Analgesic Options for Posterior Spinal Fusion for Adolescent Idiopathic Scoliosis

Rebecca Hong, MD
Assistant Professor
Pediatric Anesthesiology
University of Michigan
Objectives

• Methods of analgesia for PSF for AIS
• Intrathecal Morphine- our experience at U of M
• Less common adjuvants for analgesia following PSF
Analgesic Options for PSF

- PCA
- Epidural
- Intrathecal morphine (ITM)
- Adjuvants
Epidural

With Bupivacaine
- Best quality analgesia
- Concern for delayed diagnosis of surgical complication

Without Bupivacaine
- Frustrating equipment
- No “level”
- Delivery of central-acting narcotic
- Patient comfort comparable to PCA
PCA

- Usually morphine
- Basal rate
- Analgesic method to which all others are compared
Intrathecal Morphine (ITM)

• Dose?
• Transition to PCA
• Analgesia appears to be better while the ITM is working
• Floor vs PICU?
ITM for PSF is Not New
4 studies, 1988-2001; ITM dose 2-25 mcg/kg

Respiratory depression only a problem in 1 study
- 5/33 pts with late (~ 6hrs post op) respiratory depression
  - All responded to naloxone

Less EBL in the ITM groups

Similar side effects
<table>
<thead>
<tr>
<th>Group</th>
<th>No ITM</th>
<th>Moderate dose (9-19 mcg/kg)</th>
<th>High dose (&gt;=20mcg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>68</td>
<td>293</td>
<td>46</td>
</tr>
<tr>
<td>Mean ITM dose</td>
<td>0</td>
<td>14 mcg/kg</td>
<td>24 mcg/kg</td>
</tr>
<tr>
<td>Mean Pain score (PACU)</td>
<td>5.2</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Time to IV rescue</td>
<td>6.6 hours</td>
<td>16.7 hours</td>
<td>22.9 hours</td>
</tr>
<tr>
<td>Resp. depression</td>
<td>1 (1.5%)</td>
<td>8 (2.7%)</td>
<td>7 (15.2%)</td>
</tr>
<tr>
<td>PICU admission</td>
<td>0</td>
<td>6 (2%)</td>
<td>8 (17.4%)</td>
</tr>
</tbody>
</table>
PCA (morphine), ITM/PCA (7mcg/kg), EPI (hydromorphone/bupivacaine) groups

ITM/PCA had lowest pain scores for 1st 8 hours, then EPI

Respiratory adverse events most frequent in EPI group at 11/55; ITM/PCA was 1/42 and PCA 0/41

Pruritus worst in EPI group
Why Are We Using ITM at Mott Now?

- Surgeon request, March 2014
- Clinical protocol to transition from ITM directly to oral analgesics - May 2014
- Favorable initial chart review, expanded use in 2015
ITM for PSF: 2015 Clinical Protocol

- ITM dose = 8-10 mcg/kg, max 800 mcg
- Advise against sufentanil infusions
- Acetaminophen
- Ketorolac
- Valium IV PRN
- 16 hours post-ITM: schedule oxycodone
ITM vs EPI for PSF for Idiopathic Scoliosis: Results

• No IV narcotics after PACU
• No patients admitted to PICU or had RRT/Code called for cardiopulmonary concerns
• Discharge home ½ day sooner, earlier ambulation, and earlier Foley catheter removal for ITM group
ITM vs EPI for PSF for Idiopathic Scoliosis: Results

<table>
<thead>
<tr>
<th>Group</th>
<th>ITM (n = 20)</th>
<th>EPI (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PONV</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Pruritus</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Nasal Cannula O₂</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Over-Sedation</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Agitation</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Urinary Retention</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Other Adverse Event</td>
<td>1 = desat with sleeping</td>
<td>1 = hypotension + desat</td>
</tr>
</tbody>
</table>
ITM vs. EPI Pain Scores

Follow-up Study (2015-2016)

• Purposes
  • Continue to evaluate safety of ITM
  • Improve pain control after ITM wears off
  • Improve rates of adverse events/side effects
Key Differences

- Mean 9 mcg/kg ITM, max 800mcg
- Oxycodone given 2 hours earlier
- Nalbuphine and ondansetron both ordered ATC instead of PRN for 24 hours
Outcomes: Follow-up Study

- 28 patients/group
- Similar to superior analgesia
- Earlier discharge, Foley removal, ambulation in ITM group
- No difference in adverse events
- <10% of patients to PICU

Michigan Difference for Adolescent PSF

- ITM protocol used for almost all patients
- Multidisciplinary care plan addresses analgesia, wound, antibiotics, diet, ambulation, PT, discharge
- Most patients going home on POD #2 or #3!
Changing Gears...
Other Analgesic Approaches to Analgesia for PSF

- Dexmedetomidine
- Ketamine
- Gabapentin/Pregabalin
- Clonidine
- Methadone
Other Approaches to Analgesia for PSF

- Propofol/remi vs. Propofol/dexmedetomidine
- Hydromorphone PCA post-op for all
- **Dexmedetomidine better?**

*BMC Anesthesiol. 2015;15:21*
• PCA only (usually morphine) vs. PCA + Dexmedetomidine (started in OR)
• Morphine equivalents as a proxy for pain
• No difference!
Other Approaches to Analgesia for PSF: Ketamine

- Morphine consumption less in ketamine group
- No difference in pain scores or side effects
Ketamine

Prolonged Perioperative Low-Dose Ketamine Does Not Improve Short and Long-term Outcomes After Pediatric Idiopathic Scoliosis Surgery

Marina Perelló, MD, David Artés, MD, Cristina Pascuets, MD, Elisabeth Esteban, PhD, and Ana M. Ey Batlle, MD

Spine. 2017;42(5):E304-E312

• No difference in any outcome
Other Approaches to Analgesia for PSF: Methadone

- μ-agonist & NMDA antagonist
- Rapid onset, slow elimination
- No active metabolites
- High interpatient variability

http://www.opiateaddictionresource.com/media/images/methadone_tablets
Other Approaches to Analgesia for PSF: Methadone

- May be better as an adjuvant
- **No difference** in pain scores or opioid use

Perioperative Pharmacokinetics of Methadone in Adolescents

Anshuman Sharma, M.D.,* Danielle Tallchief, R.N.,† Jane Blood, R.N.,† Thomas Kim, Ph.D.,‡ Amy London, B.S.,§ Evan D. Kharasch, M.D., Ph.D.||

Clonidine

- Selective $\alpha_2$-agonist
- Lipid soluble
- Anti-hypertensive
- Frequently used off-label
Other Approaches to Analgesia for PSF

- Retrospective; 3 groups (P, G, C)
- Possibly better pain control with gabapentin and clonidine
- No difference in observed side effects

Evaluation of Gabapentin and Clonidine Use in Children Following Spinal Fusion Surgery for Idiopathic Scoliosis: A Retrospective Review

Dinesh K. Choudhry, MD, FRCA,* B. Randall Brenn, MD,* Karen Sacks, APRN,* and Suken Shah, MD†

J Pediatr Orthop. Epub Apr 2017
• Pediatric dosing: 10-15mg/kg/day initial dose, titrate up to 40mg/kg/day
Gabapentin

Gabapentin Use in Pediatric Spinal Fusion Patients: A Randomized, Double-Blind, Controlled Trial

Lynn M. Rusy, MD,*§ Keri R. Hainsworth, PhD,* Tom J. Nelson, PharmD, RPh,§
Michelle L. Czarnecki, MSN, RN, BC, CPNP,§ J. Channing Tassone, MD,†§
John G. Thometz, MD,†§ Roger M. Lyon, MD,†§ Richard J. Berens, MD,*†§
and Steven J. Weisman, MD*†§


- Gabapentin 15mg/kg preop, then 5mg/kg TID x 5 days postop
- Reduction in morphine requirements, pain scores x 48 h
- No change in opioid-related adverse effects
But...Figures From This Study:

Morphine Consumption

Pain Scores

Figure 2. Total morphine consumption. Data are shown as mean (mg/kg/hr ± SD). *P < 0.05.

Figure 3. Postoperative pain scores. Data are shown as mean (SD). P < 0.05.
Gabapentin and PSF

- Several other studies exist in adult literature for gabapentin & pregabalin
- Most show reduction in total morphine consumption
- Many show small reduction in pain scores
Gabapentin and PSF

• What dose to use?
• Median effective dose of gabapentin = 21.7 mg/kg (1200mg adult dose)
• Side effects?
• Further studies needed
Is Adult PSF Comparable to Adolescent PSF?

**Adolescent**
- Correct curvature
- ~10 thoracolumbar segments
- SSEP’s & MEP’s
- ♀ >> ♂

**Adult**
- Pain/Neuropathy
- Few segments, typically lumbar
- Often literature includes discectomy procedures
- Occasional neuro monitoring
- ♀ ≈ ♂
References


Li Y, Hong RA, Robbins CB, Gibbons KM, Holman AE, Caird MS, Farley FA, Abbott MD, Burke MC. Intrathecal morphine and oral analgesics provide safe and effective pain control after posterior spinal fusion for adolescent idiopathic scoliosis. Spine. 2017; epub ahead of print May 2017 DOI: 10.1097/BRS.0000000000002245