Airway Devices and Techniques in Pediatric Anesthesia

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Most normal children have easy to handle airways in experienced hands
How about the occasional pediatric anesthetist or the “inadvertent” pediatric airway expert?
Multiple newer devices—some requiring minimal practice, some require substantial practice
Keep skills in mask ventilation especially for infants!
Learn and maintain a few new devices at a non-pediatric center

The “normal” pediatric airway
- Large occiput
- Redundant soft tissue/adenotonsillar hypertrophy
- Large tongue relative to oral space
- Cephalad position of the larynx
- Floppy, omega-shaped epiglottis
- Angled vocal cords

The difficult pediatric airway
- Usually associated with dysmorphic features
- Poor visualization of larynx with direct laryngoscopy reported at about 1%
Conditions associated with a difficult pediatric airway

**Improve with age:**
- Pierre-Robin
- Goldenhar

**Worsen with age:**
- Treacher–Collins
- Apert/Pfeiffer
- Glycogen storage
- Beckwith–Wiedemann
- Joint disease eg arthrogryposis
- Freeman–Sheldon
- FOP
- Dwarfism

Syndromes associated with difficult intubation

Unexpected difficult pediatric airway: main points

- Limit the number of attempts at laryngoscopy
- Early use of alternative technologies including use of supra-glottic airways for rescue or as conduits for tracheal intubation
- Consider waking patient and transfer to pediatric center for elective cases

from the Difficult Airway Society guidelines

The difficult mask pediatric airway

- Anatomical: anomalies, masses, adenotonsillar hypertrophy
- Functional: laryngospasm (inadequate depth of anesthesia), bronchospasm, thoracic rigidity, overinflated stomach
**Difficulty with supra-glottic devices**

Limited mouth opening as in:

- Facial burns
- Oral tumors eg. Teratoma
- Epidermolysis bullosa
- Freeman–Sheldon syndrome

**Difficult intubation: limited mouth opening or inadequate submandibular space**

- Pierre–Robin
- Goldenhar syndrome
- Treacher–Collins syndrome
- Mucopolysaccharidoses

**What makes the difficult pediatric airway different from the adult?**

- Lack of patient cooperation
- Size constraints for airway equipment
- High oxygen consumption / rapid desaturation
- Lack of experience of anesthesiologist (infrequent need)

**Old Options**

- Direct laryngoscopy
- Fiberoptic bronchoscopy – assisted intubation
- Light wand
Newer Options

- Supraglottic airway devices (SADs)/Laryngeal Mask Airway (LMAs)
- Optical stylet
- Video laryngoscopy

LMAs

- Classic / Unique
- Flexible
- ProSeal
- Supreme
- Air Q

LMA Types: Pros and Cons

<table>
<thead>
<tr>
<th>Type</th>
<th>Available sizes</th>
<th>Shape</th>
<th>Suction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic/Unique</td>
<td>1/1.5/2/2.5</td>
<td>Straight</td>
<td>No</td>
</tr>
<tr>
<td>Flexible</td>
<td>1/1.5/2/2.5</td>
<td>Floppy</td>
<td>No</td>
</tr>
<tr>
<td>Pro-Seal</td>
<td>1/1.5/2/2.5</td>
<td>Straight + Introducer</td>
<td>Yes</td>
</tr>
<tr>
<td>Supreme</td>
<td>1 and 2</td>
<td>Firm/curved</td>
<td>Yes</td>
</tr>
<tr>
<td>Air-Q</td>
<td>1/1.5/2/2.5</td>
<td>Firm/curved</td>
<td>No</td>
</tr>
</tbody>
</table>

Other Supraglottic Airways

<table>
<thead>
<tr>
<th>Type</th>
<th>Features</th>
<th>Cons</th>
<th>Suction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambu Aura-i</td>
<td>Intubating supraglottic device</td>
<td>Narrow proximal airway tube limits cuffed ETT</td>
<td>No</td>
</tr>
<tr>
<td>i-gel</td>
<td>Distal cuff does not require inflation</td>
<td>Flexion kinks proximal tubing; expensive</td>
<td>Yes–gastric side channel</td>
</tr>
<tr>
<td>Cobra</td>
<td>Distal widened cobra head with soft grills; circumferential proximal cuff Higher cuff–seal pressures</td>
<td>Easily displaced</td>
<td>No</td>
</tr>
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</table>
Cobra  Aura-I  i-gel

Classic vs. Air-Q for intubation

<table>
<thead>
<tr>
<th>Device Size</th>
<th>Air-Q Pt. size (kg)</th>
<th>LMA Pt. size (kg)</th>
<th>Max ETT LMA uncuffed</th>
<th>Max ETT Air-Q cuffsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;7</td>
<td>&lt;5</td>
<td>3.5</td>
<td>4.5</td>
</tr>
<tr>
<td>1.5</td>
<td>7-17</td>
<td>5-10</td>
<td>4.0</td>
<td>5.0</td>
</tr>
<tr>
<td>2</td>
<td>17-30</td>
<td>10-20</td>
<td>4.5</td>
<td>5.5</td>
</tr>
<tr>
<td>2.5</td>
<td>30-50</td>
<td>20-30</td>
<td>5.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Cuffed ETT with LMA Unique

Cuffed ETT with LMA Unique
Cuffed ETT with LMA Unique: Cumbersome

AIR-Q Intubating LMA

Indirect Laryngoscopy
- Airtraq Disposable Laryngoscope (Prodol Meditec)
- GlideScope Video Laryngoscope, Cobalt (Verathon)
- Storz DCI Video Laryngoscope
- Truview PCD Infant (Truphatek)

Airtraq
- Single-use
- Heat from lamp antifogs
- Eyepiece or attachable camera with wireless monitor
- Infant size 0 (2.5–3.5 ETT)
- Pediatric size 1 (3.5–5.5 ETT)
- Require mouth opening of 12–13 mm
- Model available for nasotracheal intubation
- Stylet not recommended
**Airtraq**

**GlideScope Video Laryngoscope, Cobalt**
- Single-use blade with reusable video baton
- Monitor screen/ optional built-in video recorder
- Two pediatric sizes
- Heated tip for anti-fogging
- Broad view far from glottis requires stylet / indirect placement
- Mouth opening 10mm required
Storz DCI Laryngoscope (SVL)

- Miller-like blades sizes 0 and 1
- Video lens located with light source close to the blade tip
- Useful for direct or indirect visualization
- Requires smallest mouth opening (5mm)
- Stylet or coaxially inserted into the groove of the blade
Truview PCD Infant

- Small with an eyepiece for wide view
- Small camera may be attached
- Miller–like blade
- Oxygen insufflation adapter provides anti-fogging and increased inspired O₂
- Requires 8mm mouth opening

Video scopes: comparison

<table>
<thead>
<tr>
<th></th>
<th>GlideScope</th>
<th>Airtraq</th>
<th>StorzVL</th>
<th>Truview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height mm</td>
<td>10</td>
<td>12</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Field of view</td>
<td>wide</td>
<td>glottis +</td>
<td>glottis only</td>
<td>glottis only</td>
</tr>
<tr>
<td>Portability</td>
<td>++</td>
<td>+++*</td>
<td>+</td>
<td>+++*</td>
</tr>
<tr>
<td>Anti-fog?</td>
<td>Yes (lamp)</td>
<td>Yes (lamp)</td>
<td>No</td>
<td>Yes(O₂ flow)</td>
</tr>
<tr>
<td>Stylet?</td>
<td>Needed</td>
<td>Not needed</td>
<td>No/Yes**</td>
<td>Needed</td>
</tr>
<tr>
<td>Camera/ Monitor?</td>
<td>Yes (must)</td>
<td>Yes/No</td>
<td>Yes</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Reusable?</td>
<td>Single-use blades</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*without video
**may be used without stylet when ETT in the groove of the laryngoscope

Optical stylets: update to the lightwand

- Shikani Optical Stylet (SOS; Clarus Medical)
- Bonfils Endoscope (Karl Storz)
Shikani Optical Stylet

- SOS placed inside appropriately sized and lubricated ETT
- Tip just proximal to the end of the ETT
- SOS is malleable—bend to desired shape
- Device advanced along curvature of the tongue
- SOS placed just past the vocal cords and tube advanced into trachea

Shikani Optical Stylet

- Single or two-practitioner techniques
- Midline or left retromolar approach
- May be used with jaw thrust or in addition to laryngoscope for tongue displacement
- Port for insufflating oxygen

Shikani optical stylet

Bonfils Endoscope

- Rigid stylet with anterior curve
- High quality fiberoptic image
- Two configurations—eyepiece or mounted video camera
- Midline or retromolar approach
- Port for insufflating oxygen
- Aided by jaw thrust or laryngoscope
Fiberoptic Intubation: Challenges

- Small scopes—either flexible tip or suction port, not both
- Need to use larger than desired ETT
- Difficult to maintain oxygenation—scope occupies most of the airway
- Oral intubation—difficult to stay midline, but nares too small for nasal intubation
- Floppy scope not a great stylet
- Relatively long time until intubation

Fiberoptic Intubation

- Maintain spontaneous ventilation when possible
- Well-lubricated scope
- Nasal trumpet with 15mm adapter in contralateral nare for oxygenation
- Consider antisialogogues
Fiberoptic Intubation

The difficult pediatric airway: decision-making

- Emergency vs. elective
- Acute vs. long-term
- Pulmonary vs. airway problem
- Experience of team
The difficult pediatric airway
Guiding principles

- Maintain and teach proficient pediatric mask airway skills
- For elective cases, refer expected difficult airways to pediatric centers
- Ask for help early (after the first failed intubation attempt)
- Limit the number of attempts at intubation with the same technique and equipment
- Practice and maintain a few alternative techniques

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