



# New Developments in Neuraxial Anesthesia

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# Disclosures

- No conflicts of interest or financial disclosures

# New Developments in Neuraxial Anesthesia

- Benefits of neuraxial anesthesia in surgical procedures
- Sedation techniques
- New anticoagulation guidelines
- Multiport vs. single port catheters

# Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials

Anthony Rodgers, Natalie Walker, S Schug, A McKee, H Kehlet, A van Zundert, D Sage, M Futter, G Saville, T Clark, S MacMahon

- Systematic review of 141 trials, 9559 patients
- Overall mortality after 30 days was 1/3 less in neuraxial group
- Decreased pulmonary embolisms, cardiac events, strokes, deaths from infection, and deaths from other causes

**Table 2** Summary of vascular events and bleeding

Group	Vascular events												Bleeding			
	Deep vein thrombosis		Pulmonary embolism		Myocardial infarction		Cardiac arrhythmia		Other fatal cardiac event		Stroke		Perioperative transfusion requiring >2 units red cells		Postoperative bleed requiring transfusion	
	NB	No NB	NB	No NB	NB	No NB	NB	No NB	NB	No NB	NB	No NB	NB	No NB	NB	No NB
General	26															0
Orthopaedics	117															57
Urology	2															0
Vascular	0															11
Other	0															1
<b>Total</b>	<b>145</b>	<b>220</b>	<b>30</b>	<b>66</b>	<b>45</b>	<b>59</b>	<b>59</b>	<b>76</b>	<b>9</b>	<b>4</b>	<b>19</b>	<b>23</b>	<b>193</b>	<b>280</b>	<b>31</b>	<b>69</b>

• Neuraxial blockade reduced risk of PE/DVT by almost half  
 • 1/3 fewer cardiac events  
 • Decreased bleeding with decreased transfusions in NB

NB=neuraxial blockade.



## **Recent Advances in Epidural Analgesia**

**Maria Bauer,<sup>1</sup> John E. George III,<sup>2</sup> John Seif,<sup>2</sup> and Ehab Farag<sup>1,2</sup>**

<sup>1</sup> *Department of Outcomes Research, Cleveland Clinic, Cleveland, OH 44195, USA*

<sup>2</sup> *Anesthesiology Institute, Cleveland Clinic, Cleveland, OH 44195, USA*

- ↓ DVT 44%/↓ PE 55%
- ↓ Transfusion requirements 50%
- ↓ Pneumonia 39%/↓ Respiratory depression 59%
- Reduced incidence of postop ileus
- Reduced time to extubation and ICU stay
- Decreased perioperative coagulability
- Attenuation of stress response in CAGB surgery

# A Prospective Randomized Study of the Potential Benefits of Thoracic Epidural Anesthesia and Analgesia in Patients Undergoing Coronary Artery Bypass Grafting

Nicholas B. Scott, FRCS (Ed), FFARCS(I)\*, Deborah J. Turfrey, FRCA\*,  
Dominic A. A. Ray, FRCA, MSc\*, Onyukwelu Nzewi, FRCS\*, Nicholas P. Sutcliffe, FRCA, MRCP\*,  
Adarsh B. Lal, FRCA\*, John Norrie, MSc†, Werner J. B. Nagels, MD\*, and  
G. Pradeep Ramayya, FRCA\*

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- 420 patients undergoing routine CABG
- TEA 0.125% bupivacaine/0.6 µg/mL clonidine vs. alfentanil infusion/morphine PCA
- Postop complications data collected for 5 days
- Pulmonary complications, arrhythmias, MI, renal failure, CVA, acute confusion, bleeding



Table 4. Unadjusted and Adjusted Odds Ratios for GA Versus TEA for Various Outcomes

Outcome	TEA ( <i>n</i> = 206), <i>n</i> (%)	GA ( <i>n</i> = 202), <i>n</i> (%)	Unadjusted		Adjusted <sup>a</sup>	
			OR (95% CI)	<i>P</i> value	OR (95% CI)	<i>P</i> value
Supraventricular arrhythmia	21 (10.2)	45 (22.3)	2.53 (1.44–4.42)	0.0012	2.56 (1.41–4.66)	0.0020
Lower respiratory tract infection	31 (15.3)	59 (29.2)	2.33 (1.43–3.79)	0.0007	2.06 (1.22–3.47)	0.0065
Renal failure	4 (2.0)	14 (6.9)	3.69 (1.34–10.2)	0.016 <sup>b</sup>	Not fitted <sup>c</sup>	
CVA	2 (1.0)	6 (3.0)	3.12 (0.62–15.7)	0.17 <sup>b</sup>	Not fitted <sup>c</sup>	
Acute confusion	3 (1.5)	11 (5.5)	3.90 (1.07–14.2)	0.031 <sup>b</sup>	Not fitted <sup>c</sup>	
Significant bleeding	35	23	0.63 (0.36–1.11)	0.11	0.52 (0.28–0.96)	0.035
Any complications	84	108	1.67 (1.13–2.47)	0.011	1.44 (0.95–2.19)	0.089

TEA = thoracic epidural analgesia; GA = general anesthesia; OR = odds ratio; CVA = cerebrovascular accident; CI = confidence interval.

<sup>a</sup> Data missing on some of the adjusted covariates for nine subjects.

<sup>b</sup> Fisher's exact tests.

<sup>c</sup> Adjusted model not fitted because of sparsity of events.

Table 5. Preextubation Lung Volume and Time to Endotracheal Extubation

Description	GA group		TEA group		P value
	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	
Maximal expiratory lung volume (mL)	46	733 (208)	47	985 (326)	<0.001
Time to extubation	<i>n</i>	%	<i>n</i>	%	
Immediate (<4 h)	11	5.5	51	25.0	<0.0001
<12 h	136	67.8	112	54.9	
12–24 h	25	12.4	19	9.3	
>24 h	29	14.3	22	10.8	

GA = general anesthesia; TEA = thoracic epidural analgesia.

- 50% reduction in lower respiratory tract infections
- 30% increase in lung volumes
- Faster extubation within first 4 hours
- Quicker transfer from ICU to step down unit

# Stress Response to Surgery

- Release of cytokines
- Oxygen free radical production
- Influx of neutrophils
- Release of prostanoids

Local Wound

Modulation by CNS

- Pain
- Anxiety
- Hypothermia
- Hyperthermia

- Catecholamines
- Glucagon
- Cortisol
- ACTH

Endocrine Response

Systemic Inflammation

Systemic Response

- Increased Oxygen Consumption
- Increased Metabolic Rate
- Increased Temperature
- Protein Catabolism, Loss Lean Body Mass
- Blood Flow Maldistribution Leading to Ischemia

Normal Wound Healing

Fatigue

SIRS

Sepsis

Multi-Organ Failure

## ***Effects of Preemptive Analgesia on Pain and Cytokine Production in the Postoperative Period***

*Benzion Beilin, M.D.,\* Hanna Bessler, Ph.D.,† Eduard Mayburd, M.D.,‡ Genady Smirnov, M.D.,§ Arie Dekel, M.D.,|| Israel Yardeni, M.D.,# Yehuda Shavit, Ph.D.\*\**

- Hysterectomy patients receiving lumbar epidurals
- Preemptive analgesia (PA) epidural doses with continuation of PCEA vs. postop PCEA alone
- Decreased pain scores in PA + PCEA group
- Decreased postop cytokine production in PA + PCEA group

## **Intraoperative thoracic epidural anaesthesia attenuates stress-induced immunosuppression in patients undergoing major abdominal surgery<sup>†</sup>**

**O. Ahlers<sup>1\*</sup>, I. Nachtigall<sup>1</sup>, J. Lenze<sup>1</sup>, A. Goldmann<sup>1</sup>, E. Schulte<sup>1</sup>, C. Höhne<sup>2</sup>,  
G. Fritz<sup>3</sup> and D. Keh<sup>1</sup>**

- Intraoperative use of thoracic epidural (TEA-I) vs. postop thoracic epidural (TEA-P) alone
- Stress response and immune response
- Decreased epinephrine and cortisol in TEA-I
- Decreased cytokine production, circulating NK cells

## Regional Anesthesia

Section Editor: Terese T. Horlocker

# Neuraxial Anesthesia for the Prevention of Postoperative Mortality and Major Morbidity: An Overview of Cochrane Systematic Reviews

Joanne Guay, MD,\* Peter T. Choi, MD,† Santhanam Suresh, MD,‡ Natalie Albert, MD,§  
Sandra Kopp, MD,|| and Nathan Leon Pace, MD¶

- Analyzed data from 9 systemic reviews
- Decreased 30 day mortality in intermediate-to-high risk surgery
- Decreased risk of pneumonia
- No difference in risk of MI
- No difference when neuraxial anesthesia was combined with GA

Anesth Analg 2014; 119: 716-25

# Does Regional Analgesia for Major Surgery Improve Outcome? Focus on Epidural Analgesia

Fabian O. Kooij, MD, Wolfgang S. Schlack, MD, PhD, DEAA, Benedikt Preckel, MD, PhD, DEAA, and Markus W. Hollmann, MD, PhD, DEAA

- Conflicting evidence with inconclusive or flawed data
- No definite reduction in cardiovascular complications in general or cardiac surgery
- No reduction in postop pulmonary complications in general surgery
- Statistical but not clinical significance decrease in pain scores with epidural analgesia

# Is Neuraxial Anesthesia Better or Not?



Anesth Analg 2014; 119: 501-2

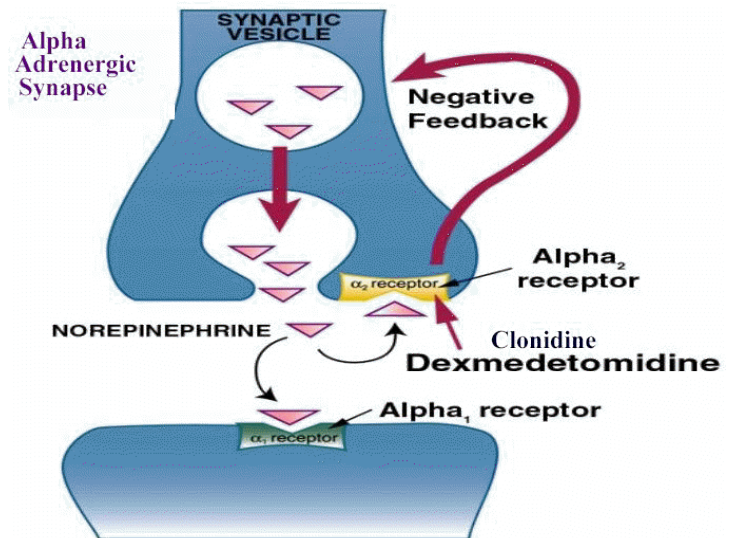


# Sedation Techniques

- Reassurance
- Midazolam
- Fentanyl
- Propofol
- Ketamine
- Remifentanyl
- Dexmedetomidine

# Dexmedetomidine

- Potent, highly-selective  $\alpha$ -2 agonist
- Sedative, anxiolytic and analgesic effects
- Does not cause respiratory depression
- $T_{1/2\alpha} = 6$  minutes (distribution half life)
- $T_{1/2\beta} = 2$  hours (elimination half life)
- Side effects: hypotension and bradycardia



# Comparison of Dexmedetomidine, Propofol and Midazolam for Short-Term Sedation in Postoperatively Mechanically Ventilated Neurosurgical Patients

VINIT K. SRIVASTAVA<sup>1</sup>, SANJAY AGRAWAL<sup>2</sup>, SANJAY KUMAR<sup>3</sup>, ABHISHEK MISHRA<sup>4</sup>, SUNIL SHARMA<sup>5</sup>, RAJ KUMAR<sup>6</sup>

- Dex group had lower HR
- Extubation time was slightly lower in Propofol (26.13 ± 5 min) vs. Dex (35.28 ± 5.92 min)
- Less fentanyl requirement with Dex
- Dex pts were easily arousable and cooperative

# Monitored Anesthesia Care with Dexmedetomidine: A Prospective, Randomized, Double-Blind, Multicenter Trial

K. Candiotti, S. Bergese, P. Bokesch, M. Feldman, W. Wisemandle, A. Bekker

- Dex (1  $\mu\text{g}/\text{kg}$  or 0.5  $\mu\text{g}/\text{kg}$  load then 0.6  $\mu\text{g}/\text{kg}/\text{h}$ ) vs. placebo with midazolam/fentanyl rescue
- Wide range of MAC cases – orthopedic, ophthalmic, plastic, vascular stents, breast biopsies, hernias, AV fistulas, excision of lesions
- All patients in placebo group required rescue except for cataract surgery
- Significantly more respiratory depression in placebo group
- Increased patient satisfaction in dex group

# Neuraxial Anesthesia and Anticoagulation

Changes from ASRA 2010 Guidelines

# ASRA 2010 Guidelines Review

	Needle/Catheter Insertion		Catheter Removal/Restart Med	
	Prophylaxis	Therapeutic	Prophylaxis	Therapeutic
Heparin (UFH)	<ul style="list-style-type: none"> <li>No contraindication (5,000U BID)</li> <li>Indeterminate for TID</li> </ul>	<ul style="list-style-type: none"> <li>Delay heparin 1 hour after insertion</li> </ul>	<ul style="list-style-type: none"> <li>Restart heparin 1 hour later</li> </ul>	<ul style="list-style-type: none"> <li>Remove catheter 2-4 hours after last dose</li> <li>Restart heparin 1 hour later</li> </ul>
LMWH	<ul style="list-style-type: none"> <li>Wait 12 hours after last dose</li> </ul>	<ul style="list-style-type: none"> <li>Wait 24 hours after last dose</li> </ul>	<ul style="list-style-type: none"> <li>Single daily dosing</li> <li>1st dose 6-8 hours postop</li> <li>2<sup>nd</sup> dose 24 hours</li> <li><b>Wait 4 hours to restart*</b></li> </ul>	<ul style="list-style-type: none"> <li>Twice daily dosing</li> <li>Wait 24 hours postop</li> <li>Remove catheter before 1<sup>st</sup> dose</li> <li><b>Wait 4 hours to restart *</b></li> </ul>

# ASRA 2010 Guidelines Review

	Needle /Catheter Insertion	Catheter Removal
Warfarin	<ul style="list-style-type: none"> <li>• Stop Warfarin 4-5 days prior</li> <li>• Check INR</li> </ul>	<ul style="list-style-type: none"> <li>• INR &lt;1.5, remove catheter with neuro checks for 24 hours</li> <li>• INR 1.5 – 3, remove catheter with caution and neuro checks before and after until INR is normal</li> <li>• INR &gt; 3, no recommendation</li> </ul>
Ticlopidine (Ticlid®)	<ul style="list-style-type: none"> <li>• Stop 14 days prior</li> </ul>	
Clopidogrel (Plavix®)	<ul style="list-style-type: none"> <li>• Stop 7 days prior</li> <li>• If only stopped 5-7 days, check platelets</li> </ul>	
Abciximab (Reopro®)	<ul style="list-style-type: none"> <li>• Stop 24-48 hours prior</li> <li>• Check platelets</li> </ul>	
Eptifibatide (Integrilin®) Tirofiban (Aggrostat®)	<ul style="list-style-type: none"> <li>• Stop 4-8 hours prior</li> <li>• Check platelets</li> </ul>	

# ASRA 2010 Guidelines Review

	Needle/Catheter Insertion	Catheter removal
Fondaparinux (Arixtra®)	<ul style="list-style-type: none"><li>• No specific recommendations</li><li>• Follow clinical trial info</li><li>• Stop 48 hours prior</li></ul>	<ul style="list-style-type: none"><li>• Wait 36 hours from last dose</li><li>• Restart medication 12 hours after removal</li></ul>
Plasugrel (Effient®)	<ul style="list-style-type: none"><li>• Stop 7 days prior</li></ul>	<ul style="list-style-type: none"><li>• Restart 7 hours after removal</li></ul>
NSAIDS	No contraindication	
Herbal medications	No contraindication	



	Dabigatran (Pradaxa®)	Rivaroxaban (Xarelto®)	Apixaban (Eliquis®)
Target	Factor II	Factor Xa	Factor Xa
Half-life	14-17 hours	5- 9 hours 9-13 hours (elderly)	10-14 hours
Peak effect	2 hours	2-4 hours	2-4 hours
Regional anesthesia recommendations	<ul style="list-style-type: none"> <li>• Stop 48 hours</li> <li>• Stop longer for renal impairment, age, low body weight</li> <li>• Restart 2 hours from catheter removal</li> </ul>	<ul style="list-style-type: none"> <li>• No specific recommendations for placement or wait 24 hours</li> <li>• Do not remove catheter until 18-24 hours from last dose</li> <li>• Restart 6 hours from catheter removal</li> </ul>	<ul style="list-style-type: none"> <li>• Stop 48 hours</li> <li>• Stop longer for renal impairment, age, low body weight</li> </ul>

## REGIONAL ANAESTHESIA

### **New oral anticoagulants and regional anaesthesia**

H. T. Benzon<sup>1\*</sup>, M. J. Avram<sup>1</sup>, D. Green<sup>2</sup> and R. O. Bonow<sup>2</sup>

- Current recommendations use 1-2 half-lives before neuraxial injection
- Studies based on healthy subjects
- Use current guidelines for high-risk patients
- Consider waiting 5 half-lives for healthier low-risk patients
- Restart medication 8 hours minus time to peak effect

# Epidural Catheters

Soft-tip vs. stiff? Multiport vs. single?

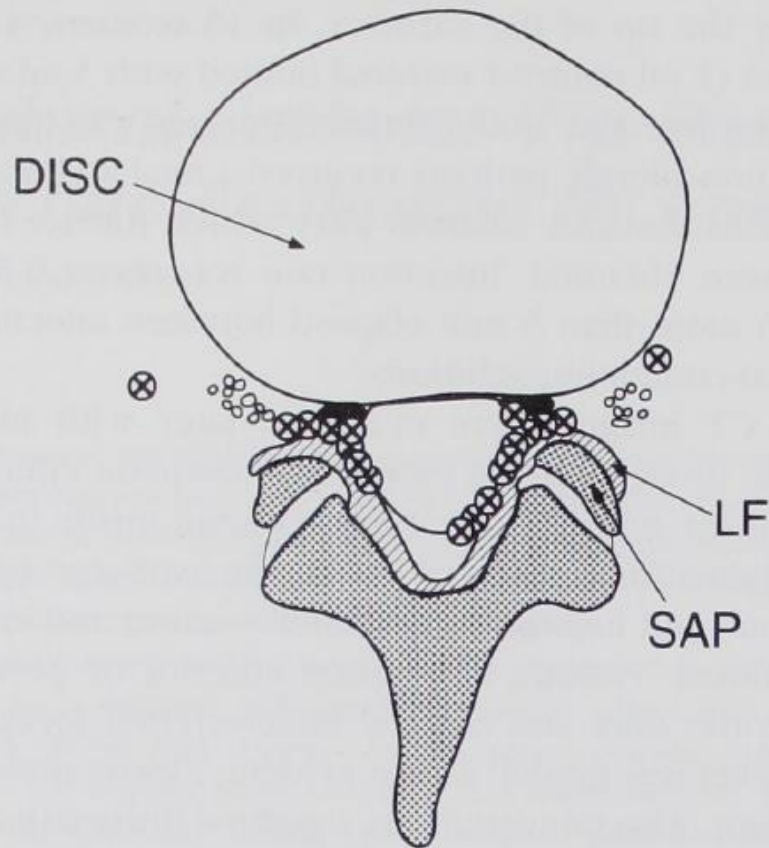
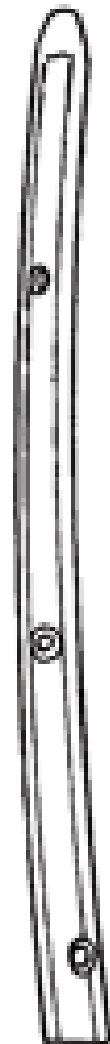


Fig. 1. Locations of 19 catheter tips (circled x) placed by a midline approach. The position of six catheter tips that did not lie at the longitudinal level of the intervertebral foramen and disc shown in the drawing are indicated in their correct position in the axial plane. In this and other images, anterior is at the top of the image, and anatomic left is at the right of the image. LF = ligamentum flavum; SAP = superior articular process.

Hogan, Quinn. Epidural Catheter Tip Position and Distribution of Injectate Evaluated by Computed Tomography. *Anesthesiology* 1999; 90:964-70.



End hole



Side holes

**Fig 3**

*Epidural catheters*

# Multiport vs. Single port Catheters

## Multiport catheter

- 3 lateral holes
- Most fluid flows through proximal port
- More even distribution of solution
- Higher analgesia rates with low flows
- Less requirement for catheter manipulation

## Single port catheter

- Single-holed, open end
- Less theoretical risk of multi-compartmental block
- More prone to obstruction
- Less likely to aspirate blood
- Efficacy is equivalent with high flows

D'Angelo, R. et al. A comparison of multiport and uniport epidural catheters in laboring patients. *Anesth Analg* 1997; 84: 1276-9.

# Decreased incidence of complications in parturients with the Arrow (FlexTip Plus™) epidural catheter

Brian R. Banwell MD,  
Pat Morley-Forster MD FRCPC,  
Richard Krause MD

CAN J ANAESTH 1998 / 45: 4 / pp 370–72

## Soft catheters reduce the risk of intravascular cannulation during epidural block—A retrospective analysis of 1117 cases in a medical center

Chih-Kai Shih <sup>a,b</sup>, Fu-Yuan Wang <sup>a</sup>, Chia-Fang Shieh <sup>c</sup>, Jui-Mei Huang <sup>a</sup>, I-Cheng Lu <sup>a,b,d</sup>,  
Li-Chen Wu <sup>a</sup>, David Vi Lu <sup>a,\*</sup>

Kaohsiung Journal of Medical Sciences (2012) 28, 373–376

# Conclusion

- Neuraxial anesthesia decreases risk of
  - Venous thromboembolisms
  - Pulmonary complications
  - Arrhythmias
  - Postoperative ileus
  - Transfusion requirements
  - Pain
  - Stress/immune response
- Dexmedetomidine is a useful alternative sedation technique
- Anticoagulation updates for LMWH and new anticoagulants Pradaxa®, Xarelto®, and Eliquis®
- Consider using 5 half-lives for anticoagulants
- Soft-tipped multiport catheters offer advantages to stiff single port catheters