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

<table>
<thead>
<tr>
<th>Group</th>
<th>Deep vein thrombosis</th>
<th>Pulmonary embolism</th>
<th>Myocardial infarction</th>
<th>Cardiac arrhythmia</th>
<th>Other fatal cardiac event</th>
<th>Stroke</th>
<th>Bleeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NB</td>
<td>No NB</td>
<td>NB</td>
<td>No NB</td>
<td>NB</td>
<td>No NB</td>
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<tr>
<td>General</td>
<td>26</td>
<td></td>
<td>30</td>
<td></td>
<td>45</td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>Orthopaedics</td>
<td>117</td>
<td></td>
<td>30</td>
<td></td>
<td>45</td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>Urology</td>
<td>2</td>
<td></td>
<td>30</td>
<td></td>
<td>45</td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>Vascular</td>
<td>0</td>
<td></td>
<td>30</td>
<td></td>
<td>45</td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td></td>
<td>30</td>
<td></td>
<td>45</td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>Total</td>
<td>145</td>
<td></td>
<td>30</td>
<td></td>
<td>45</td>
<td></td>
<td>59</td>
</tr>
</tbody>
</table>

- 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.
Fig 3  Effects of neuraxial blockade (NB) on postoperative complications. Diamonds denote 95% confidence intervals for odds ratios of combined trial results. The vertical dashed line represents the overall pooled result. Size of shaded boxes is proportional to number of events.
Recent Advances in Epidural Analgesia

Maria Bauer,¹ John E. George III,² John Seif,² and Ehab Farag¹,²

¹ Department of Outcomes Research, Cleveland Clinic, Cleveland, OH 44195, USA
² 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(1)*, 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*

*Department of Anaesthesia and Intensive Care, HCI International Medical Centre, Clydebank, Scotland, United Kingdom; and †Robertson Centre for Biostatistics, Boyd Orr Building, University of Glasgow, Glasgow, Scotland, United Kingdom

- 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

Anesth Analg 2001;93:528–35
<table>
<thead>
<tr>
<th>Outcome</th>
<th>TEA (n = 206), n (%)</th>
<th>GA (n = 202), n (%)</th>
<th>Unadjusted</th>
<th>Adjusted&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>P value</td>
<td>OR (95% CI)</td>
<td>P value</td>
</tr>
<tr>
<td>Supraventricular arrhythmia</td>
<td>21 (10.2)</td>
<td>45 (22.3)</td>
<td>2.53 (1.44–4.42)</td>
<td>0.0012</td>
</tr>
<tr>
<td>Lower respiratory tract infection</td>
<td>31 (15.3)</td>
<td>59 (29.2)</td>
<td>2.33 (1.43–3.79)</td>
<td>0.0007</td>
</tr>
<tr>
<td>Renal failure</td>
<td>4 (2.0)</td>
<td>14 (6.9)</td>
<td>3.69 (1.34–10.2)</td>
<td>0.016&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>CVA</td>
<td>2 (1.0)</td>
<td>6 (3.0)</td>
<td>3.12 (0.62–15.7)</td>
<td>0.17&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Acute confusion</td>
<td>3 (1.5)</td>
<td>11 (5.5)</td>
<td>3.90 (1.07–14.2)</td>
<td>0.031&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Significant bleeding</td>
<td>35</td>
<td>23</td>
<td>0.63 (0.36–1.11)</td>
<td>0.11</td>
</tr>
<tr>
<td>Any complications</td>
<td>84</td>
<td>108</td>
<td>1.67 (1.13–2.47)</td>
<td>0.011</td>
</tr>
</tbody>
</table>

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.
- 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

Table 5. Preextubation Lung Volume and Time to Endotracheal Extubation

<table>
<thead>
<tr>
<th>Description</th>
<th>GA group</th>
<th></th>
<th>TEA group</th>
<th></th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean (sd)</td>
<td>n</td>
<td>Mean (sd)</td>
<td></td>
</tr>
<tr>
<td>Maximal expiratory lung volume (mL)</td>
<td>46</td>
<td>733 (208)</td>
<td>47</td>
<td>985 (326)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Time to extubation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate (&lt;4 h)</td>
<td>11</td>
<td>5.5</td>
<td>51</td>
<td>25.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>&lt;12 h</td>
<td>136</td>
<td>67.8</td>
<td>112</td>
<td>54.9</td>
<td></td>
</tr>
<tr>
<td>12–24 h</td>
<td>25</td>
<td>12.4</td>
<td>19</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>&gt;24 h</td>
<td>29</td>
<td>14.3</td>
<td>22</td>
<td>10.8</td>
<td></td>
</tr>
</tbody>
</table>

GA = general anesthesia; TEA = thoracic epidural analgesia.
Stress Response to Surgery

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

Modulation by CNS
- Pain
- Anxiety
- Hypothermia
- Hyperthermia

Endocrine Response
- Catecholamines
- Glucagon
- Cortisol
- ACTH

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

Normal Wound Healing
- Fatigue
- SIRS
- Sepsis

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

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 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
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

Anesth Analg 2014; 119: 740-44
Is Neuraxial Anesthesia Better or Not?

Sedation Techniques

- Reassurance
- Midazolam
- Fentanyl
- Propofol
- Ketamine
- Remifentanil
- Dexmedetomidine
Dexmedetomidine

- Potent, highly-selective α-2 agonist
- Sedative, anxiolytic and analgesic effects
- Does not cause respiratory depression
- T ½ α = 6 minutes (distribution half life)
- T ½ β = 2 hours (elimination half life)
- Side effects: hypotension and bradycardia

Curr Opin Anaesthesiol 2008, 21:457-461
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 µg/kg or 0.5 µg/kg load then 0.6 µg/kg/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
<table>
<thead>
<tr>
<th>ASRA 2010 Guidelines Review</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Needle/Catheter Insertion</strong></td>
</tr>
<tr>
<td><strong>Prophylaxis</strong></td>
</tr>
<tr>
<td><strong>Heparin (UFH)</strong></td>
</tr>
<tr>
<td>• No contraindication (5,000U BID)</td>
</tr>
<tr>
<td>• Indeterminate for TID</td>
</tr>
<tr>
<td><strong>LMWH</strong></td>
</tr>
<tr>
<td>• Wait 12 hours after last dose</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

*FDA Drug Safety Communication 11/6/2013*
### ASRA 2010 Guidelines Review

<table>
<thead>
<tr>
<th>Medical Agent</th>
<th>Needle /Catheter Insertion</th>
<th>Catheter Removal</th>
</tr>
</thead>
</table>
| **Warfarin**  | • Stop Warfarin 4-5 days prior  
• Check INR | • INR <1.5, remove catheter with neuro checks for 24 hours  
• INR 1.5 – 3, remove catheter with caution and neuro checks before and after until INR is normal  
• INR > 3, no recommendation |
| **Ticlopidine**  
(Ticlid®) | • Stop 14 days prior | |
| **Clopidogrel**  
(Plavix®) | • Stop 7 days prior  
• If only stopped 5-7 days, check platelets | |
| **Abciximab**  
(Reopro®) | • Stop 24-48 hours prior  
• Check platelets | |
| **Eptifibatide**  
(Integrilin®)  
Tirofiban  
(Aggrostat®) | • Stop 4-8 hours prior  
• Check platelets | |
### ASRA 2010 Guidelines Review

<table>
<thead>
<tr>
<th>Medication</th>
<th>Needle/Catheter Insertion</th>
<th>Catheter removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fondaparinux (Arixtra®)</td>
<td>• No specific recommendations&lt;br&gt;• Follow clinical trial info&lt;br&gt;• Stop 48 hours prior</td>
<td>• Wait 36 hours from last dose&lt;br&gt;• Restart medication 12 hours after removal</td>
</tr>
<tr>
<td>Plasugrel (Effient®)</td>
<td>• Stop 7 days prior</td>
<td>• Restart 7 hours after removal</td>
</tr>
<tr>
<td>NSAIDS</td>
<td>No contraindication</td>
<td></td>
</tr>
<tr>
<td>Herbal medications</td>
<td>No contraindication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dabigatran (Pradaxa®)</td>
<td>Rivaroxaban (Xarelto®)</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td><strong>Target</strong></td>
<td>Factor II</td>
<td>Factor Xa</td>
</tr>
<tr>
<td><strong>Half-life</strong></td>
<td>14-17 hours</td>
<td>5-9 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9-13 hours (elderly)</td>
</tr>
<tr>
<td><strong>Peak effect</strong></td>
<td>2 hours</td>
<td>2-4 hours</td>
</tr>
<tr>
<td><strong>Regional anesthesia recommendations</strong></td>
<td>• Stop 48 hours&lt;br&gt; • Stop longer for renal impairment, age, low body weight&lt;br&gt; • Restart 2 hours from catheter removal</td>
<td>• No specific recommendations for placement or wait 24 hours&lt;br&gt; • Do not remove catheter until 18-24 hours from last dose&lt;br&gt; • Restart 6 hours from catheter removal</td>
</tr>
</tbody>
</table>
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.
Fig 3

Epidural catheters

End hole

Side holes
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

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


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

Chih-Kai Shih a,b, Fu-Yuan Wang a, Chia-Fang Shieh c, Jui-Mei Huang a, I-Cheng Lu a,b,d, Li-Chen Wu a, David Yi Lu a,*

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