Different size cuffed ETT in children: the effect of size on intracuff pressure

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Background
- Khine formula for cuffed ETT [ETT = (age/4) + 3] a guide for cETT use in children
- In vitro experiment:
  - A seal was created inside a PVC pipe (to mimic the trachea)
  - The smaller cETT- a larger volume of air was needed to create a seal

The measured IP was also higher in the smaller cETTs (Table-1)

Methods
- IRB approval
- Patients 4 to 8 years of age
- Randomly assigned 2 groups:
  - Standard size (S): Based on the Khine formula
  - Smaller size (s): Half-size smaller
- Cuff inflated by air-leak test at a CPAP of 20 cmH₂O
- Air leak test was repeated if the IP was >30 cmH₂O, <10 cmH₂O or if there was an audible air leak during positive pressure ventilation
- After inflation of the cuff, the baseline IP was measured

Results
- 87 patients
- 42 (S); 45 (s)
- The volume of air required
  - S: 1.6 ± 0.3 mL
  - s: 1.6 ± 0.4 mL
- Baseline IP
  - S: 23 ± 5 cmH₂O
  - s: 41 ± 24 cmH₂O
- The mean air volume required and baseline IP of different age groups are shown in Table 2

Discussion
- Confirmation of in vitro findings:
  - The IP in the smaller sized cETTs was higher than the standard sized cETTs
  - The volume of air to inflate the cuff needed to achieve a seal of the airway at a CPAP 20 cmH₂O was similar
  - There seems to be no advantage to the use of a smaller cETT and in fact, the IP required to achieve a seal is higher

References
2. Paediatr Anaesth 2014;24:999-1004

Table 2: In vivo study: Air required to inflate the cuff to seal the trachea at a CPAP of 20 cm of H₂O and the corresponding baseline intracuff pressure (IP) and the number of patients (n):

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Volume of air in cuff (ml)</th>
<th>IP (cmH₂O)</th>
<th>Volume of air in cuff (ml)</th>
<th>IP (cmH₂O)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard size cETT</td>
<td>Smaller size cETT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1.3 ± 0.9</td>
<td>30 ± 32 (9)</td>
<td>1.3 ± 0.6</td>
<td>42 ± 37 (13)</td>
</tr>
<tr>
<td>5</td>
<td>1.2 ± 0.5</td>
<td>21 ± 14 (17)</td>
<td>1.4 ± 0.3</td>
<td>38 ± 31 (13)</td>
</tr>
<tr>
<td>6</td>
<td>2.0 ± 1.4</td>
<td>24 ± 14 (6)</td>
<td>1.4 ± 0.5</td>
<td>28 ± 38 (11)</td>
</tr>
<tr>
<td>7</td>
<td>1.7 ± 0.6</td>
<td>21 ± 17 (7)</td>
<td>1.5 ± 1.0</td>
<td>18 ± 5 (5)</td>
</tr>
<tr>
<td>8</td>
<td>2.0 ± 0.5</td>
<td>18 ± 7 (3)</td>
<td>2.3 ± 0.4</td>
<td>80 ± 42 (3)</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>1.61 ± 0.3</td>
<td>23 ± 5 (42)</td>
<td>1.6 ± 0.4</td>
<td>41 ± 24 (45)</td>
</tr>
</tbody>
</table>

Table 1: In vitro study: Volume of air required to inflate the cuff to seal a PVC pipe and the corresponding intracuff pressure (IP)

<table>
<thead>
<tr>
<th>ETT size</th>
<th>Volume of air in cuff (ml)</th>
<th>IP (cmH₂O)</th>
<th>Volume of air in cuff (ml)</th>
<th>IP (cmH₂O)</th>
<th>Volume of air in cuff (ml)</th>
<th>IP (cmH₂O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5 mm</td>
<td>1.6 ± 0.1</td>
<td>13 ± 1</td>
<td>1.9 ± 0.0</td>
<td>31 ± 3</td>
<td>1.6 ± 0.1</td>
<td>48 ± 5</td>
</tr>
<tr>
<td>4 mm</td>
<td>1.9 ± 0.0</td>
<td>31 ± 3</td>
<td>1.6 ± 0.1</td>
<td>48 ± 5</td>
<td>1.6 ± 0.1</td>
<td>48 ± 5</td>
</tr>
<tr>
<td>3.5 mm</td>
<td>2.0 ± 0.3</td>
<td>33 ± 4</td>
<td>1.7 ± 0.2</td>
<td>40 ± 5</td>
<td>1.5 ± 0.1</td>
<td>45 ± 5</td>
</tr>
</tbody>
</table>