Changes in intracuff pressure of cuffed endotracheal tubes while positioning for adenotonsillectomy in children

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Background

Benefits of achieving an effective tracheal seal when using a cuffed endotracheal tube (ETT):
- Improved ventilation dynamics
- Increased accuracy of capnography
- Decreased use of volatile anesthetic agents
- Decreased risk of airway fire during adenotonsillectomy (AT)2,3

Potential risks of using a cuffed ETT:
- Elevated intracuff pressure (IP) can compress the tracheal wall and decrease perfusion of the tracheal mucosa.4
- Failure to seal the airway with an inadequately inflated cuff

Objective:
This prospective study explores the combined effect of neck extension, retractor placement, and suspension of the retractor from a Mayo stand on the IP in pediatric patients during AT.

Methods

Inclusion criteria: Patients less than 18 years of age undergoing AT under general anesthesia with a cuffed ETT

Exclusion criteria: Patients with limited range of motion of the neck, clinical concerns for cervical spine instability, or a history of potential for airway abnormalities, including subglottic stenosis

Data collection:
- Inflation of the ETT cuff using the audible air-leak test to a CPAP of 20 cm H2O to seal the trachea
- Attachment of a modified arterial line transducer to the pilot balloon for continuous IP monitoring.5,6
- If IP > 30 cm H2O or audible air leak around cuff, then repeat air-leak test to reseal
- Measurement of baseline IP with patient’s head in neutral position*
- Placement of shoulder roll to extend patient’s neck, insertion of Crowe-Davis retractor, and suspension from a Mayo
- Measurement of second of IP after positioning*

Results

Table 1. Summary of patient demographics

<table>
<thead>
<tr>
<th>Total number of patients</th>
<th>84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (male/female)</td>
<td>38/46</td>
</tr>
<tr>
<td>Number of patients &lt; 6 years</td>
<td>47</td>
</tr>
<tr>
<td>Age (years)</td>
<td>5.7 ± 3.9</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>28.9 ± 20.1</td>
</tr>
<tr>
<td>Tube size range (mm ID)</td>
<td>3.5 – 7.0</td>
</tr>
</tbody>
</table>

- Mean IP increased from 16 ± 8 cm H2O (95% CI: 14, 18 cm H2O) at baseline to 19 ± 12 cm H2O (95% CI: 16, 21 cm H2O) after positioning (P=0.0004 compared to baseline).
- The mean change in IP after positioning was 3 ± 7 cm H2O (95% CI: 1, 5 cm H2O).

Table 2. Changes in intracuff pressure (IP) with positioning for surgery

<table>
<thead>
<tr>
<th>IP increased</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final IP &gt; 30 cm H2O</td>
<td>9</td>
</tr>
<tr>
<td>Final IP &gt; 40 cm H2O</td>
<td>2</td>
</tr>
<tr>
<td>Final IP &gt; 50 cm H2O</td>
<td>1</td>
</tr>
<tr>
<td>IP decreased</td>
<td>28</td>
</tr>
<tr>
<td>No change in IP</td>
<td>10</td>
</tr>
</tbody>
</table>

- The maximum IP measured after positioning for surgery was 60 cm H2O.
- The maximum decrease in IP after positioning for surgery was 10 cm H2O.

When subdivided by patient age (0 to 5 years and 6 to 17 years), no significant difference in IP or the changes were appreciated. In addition, linear regression analysis revealed no statistically significant relationship between changes in IP and patient weight or age.

Discussion

Both increases and decreases in the IP may occur following positioning of the pediatric patient for AT with the combined maneuver of neck extension and placement of the Crowe-Davis retractor.

Increases in IP:
- In 11.9% of patients in this study, we measured IPs greater than 30 cm H2O after positioning for surgery.
- Increases of this magnitude can potentially compromise perfusion to the tracheal mucosa, and result in permanent tracheal sequela.4

Decreases in IP:
- There was a decrease in IP in approximately 33% of the patients.
- The risk of airway fire during oropharyngeal surgeries is generally controlled by limiting the inspired oxygen concentration, but under certain conditions, an increase in the inspired oxygen concentration may be necessary to maintain patient stability. In the presence of an electrocautery, a leak around the cuff during this period could place the patient at increased risk for an airway fire.5,6,7

Conclusions:
- IP is dynamic, and continuous monitoring may be required in pediatric patients.
- During oropharyngeal surgeries, consider repeating or deferring the performance of the air-leak test until after the surgical team has positioned the patient with the neck extended and the Crowe-Davis retractor placed.

Acknowledgements

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References