Perioperative Neurologic Injury Associated with Rib-Distraction Surgery

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Amy McIntosh, Jack Flynn, Ron El-Hawary

Children’s Spine Study Group
Disclosures

- **Ron El-Hawary**
  - Consultant: Depuy-Synthes, Medtronic, Halifax Biomedical
  - Institutional Research Support: Depuy-Synthes, Medtronic

- **Youssef Mandourah**
  Nothing to disclose

- **Luke Gauthier**
  Nothing to disclose

- **Alex Soroceanu**
  Nothing to disclose

- **Amy MacIntosh**
  Nothing to disclose
Neurologic injury can be associated with growth friendly spine surgery.

- Spine–based neurologic complications (Sankar’09)
  - 0.1% Clinical Injury
  - 0.9% Implant – neuromonitoring changes
  - 0.9% Exchange – neuromonitoring changes

- Rib–based neurologic complications (Skaggs’09)
  - 1.5% Implant – clinical injury
  - 1.3% Exchange – clinical injury
  - (original FDA–IDE data)
Purpose

- To define the rates of neurologic injury associated with contemporary rib-based surgery.

- To determine if pre-operative diagnosis organized by the Classification for Early-Onset Scoliosis (C–EOS) affects these rates.
Methods

- Children’s Spine Study Group database
  - Retrospective review
  - 2004–2012

- Inclusion:
  - Rib–based
  - Clinical Neurologic Injuries + Neuromonitoring Changes

- Exclusion
  - Spine–based
# Results

## Demographics Database

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient #</td>
<td>524</td>
</tr>
<tr>
<td>Age (mean)</td>
<td>5.7y</td>
</tr>
<tr>
<td>Scoliosis (mean)</td>
<td>68°</td>
</tr>
<tr>
<td>Kyphosis (mean)</td>
<td>48°</td>
</tr>
</tbody>
</table>

## C–EOS

<table>
<thead>
<tr>
<th>Condition</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congenital</td>
<td>222</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>163</td>
</tr>
<tr>
<td>Syndromic</td>
<td>63</td>
</tr>
<tr>
<td>Idiopathic</td>
<td>67</td>
</tr>
</tbody>
</table>
# Neurologic Injuries (1.7%)

<table>
<thead>
<tr>
<th>Demographics Injury Patients</th>
<th>N=9</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean)</td>
<td>4.1y</td>
<td></td>
</tr>
<tr>
<td>Scoliosis (mean)</td>
<td>66°</td>
<td></td>
</tr>
<tr>
<td>Kyphosis (mean)</td>
<td>44°</td>
<td></td>
</tr>
</tbody>
</table>

- Initial implantation: 8
- Lengthening: 0
- Exchange: 1
- Brachial plexus: 5
- Lower Extremity: 1
- Re-operations: 4
- Full resolution: 7
# Neurologic Injuries (1.7%)

<table>
<thead>
<tr>
<th>C-EOS</th>
<th>Neurologic Injury</th>
<th>Total</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall (N)</td>
<td>9</td>
<td>524</td>
<td>1.7%</td>
</tr>
<tr>
<td>Congenital</td>
<td>8</td>
<td>222</td>
<td>3%</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>1</td>
<td>163</td>
<td>0.6%</td>
</tr>
<tr>
<td>Syndromic</td>
<td>0</td>
<td>63</td>
<td>0%</td>
</tr>
<tr>
<td>Idiopathic</td>
<td>0</td>
<td>67</td>
<td>0%</td>
</tr>
</tbody>
</table>

Chi-Square
P=\textless0.05^*
Additional Diagnoses (6 of 9)

- Neural Axis
  - 4 occurrences
- Congenital Intra–Spinal
  - 2 occurrences
- Congenital Extra–Spinal
  - 4 occurrences

<table>
<thead>
<tr>
<th>Primary Dx.</th>
<th>Secondary Dx.</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>-</td>
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<tr>
<td>+</td>
<td>-</td>
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<td>+</td>
<td>+</td>
</tr>
<tr>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

0.8% Neuro Injury

3.8%* Neuro Injury
Discussion

- **Strengths**
  - Large numbers
  - C–EOS

- **Limitations:**
  - Pitfalls of database
  - Heterogeneous definition
Discussion

- Sankar et al (Spine–based)
  - Clinical injury rate 0.1%

- Skaggs et al. (Rib–based)
  - Clinical: Primary 1.5%, exchange 1.3%
  - Monitoring changes: Primary 1.5%, lengthening 0.08%

- This study (Rib–based) – 1.7%
  - Lower extremity (SCI?) 0.2%
  - Brachial plexus 0.95%
  - Neuromonitoring change 0.38%
Discussion

- Secondary Diagnosis
  - Neural axis
  - Extra-spinal anomalies (eg. Sprengel’s)
    - 10% from single center study
    - Joiner et al. 2013 JBJS
  - Congenital Kyphosis
    - Known higher risk for SCI
Conclusions

- Neurologic Injury rate with rib-based surgery
  - 1.7%

- C–EOS is predictive of neurologic injury
  - Congenital greatest risk (3%)

- Additional secondary diagnosis
  - ↑ risk of neurological injury
    - 3.8% vs. 0.82% without secondary diagnosis
Thank You