integrity of mucosal barrier. TEA reversed impaired intraoperative intestinal oxygenation during major surgery and protected intestinal barrier function in experimental hypoxemia.^{46,47} In acute experimental pancreatitis and in sepsis TEA improved mucosal capillary perfusion.^{48,49} In healthy rats a shift from intermittent to continuous capillary perfusion in the face of mild hypotension was recorded during TEA.⁵⁰ Similarly, in patients undergoing esophagectomy continuous epidural infusion of Bupivacaine without a bolus dose increased anastomotic mucosal blood flow compared to the control group.⁵¹ In these studies, TEA was associated with no or only moderate hypotension. After esophagectomy the postoperative increase in cardiac output during the weaning procedure was blunted by TEA, thereby suggesting altered hemodynamic regulation.⁵¹

However, a number of clinical and experimental studies revealed adverse effects of TEA on parameters of intestinal perfusion.⁵²⁻⁵⁵ Only recently in 10 patients undergoing esophagectomy TEA has been demonstrated to reduce laser Doppler flow in the distal gastric tube mucosa.⁵⁶ All these studies reported substantial deterioration in systemic hemodynamic parameters. Mean arterial pressure was reduced by 20 – 50 % after induction or during maintenance of TEA (52,53,55,56). Cardiac output remained stable in only one of these studies,⁵⁵ but was decreased up to 35% in two other.^{52,56} Furthermore, as far as data are

provided, the animal experimental studies revealing adverse perfusion effects of TEA are related to an extended or total sympathetic block.^{52,53} The clinical study described a sensoric block reaching Th4.⁵⁴ Since sympathetic block has been found to exceed sensoric block in epidural anaesthesia and sympathetic preganglionic neurons origin not higher than Th1, the sensoric level of Th4 suggest an almost complete craniocaudal sympathetic block in these patients.²⁹

In conclusion, TEA seems to exert beneficial effects on intestinal perfusion as long as its hemodynamic consequences are adequately controlled.

INTESTINAL MOTILITY

Postoperatively, paralytic ileus and abdominal sepsis are life-threatening to the patient and have tremendous economic impact.⁵⁷ Pain, increased sympathetic tone, the use of systemic opioid analgesia and intestinal neuroinflammatory processes contribute to intestinal hypomotility.⁵⁸ The faster resolution of postoperative ileus after major open surgery is widely undisputed and attributed to superior pain therapy, reduced opioid consumption and sympathetic block.^{6,59} In a direct comparison to lidocain-PCIA, epidural application of lidocaine was shown to be more effective concerning pain control and resolution of hypomotility after colonic surgery.⁶⁰ TEA resulted in a faster resolution of postoperative ileus after major non-intestinal surgery also.⁶¹

The use of TEA in the setting of fast-track-regimen and minimal invasive approaches for major procedures has been questioned.⁶ Two recent studies of TEA after laparoscopic surgery reported improved bowel motility,^{62,63} while one other did not prove an effect of TEA.⁶⁴ However, differences in study design, technique of TEA and the surgical procedures do hinder comparison and interpretation of the data. The faster resolution of ileus was demonstrated on the background of a non-accelerated standard care. Surgery lasted about 3h and the surgical cases included major resections, such as hemicolectomy, in 12% to 55%.^{62,63} In contrast to this, TEA failed to exert beneficial effects when added to an established fast-track-program after laparoscopic sigmoidal resection with a duration of surgery of 2h.⁶⁴

ANASTOMOTIC PERFUSION AND PATENCY

The impact of TEA on anastomotic perfusion and healing of anastomosis is still unclear.

In colorectal surgery TEA has been found to decrease anastomotic blood flow and improved gastric and transverse colonic blood flow.⁵⁴ After esophagectomy, reduction in the already compromised mucosal circulation of the oral end of the gastric tube was more pronounced compared to the aboral end.⁵⁶ In both studies, however, significant systemic hemodynamic alterations were present. In contrast to this, 1h (sedated patients) and 18h (awake and extubated patients) anastomotic mucosal

blood flow was increased in TEA after esophageal resection.⁵¹

Data on anastomotic patency is also equivocal until today. Both increased rate of insufficiency and improved anastomotic healing has been reported.⁶⁵ The latter finding is supported by a recent retrospective analysis of esophageal anastomosis, demonstrating a 70% risk-reduction for anastomotic leak in the TEA group (66). This protective effect might be of tremendous importance in the light of the five-fold increase in mortality in patients with anastomotic leak.

TEA AND OUTCOME

TEA provides superior pain therapy in a wide range of thoracic and abdominal surgery.¹ However, procedure specific effectivity should be recognized. While effectivity of TEA in colonic resection is well documented little benefit is reported after hysterectomy. However, all of these studies described a significantly improved pain control in TEA, lasting up to two weeks after surgery.⁶²⁻⁶⁴ Superior pain therapy and ameliorated metabolic response are related to improved quality of life after colonic resection.^{67,68} A recent meta-analysis of pulmonary effects of TEA revealed a reduced rate of pneumonia after TEA, most probably due to earlier mobilisation, reduced opioid-consumption and improved coughing.⁶⁹

Rodgers and coworker demonstrated a 30% relative risk reduction of fatal outcome after surgery in unselected patients with neuraxial anesthesia. The evaluation included lumbar and spinal anesthesia.³ These findings were corroborated by Wu, who retrospectively demonstrated mortality in the TEA-group after colectomy and lung resections.^{70,71} In cardiac surgery an actual meta-analysis shows reduction of the combined outcomes myocardial ischemia and mortality, reduced renal failure and reduced need for ventilation in TEA for cardiac surgery.⁴⁴

TEA AND TUMOR SPREAD

Tumor resection is a most important therapeutic strategy in the cure or control of malignant diseases. However, the procedure carries oncologic risk for the patients. Surgical manipulation promote systemic spread of tumor cells, which predicts a poor outcome.^{72,73} The influence of surgical stress on the immune function impairs the host's ability to eliminate the circulating tumor cells. This includes suppression of Natural Killer cell function, increased Th2-T-cell-activity and reduced innate immune reactivity.⁷⁴

Only recently two retrospective studies demonstrated reduced tumor recurrence rate and improved survival after regional anesthesia in two important tumor entities.^{75,76} These studies attracted attention to regional anesthesia as a potential tool to influence long-term outcome by perioperative

measures.⁷⁷ Morphine has been repeatedly shown to reduce Natural Killer cell activity and to promote growth in experimental colonic cancer metastasis and experimental breast cancer.⁷⁸⁻⁸¹ Hypothermia and adrenergic response also promote experimental tumor growth.⁸² Tumor growth can be prevented by effective sympathetic block and analgesia in mice.⁸³ The observed protective effects of regional anesthesia might be therefore based both on an opioid-sparing effect and on reduced neurohumoral stress response.

RISKS OF TEA

The beneficial effects of TEA can be demonstrated in large patient populations and a favourable perioperative outcome can usually not be specifically attributed to epidural anesthesia. But albeit the number needed to harm is far higher than the number needed to treat, the complications of TEA are very specifically attributable to TEA and finally to the attending anaesthesiologist. This constellation leads to forensic risks and precautions to use TEA in critical patients, although they might profit most.⁸⁴ There are three major risk categories to be considered: a) epidural bleeding, b) the unnecessary withdrawal of low dose aspirin in cardiovascular or cerebrovascular risk patients and c) epidural infection.

EPIDURAL BLEEDING

Epidural bleeding after epidural anesthesia has an estimated incidence of 1:2,700 to 1:5,400.^{1,85,86} This marked range of risk is related to different practice of perioperative thromboembolism prophylaxis and the implementation of specific guidelines for the use of epidural analgesia and anesthesia. The incidence of epidural hematoma furthermore differs with the site of insertion and the procedure. While obstetric patients have a low rate of epidural bleeding, perioperative lumbar epidural anesthesia is more frequently complicated by bloody puncture and epidural hematoma than thoracic epidural catheterization.^{1,87} Recently, in a series of 10,000 TEA no epidural hematoma was described.¹ Elderly female scheduled for lower limb arthroplasty have been repeatedly found to carry an especially high risk. In these patients alternative therapeutic strategies need to be considered.¹ Pre-existing coagulation disorders and the use of anticoagulant or antiplatelet drugs are the most prominent risk factors of perioperative epidural hematoma. Furthermore, aged patients are at increased risk of epidural complications, most probably due both to age related alterations of spinal anatomy and to impaired renal function with unexpectedly prolonged drug effects. For example, even a mild impairment of renal function increase the time of effective anticoagulation by low molecular weight heparin (LMWH) from 6.6 to 9.9 hours. In case of severe renal impairment LMWH effect lasts more than 15 hours.⁸⁸ Finally, repeated and bloody puncture increase the risk of epidural bleeding.^{1,89,90}

WITHDRAWAL OF ASPIRIN

In the western countries approximately 1.8 million coronary stents are implanted each year⁹¹ and 500,000 strokes occur annually in the European union.⁹² The high incidence of cardiovascular and cerebrovascular diseases in surgical patients results in an increased use of antiplatelet and anticoagulant drugs for secondary prophylaxis in patients scheduled for TEA.

The withdrawal of antiplatelet drugs leads to rebound effects with increased rate of thromboembolic events.^{93,94} This rebound effect is aggravated by the prothrombotic and proinflammatory state induced by surgery. In case of antiplatelet drug discontinuation within 3 weeks after stenting, mortality is to 30 - 86%.⁹¹ Late stent thrombosis after antiplatelet drug discontinuation can occur more than one year after stenting.^{95,96} Consequently it has become consensus to continue antiplatelet medication in almost all surgical cases. Only in emergency intracranial, spinal and intraocular surgery, in which bleeding is potentially catastrophic, cessation and bridging with tirofiban and Heparin is recommended.⁹¹

The use of perioperative TEA must not lead to cessation of low dose acetylsalicylic acid prescribed for secondary prophylaxis. There is most probably no increase in the rate of spinal epidural hematoma during low dose ASS intake.⁹⁷ However, the combination of ASS with other anticoagulant or antiplatelet drugs must be excluded in case TEA is planned. Standard operating procedures assuring the beginning of thromboembolic prophylaxis after surgery are suitable to increase the use of TEA in patients on ASS-prophylaxis.

When TEA is planned in patients using other antiplatelet or anticoagulant drugs, specific time intervals should be kept between the last medication and both catheter placement and catheter removal as reviewed earlier in detail.⁹⁸ Since catheter removal is a critical phase with increased incidence of epidural bleeding, neurologic surveillance must be assured until 24 h after catheter removal. This notion is emphasized by recent data from the UK reporting delayed diagnosis in 4 of 5 cases of epidural hematoma with persistent harm. Only one patient was treated in time and reached full recovery.⁸⁷

INFECTIOUS COMPLICATIONS

TEA is an invasive analgesic technique and as such inevitably associated with the risk of local infectious complications. Iatrogenic pathogen inoculation and haematogenous infection of the insertion site or the epidural catheter are the potential causes of infection within the vertebral canal.⁹⁹ Estimates of incidence vary widely.⁹⁹ Recent data from Germany report an incidence of 1 abscess in 10,000 patients with TEA (1). In the UK an incidence of 1:24,000 epidural abscesses was found after perioperative neuraxial blockade with 10 of 13 cases in the study

period related to epidural anesthesia.⁸⁷ Epidural abscess with spinal cord and radicular compression is the predominant complication after TEA and usually caused by staphylococcus aureus. Meningitis has also been reported with a lower incidence. It is usually caused by streptococcus species.^{99,100} Infectious complications may occur as early as day 2 but usually present beginning from day 4 or later. They are often, but not always, accompanied by signs of infection of the insertion site and most often present with incomplete or unspecific symptoms. This frequently results in delayed diagnosis and underlines the necessity of close clinical observation and high level of suspicion.⁸⁷ The prognosis of infectious complications is better than that of epidural bleeding. All patients with meningitis reached full recovery and approximately 50 % of patients with epidural abscesses recover without permanent disability.⁸⁷

CONCLUSIONS

TEA provides optimal pain therapy in a wide range of surgical procedures and might reduce perioperative morbidity and mortality after major abdominal and thoracic surgery. Furthermore TEA might influence tumor progression after oncologic surgery. However, due to the low overall incidence of postoperative complications in many surgical procedures and the uncertainty concerning the incidence of epidural bleeding and infectious complications, procedure-specific evidence-based recommendations concerning TEA are still hard to make.

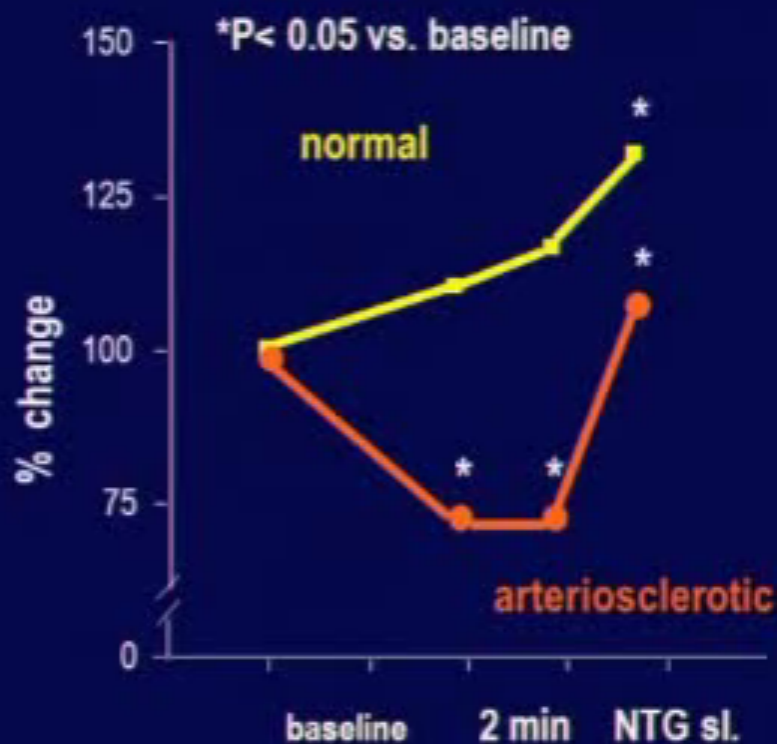
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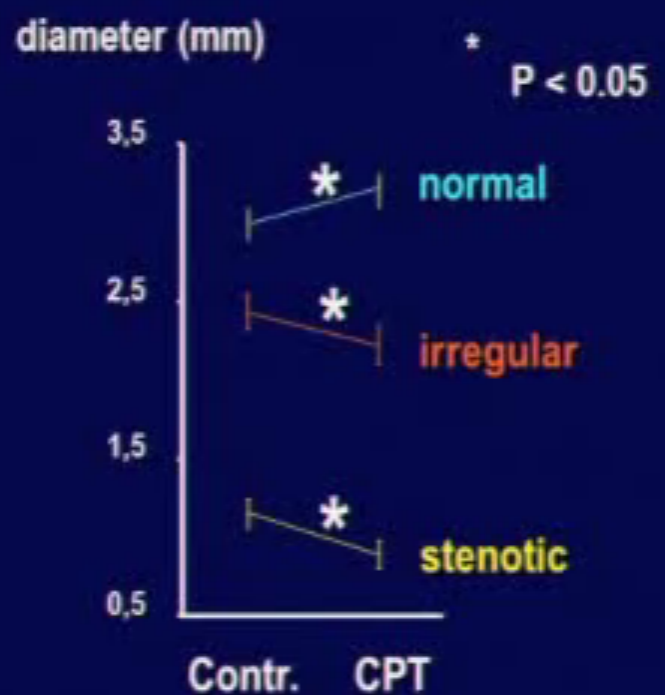
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Sympathetic Stimulation Leads to Vasoconstriction of Arteriosclerotic Coronary Arteries



Gage et al., Circulation 1986; 5: 865-876

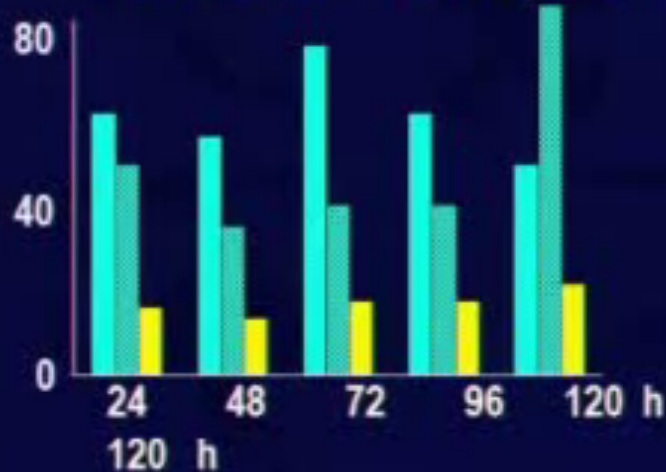


Nabel et al., Circulation 1988; 77: 43

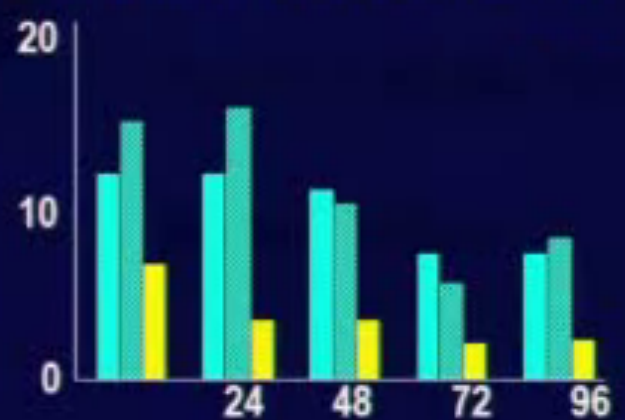
TEA and Multimodal Therapy Reduce Surgical Stress Response

- G1: General anesthesia; n=15
 - G2: General anesthesia + intraop TEA; n=15
 - G3: General anesthesia + intraop TEA + multimodal therapy; n=15
- p < 0.05 (G3 vs G1 + 2)

norepinephrine (μg / 24h-urine)

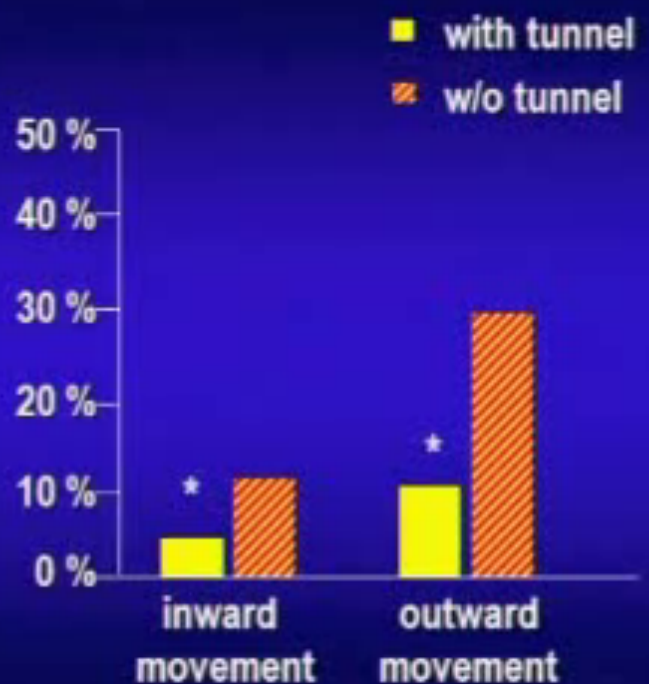


epinephrine (μg / 24 h-urine)



Brodner, Van Aken, Hertle, Kehlet et al., Anesth Analg 2001; 92: 1594-1600

Dislocation of Epidural Catheters: Effect of Tunneling



Thoracic Epidural Anesthesia and the Patient with Heart Disease: Benefits, Risks, and Controversies

Andreas Meißner, MD, Norbert Rolf, MD, and Hugo Van Aken, MD, PhD

Klinik und Poliklinik für Anästhesiologie und operative Intensivmedizin der Westfälischen Wilhelms-Universität, Münster, Germany

Blockade of the Sympathetic Nervous System

vasodilatation



blocked regions

arteries / arterioles

vasoconstriction



unblocked regions

Thoracic Epidural Anesthesia and the Patient with Heart Disease: Benefits, Risks, and Controversies

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Klinik und Poliklinik für Anästhesiologie und operative Intensivmedizin der Westfälischen Wilhelms-Universität, Münster, Germany

Anesth Analg 1997;85:517-28

517

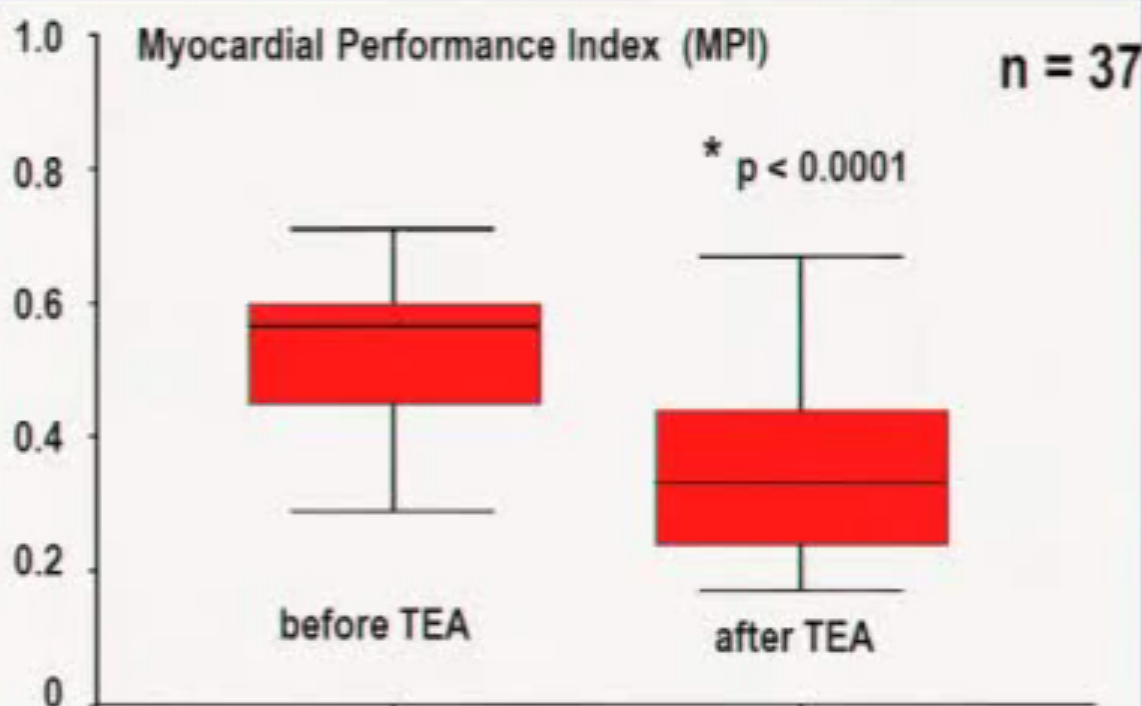
Lumbar versus Thoracic Epidural ...



The Effect of High Thoracic Epidural Anesthesia on Systolic and Diastolic Left Ventricular Function in Patients with Coronary Artery Disease

Christoph Schmidt, MD*, Frank Hinder, MD, PhD*, Hugo Van Aken, MD, PhD, FRCA, FANZCA*, Gregor Theilmeier, MD*, Christian Bruch, MD, PhD†, Stefan P. Wirtz, MD*, Hartmut Bürkle, MD, PhD*, Tim Gühs, MD*, Markus Rothenburger, MD, PhD‡, and Elmar Berendes, MD, PhD*

Departments of *Anesthesiology and Surgical Intensive-Care Medicine, †Cardiology, and ‡Chest, Heart, and Vascular Surgery, University of Münster Hospital, Germany



TEA improved myocardial function by improvement of diastolic function

TEA Reduces the Incidence of Myocardial Infarction



Beattie et al., Anesth Analg 2001; 93: 853-8

Reversible Cardiac Sympathectomy by High Thoracic Epidural Anesthesia Improves Regional Left Ventricular Function in Patients Undergoing Coronary Artery Bypass Grafting

A Randomized Trial

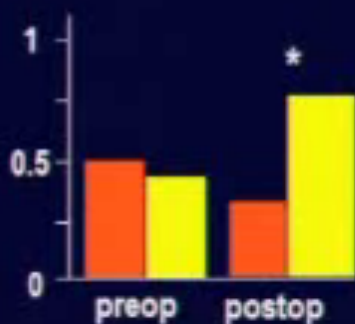
Elmar Berendes, MD; Christoph Schmidt, MD; Hugo Van Aken, MD, PhD; Matke Grosse Hartlage, MD; Stefan Wirtz, MD; Holger Reinecke, MD; Markus Rothenburger, MD; Hans-Heinrich Scheld, MD; Bernhard Schlüter, MD; Gerhard Bröckner, MD; Michael Walter, MD

Arch Surg. 2003;138:1283-1290

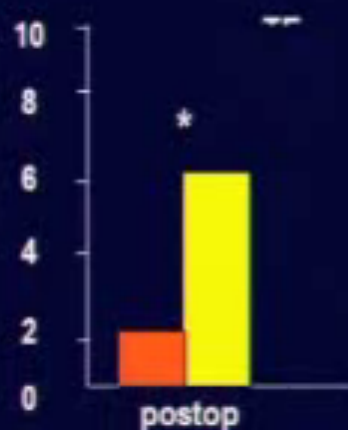
prospective randomized study, 73 patients, EF > 50%

■ TEA and GA ■ GA

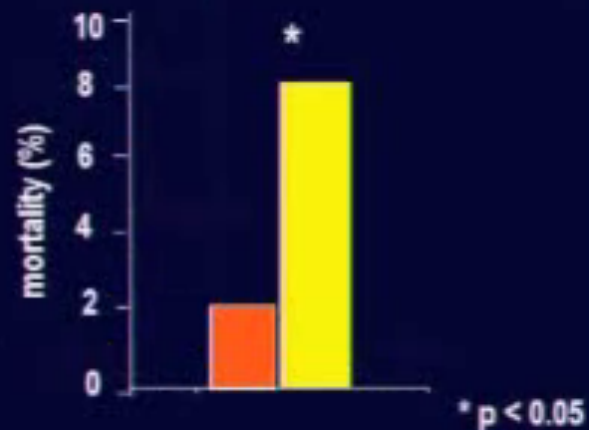
Regional wall motion abnormalities (points)



Troponin I (ng/ml)



2 years mortality

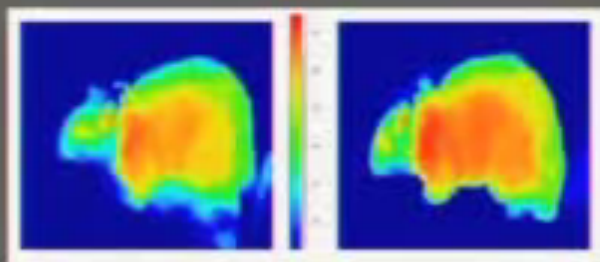
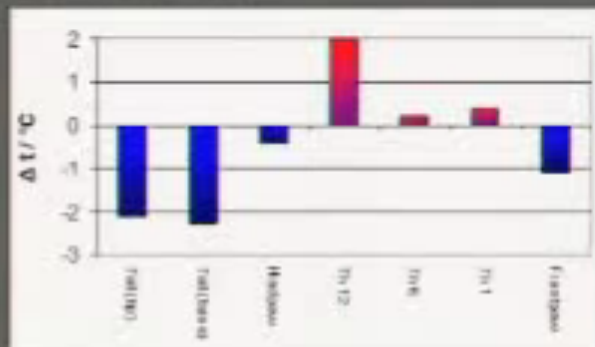


* p < 0.05

Thoracic Epidural Analgesia with Low Concentration of Bupivacaine Induces Thoracic and Lumbar Sympathetic Block

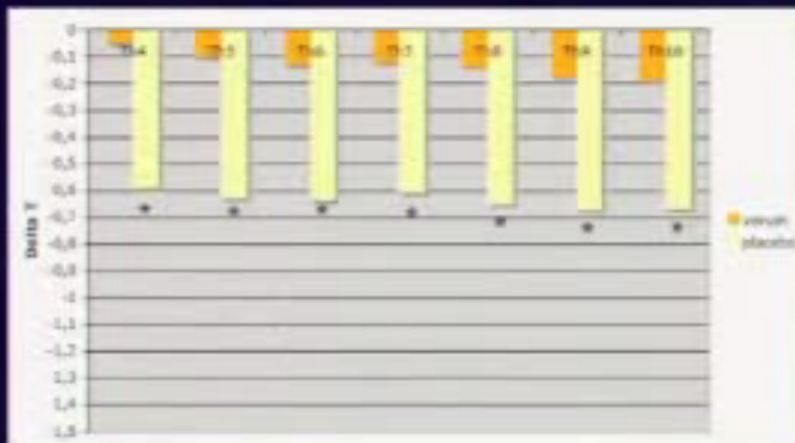
A Randomized, Double-blind Clinical Trial

Hendrik Freise, M.D.,* Andreas Meissner, M.D.,† Stefan Lauer, M.D.,* Björn Elger, M.D.,‡ Robert Radke, M.D.,§ Mathias Bruewer, M.D.,|| Gerd Brodner, M.D.,# Hugo K. Van Aken, M.D.,** Andreas W. Sielenkämper, M.D.,† Lars G. Fischer, M.D.,†



bupivacaine 0.25% 15 µl/h at T5-T7

Freise, Van Aken, Sielenkämper et al.:
Anesth Analg 2005; 100: 255

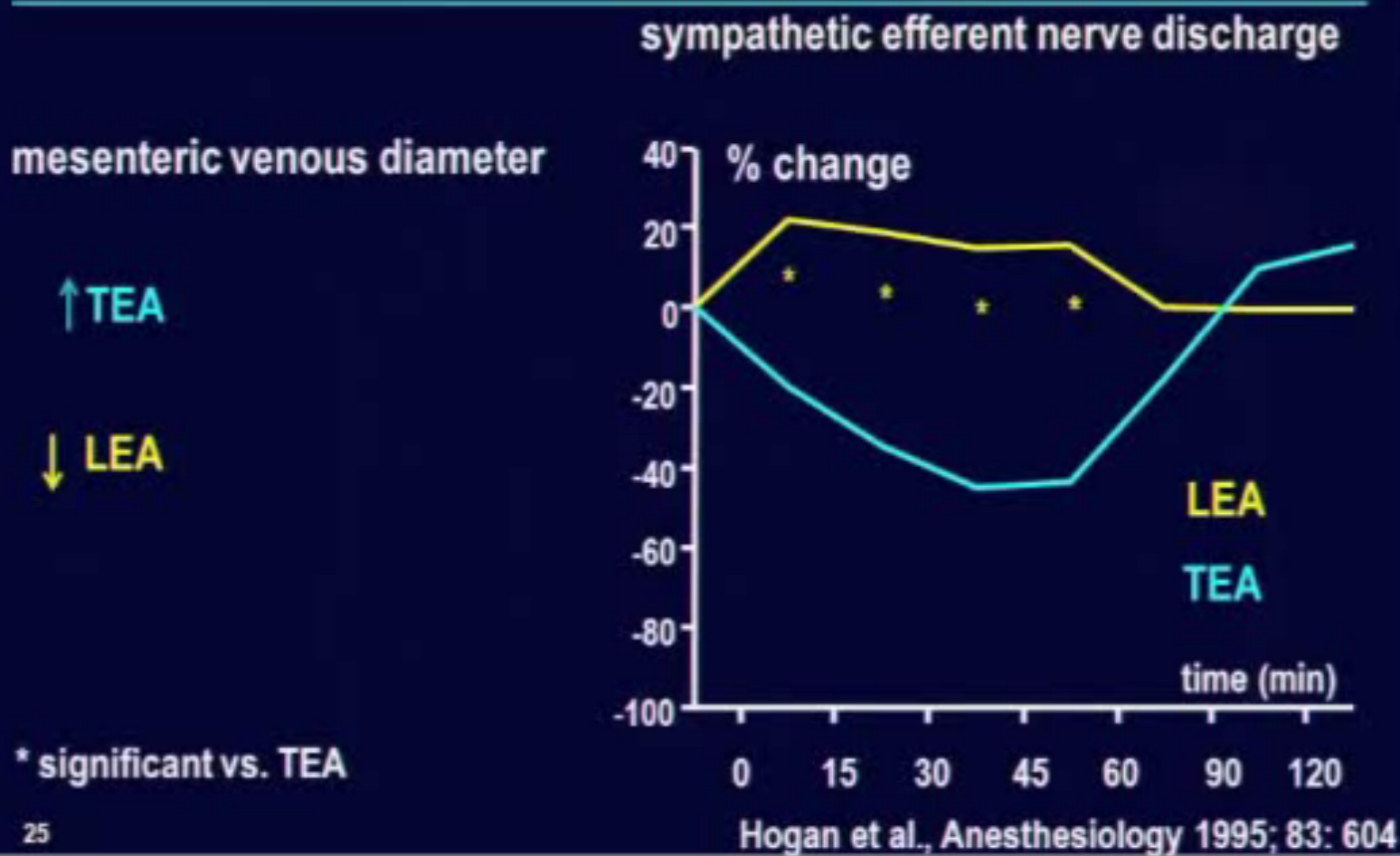


- N = 19 pts undergoing major abdominal surgery,
- TEA with 10 ml of bupivacaine 0.25% vs. placebo,
- Skin temperature measured with infrared thermography

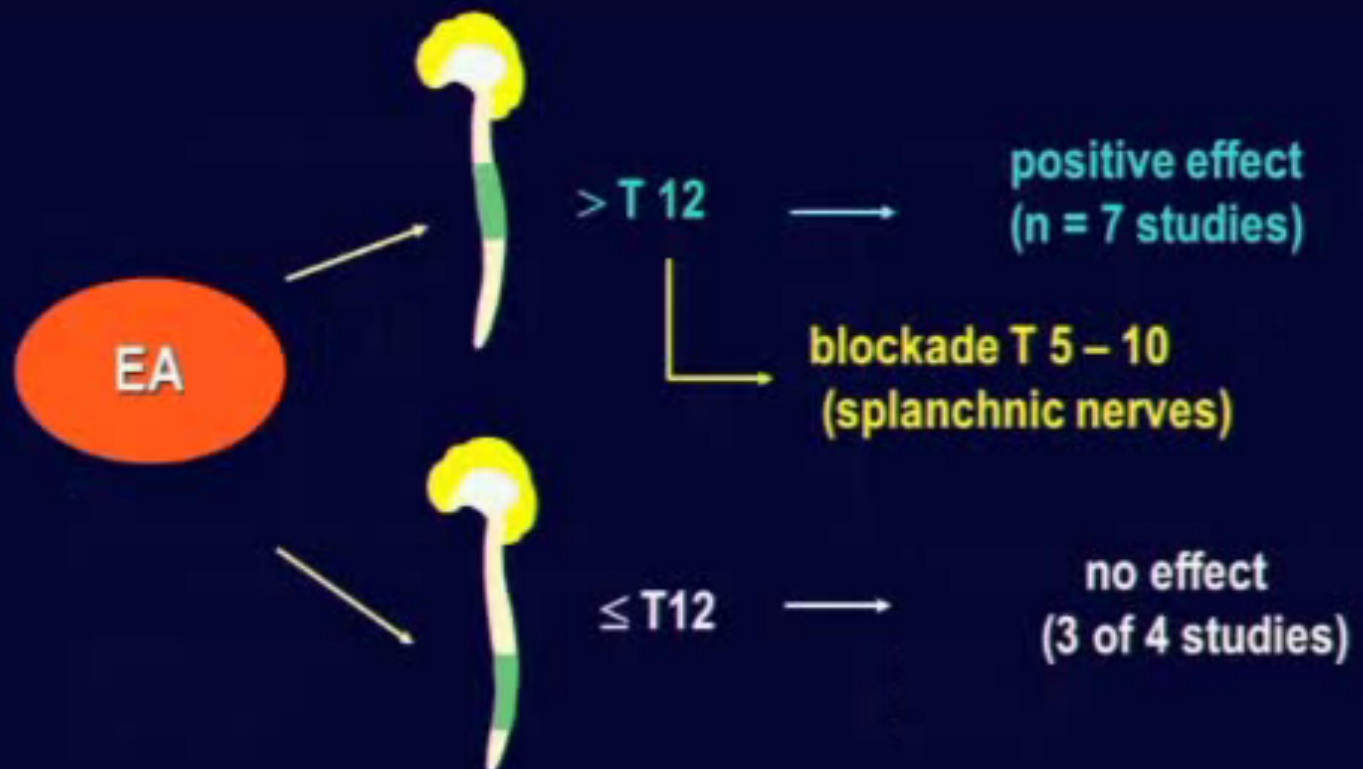
*p<0.05

Freise, Radke, Van Aken et al.:
Anesthesiology 2008; 109: 1107

Sympathetic Nerve Activity in Mesenteric Vessels during Epidural Anesthesia



Effects of TEA on Gastrointestinal Motility



Steinbrook, Anesth Analg 1998; 86: 837-44

CHEST

Official publication of the American College of Chest Physicians



Perioperative Risk Factors for Anastomotic Leakage After Esophagectomy

Pierre Michelet, Xavier-Benoît D Journo, Antoine Roch, Laurent Papazian, Jacques Ragni, Pascal Thomas and Jean-Pierre Auffray

Chest 2005;128:3461-3466

Retrospective analysis of 207 patients, 11% anastomotic leakages

Characteristic	Overall	No Anastomotic Leak	Anastomotic Leak	p Value
		(n = 184)	(n = 23)	
Cervical anastomosis	59 (28.5%)	45 (24.5%)	14 (61%)	< 0.001
Hypotensive event	51 (28.2%)	34 (21.5%)	17 (73.9%)	< 0.001
Estimated blood loss, mL	494 (±234%)	451 (±221%)	694 (±189%)	< 0.001
Epidural analgesia	93 (45%)	90 (49%)	3 (13%)	0.002
ARDS	29 (14%)	19 (10.3%)	10 (43.5%)	< 0.001

postoperative mortality in anastomotic leakage 26% vs. 5.4%

Correlation of postoperative epidural analgesia on morbidity and mortality after colectomy in Medicare patients[☆]

Christopher L. Wu MD (Associate Professor)^{a,*},
Andrew J. Rowlingson BA (Research Associate)^a,
Robert Herbert (Research Associate)^b,
Jeffrey M. Richman MD (Assistant Professor)^a,
Robert A.F. Andrews MD (Resident)^a, Lee A. Fleisher MD (Professor)^c

J Clin Anesth 2006; 18: 594-599

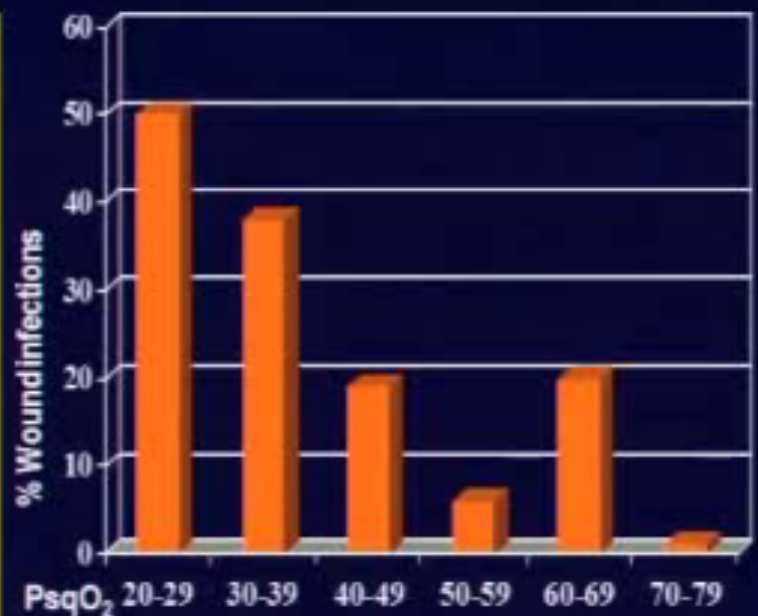
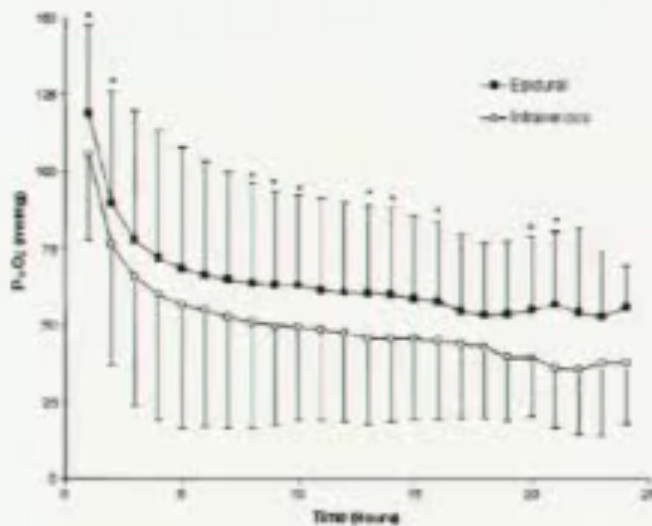
- cohort of 12817 patients obtained from a 5% nationally random sample of Medicare beneficiaries from 1997 to 2001

2253 with EDA, 10564 without EDA

Epidural analgesia results in significant decrease in mortality

- 7 days risk reduction 65%
- 30 days risk reduction 46%

TEA Improves Tissue Oxygenation



- rand. blinded study, abdom. surgery
- GA and morphine PCIA vs. GA and TEA for > 24 h, FiO₂ 0,4

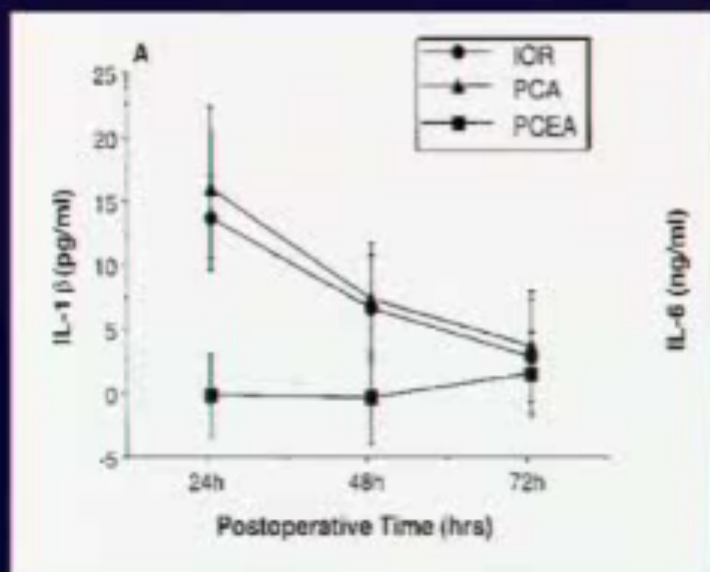
...the present study shows a clear correlation between PsqO₂ and infection rate in surgical wounds.

Buggy et al., Anesthesiology 2002; 97: 952-958

Hopf, Arch Surg 1997; 1342: 997-1004

TEA Improves the Immune System

Reduction of postoperative pro-inflammatory cytokines with EDA



150 patients, abdominal surgery

IOR: intermittent opiate regimen
pethidin i.m. if required

PCIA: morphine

PCEA: bupivacaine 0.1% with
fentanyl 2 µg/ml

Beilin et al. Anesth Analg 2003; 97: 822-827

Thoracic Epidural Anesthesia Compared to Remifentanyl Reduces Chronic Pain after Thoracomy

High-dose: remifentanyl 0.19 µg/kg/min, plus TEA postoperatively

Low-dose: remifentanyl 0.06 µg/kg/min plus TEA intra- and postoperatively

Table 3. Number of Patients with Pain

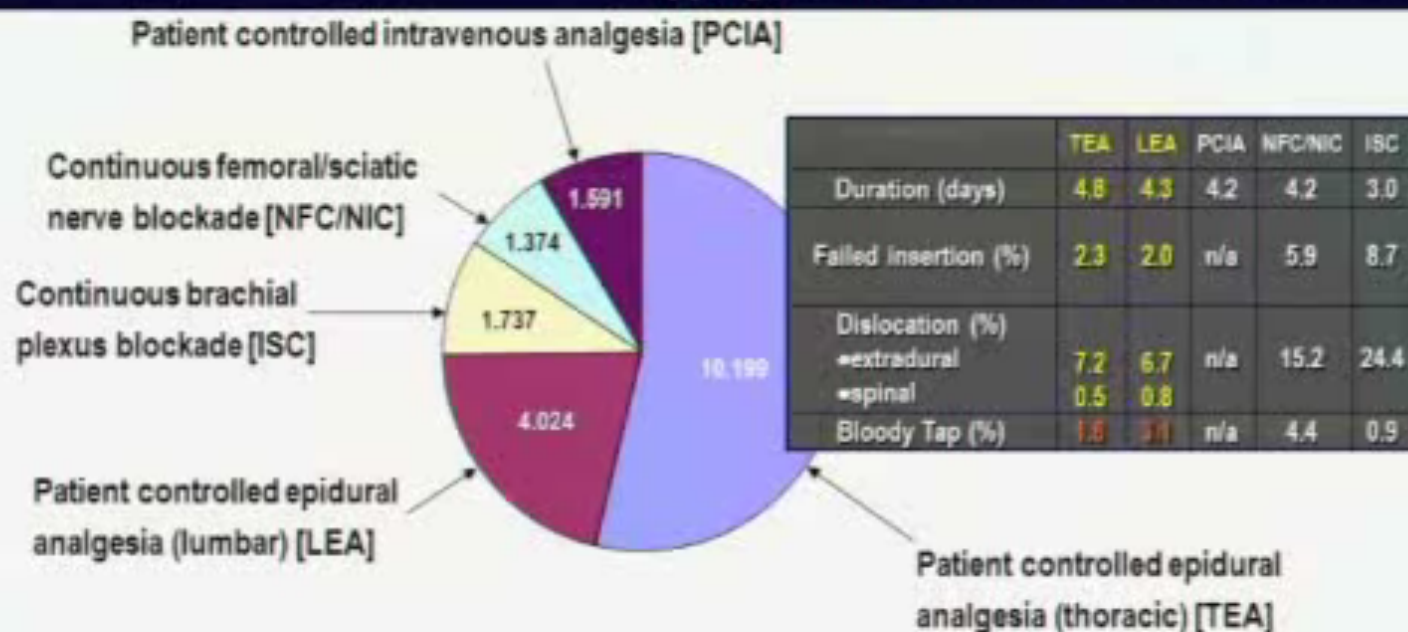
	High-Dose Group N = 20	Low-Dose Group N = 18	RR [95% CI]	<i>p</i> Value
1 month postop	16 (80%)	12 (66.7%)	1.2 [0.81-1.78]	0.364
3 months postop	15 (75%)	5 (27.8%)	2.7 [1.23-5.93]	0.013
6 months postop	16 (80%)	5 (27.8%)	2.9 [1.32-6.26]	0.008
End of study	14 (70%)	3 (16.7%)	4.2 [1.44- 12.27]	0.009

Salengros et al., J Cardiothorac Vasc Anesth 2010; 24: 608-616

Effectiveness and safety of postoperative pain management: a survey of 18 925 consecutive patients between 1998 and 2006 (2nd revision): a database analysis of prospectively raised data[†]

D. M. Pöpping^{*}, P. K. Zahn, H. K. Van Aken, B. Dasch, R. Boche and E. M. Pogatzki-Zahn

Pöpping, Zahn, Van Aken: BJA 2008; 101: 832



Effectiveness and safety of postoperative pain management: a survey of 18 925 consecutive patients between 1998 and 2006 (2nd revision): a database analysis of prospectively raised data[†]

D. M. Pöpping^{*}, P. K. Zahn, H. K. Van Aken, B. Dasch, R. Boche and E. M. Pogatzki-Zahn

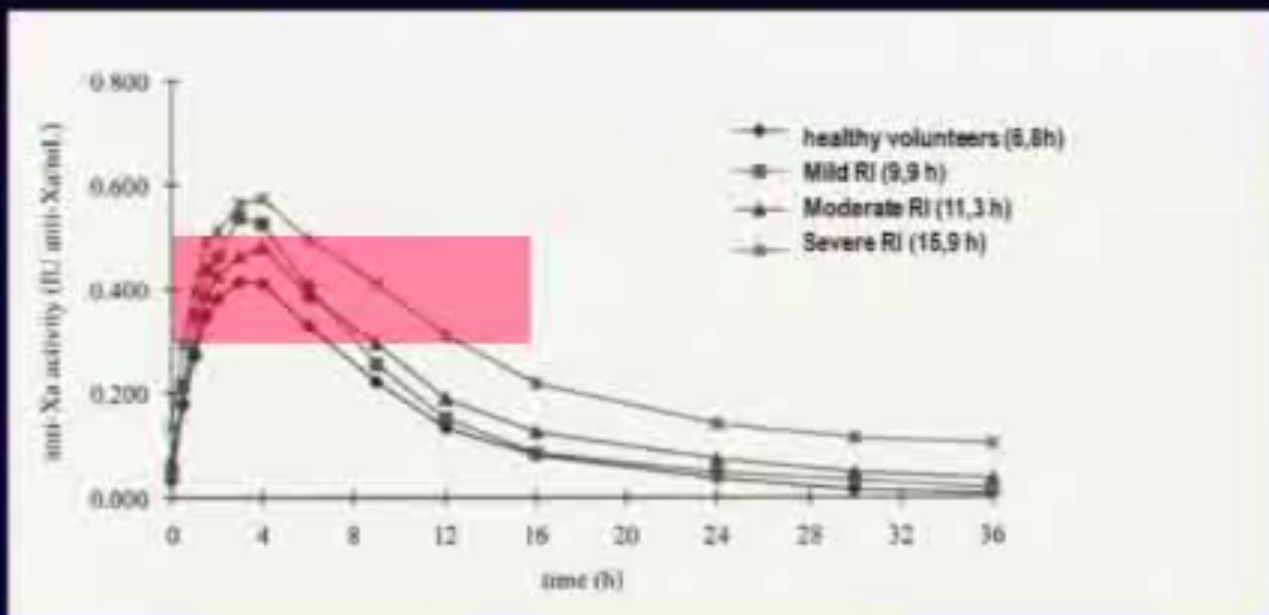
Prospective survey, 14.223 epidural anesthetics 1998-2006

Thoracic epidural hematoma	0: 10.199
Lumbar epidural hematoma (n=3)	1: 1.341
Epidural abscess (n=2)	1: 7.112
Lumbar epidural abscess	1: 4.283
Thoracic epidural abscess	1: 10.199
Surgical evacuation	1: 14.223

no permanent nerve damage except one patient with partial recovery of neurological function with persistent urinary incontinence but normal sphincter function after lumbar epidural abscess

Anti-Xa-Activity after Subcutaneous Enoxaparin

40 mg enoxaparin s.c. for 4 days
therapeutic range 0.3 -0.5 anti Xa units



Sanderink et al., Thromb Res 2002; 105: 225-231

LMWH and Chronic Kidney Disease

Creatinine clearance > 30-50 ml/min full dose

(Creatinine clearance < 30 ml/min: dose reduction (50%) FDA)

LMWH contraindicated in Germany (BfArM)

MDRD (modification of diet in renal disease)

$$\text{GFR (ml/min/1.73 m}^2\text{)} = (186 \times \text{Cr}^{-1.154} \times \text{Age}^{-0.203}) \times 0.742$$

BSA (Dubois)

$$\text{BSA (m}^2\text{)} = 0.007184 \times \text{height (cm)}^{0.725} \times \text{weight (kg)}^{0.425}$$

http://www.fda.gov/medwatch/SAFETY/2004/lovenox_PI.pdf

To continue or discontinue aspirin in the perioperative period: a randomized, controlled clinical trial

A. Oscarsson^{1,6}, A. Gupta^{1,5}, M. Fredrikson¹, J. Järhult⁴, M. Nyström¹, E. Pettersson¹,
B. Darvish⁵, H. Krook⁶, E. Swahn² and C. Eintrei¹

British Journal of Anaesthesia 104 (3): 305–12 (2010)

Perioperative cardiovascular events with and without aspirin

	Aspirin (n=109)	Per cent	Placebo (n=111)	Per cent	P-value
Troponin T $\geq 0.04 \mu\text{g}$ litre ⁻¹ after operation	4	3.7	10	9.0	0.10
Acute myocardial infarction	2		7		
Severe arrhythmia	0		2		
Cardiac arrest	0		1		
Cardiovascular death	1		0		
TIA/stroke	2		2		
Major adverse cardiac events	2	1.8	10	9.0	0.02
Cardio-cerebrovascular events	3	2.7	10	9.0	0.049

- 220 patients with CHD,
- no stents,
- no cardiothoracic operations

Aspirin and the Risk of Surgical Bleeding

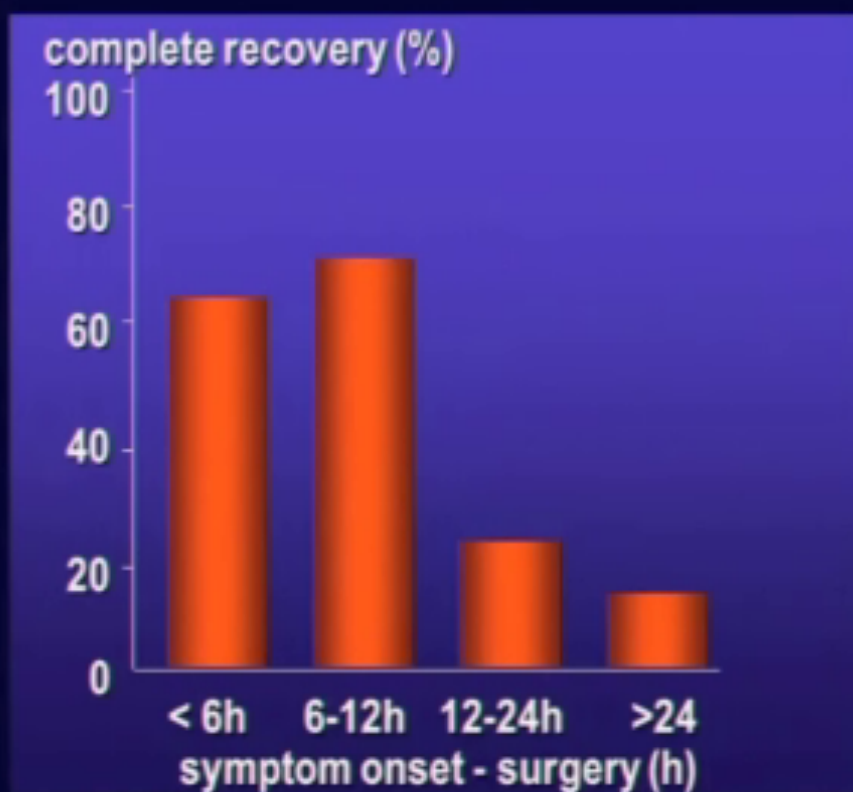
meta-analysis, 49,590 patients, 14981 on aspirin

Type of surgery	RR	P
gastroenterology, ophthalmology	1.05	ns
orthopedic surgery	0.6-6.2	ns
urology (transfusion, prostate surgery)	2.7	0.008
vascular surgery	1.2-1.9	ns
tonsillectomy	7.2	0.001

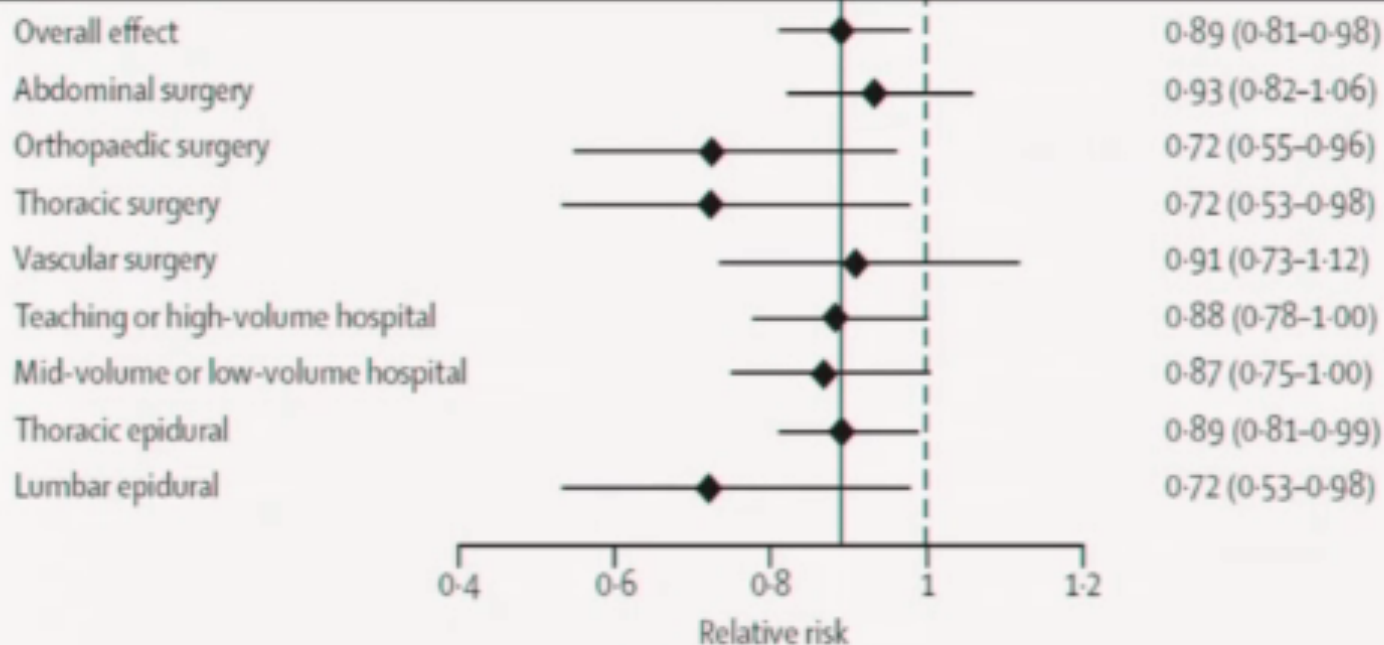
Neurosurgery not included, but even minor bleedings may be devastating

Burger et al., J Intern Med 2005; 257: 399-414

Neurologic Recovery in Patients with cord compression: Recovery dependent on Time from Symptom Onset to Surgical Decompression



Association of epidural Anaest / Analg with 30-day mortality and epidural haematoma



Epidural n=44 094	No epidural n=44 094
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Spinal decompression laminectomy†	8 (0.02%)	7 (0.02%)
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Hypotension during Fluid-restricted Abdominal Surgery

Effects of Norepinephrine Treatment on Regional and Microcirculatory Blood Flow in the Intestinal Tract

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What We Know about This Topic

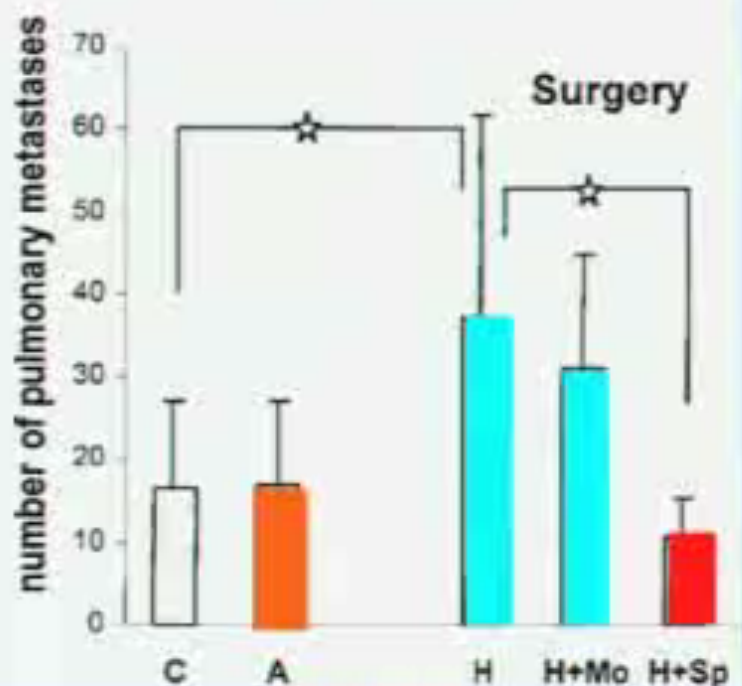
- There is a lack of correlation between intestinal microcirculation and regional splanchnic or systemic blood flow.
- It is not known whether norepinephrine, a potent vasoconstrictor, reduces intestinal microcirculatory blood flow when it is used to increase systemic perfusion pressure.

What This Article Tells Us That Is New

- Reversal of mild perioperative hypotension with norepinephrine, increased systemic blood flow, but did not significantly affect regional hepatosplanchnic blood flow nor affect oxygen tension in intestinal tissue.

Attenuation of the Tumor-promoting Effect of Surgery by Spinal Blockade in Rats

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C = control

A = anesthesia only

H = halothane anesthesia

H+Mo = halothane and systemic morphine

H+Sp = halothane and spinal block