Pre-operative Hypercarbia and Length of Hospital Stay at the Time of Growing Device Implantation and Spine Fusion in Early Onset Scoliosis

G. Redding, V. Bompadre, W. Krengel, K. White
Seattle Children’s Hospital
University of Washington School of Medicine
Seattle, Washington, USA
Background

- Children with EOS often have restrictive lung disease, respiratory muscle dysfunction, and hypoxemia during sleep.
- Pre-operative risk assessment for post-operative respiratory complications in this group of patients is not standardized.
- Specific pulmonary measures that correlate with post-operative hospital length of stay are limited to forced vital capacity (FVC); FVC values <40% predicted are associated with longer hospital stay for patients with AIS.
Published EOS/TIS LOS is longer than with AIS with FVC <40%

<table>
<thead>
<tr>
<th>N</th>
<th>Age</th>
<th>FVC</th>
<th>Procedure</th>
<th>LOS</th>
<th>% Pulm Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td>EOS Patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>38mo</td>
<td>-</td>
<td>VEPTR implant</td>
<td>11 (5-29)</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>12y</td>
<td>-</td>
<td>VEPTR</td>
<td>-</td>
<td>4/10</td>
</tr>
<tr>
<td>29</td>
<td>8yr</td>
<td>-</td>
<td>VEPTR implant</td>
<td>6.7</td>
<td>6/32</td>
</tr>
<tr>
<td>AIS Patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>183</td>
<td>6-62</td>
<td>60-80%</td>
<td>FUSION</td>
<td>-</td>
<td>3/110</td>
</tr>
<tr>
<td></td>
<td>40-60%</td>
<td></td>
<td></td>
<td>-</td>
<td>4/54</td>
</tr>
<tr>
<td></td>
<td>&lt;40%</td>
<td></td>
<td></td>
<td></td>
<td>6/19</td>
</tr>
</tbody>
</table>

Ramirez 2010, Sandami 2010, Gadipalli 2011, Zhang 2005
1. What are the pre-operative attributes of children with TIS/EOS as defined by:
   • Increased hospital stay due to pulmonary reasons
   • Increased ICU stay due to pulmonary reasons

2. Can patients with longer LOS be identified pre-operatively by assessment of hypercarbia, as measured by capillary PCO2 or metabolic compensation for chronic CO2 retention, i.e. serum total CO content, obtained with electrolytes?
Methodology

- Retrospective chart review of 52 children with EOS undergoing either initial Growing Device implantation and/or Spine Fusion
- Pre-operative documentation of CO2 status; type of surgery, hospital LOS, ICU LOS, pulmonary complication
- No primary lung disease, e.g. asthma, known pulmonary hypoplasia
- No history of surgery for congenital heart disease
Results

- 20/41 (49%) patients with EOS had CO2 assessments pre-operatively at the time of device insertion.
- 10/18 (56%) had pre-op CO2 assessments at the time of spine fusion.
- 21 (13 implant + 8 fusion) had PCO2 measurements; 17 (9 implant + 8 fusion) had total CO2 content (electrolyte) measures.
Results (cont’d)

- Pcap CO2 was normal (<45 mmHg) in all children pre-operatively at device implantation; but elevated in 4/8 (50%) at the time of fusion.

- Total serum CO2 content was high (>25 meq/dl) in 5/10 (50%) at device implantation and 7/8 (88%) at time of fusion.
Results (cont’d)

- Hospital LOS for device implantation was median of 6.5 days (range 4-37 days); for fusion, LOS was 7 days (range 5-16 days).

- ICU LOS for device implantation was a median of 2 days (range=1-14 days); for fusion ICU LOS was 2 days (range 1-6 days).

- Neither Pcap CO2 nor serum CO2 content correlated with ICU or hospital LOS.
Conclusions

- Serum CO2 content is more often abnormal than PcapCO2 values pre-operatively, reflecting chronic CO2 retention, perhaps during sleep.

- Hospital LOS and ICU LOS were similar for device implantation and spine fusion.

- CO2 measurements have not been included routinely in pre-operative assessments in our center.
Conclusions (cont’d)

• Pre-operative measures that predict post-operative outcomes for children with EOS at the time of device implantation and at the time of spine fusion remain to be determined.

• Pre-op CO2 status did not correlate with LOS in this single-center review.

• Serum CO2 content seems more likely to be useful that PcapCO2 but will require greater numbers to determine its utility.