Pediatric vs. Adult Airway

8 yrs

As a general principle: airway assumes an adult anatomic configuration at about 8 years of age

---

Large head - prominent occiput
"anatomical sniffing position"
No need to further elevate head

---

Small nares & nasal passage
Large tongue (relative to size of mouth and pharynx)
In infant: tongue touches palate
Prone to obstruction during MV
Unstable during DL

---

More rostrad larynx:
appears "anterior" on laryngoscopy
Epiglottis is:
Narrow
Stiff
Angulated over the glottis

---

Narrowest portion is the cricoid cartilage

---

Pediatric laryngoscopy

Laryngoscope choice

Stiff and narrow epiglottis → straight blade
Small mandibular space (narrow)

---

Pediatric laryngoscopy

Laryngoscope choice

<table>
<thead>
<tr>
<th>Blade</th>
<th>&lt; 1yr</th>
<th>1-2</th>
<th>2-6</th>
<th>6-10</th>
<th>&gt;10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Curved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

Pediatric laryngoscopy

Tracheal tubes

<table>
<thead>
<tr>
<th>Infant</th>
<th>Premie</th>
<th>9mo</th>
<th>&gt;2yr*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5†</td>
<td>2.5</td>
<td>4.0</td>
<td>4+ Age 4</td>
</tr>
</tbody>
</table>

†Internal diameter

### Pediatric Laryngoscopy

#### Tracheal tubes

**Uncuffed tube in < 8 yrs?**

**Why?**

- Historical reasons
- Early tracheal tubes and laryngoscopes not designed for children
- Now being reconsidered

**Should cuffed endotracheal tubes be used routinely in children?**

*Rana GC, Connolly MB, Meade MO, et al.*


*(good review article)*

- 488 children in the operating room (newborn to 8 years)
- Reduced ETT change for "leak" in cuffed group
- Reduced fresh gas flow in the cuffed group
- Used 3+age/4 to choose cuffed tube


**Should cuffed endotracheal tubes be used routinely in children?**

*Rana GC, Connolly MB, Meade MO, et al.*


**Prospective randomized controlled multi-centre trial of cuffed or uncuffed endotracheal tubes in small children**

M. Weiss et al.


- 2246 children, birth to 5 yrs of age
- Postextubation stridor similar
- Rate of tracheal tube change 2.1% vs 30.8%

### Pediatric Obesity

**32% of children presenting for surgery**

**Co-morbidities**

- Type II diabetes
- Asthma
- OSA
- Reflux
- Hyperlipidemia
- Hypertension
- Heart disease

### Pediatric Obesity

**Peri-op airway complications more common in obese children**

- Coughing (major)
- Airway obstruction (major)
- Bronchospasm
- Oxygen desaturation (major)

### Pediatric Obesity

**Normal | Obese**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficult mask ventilation</td>
<td>2.2%</td>
<td>7.4%</td>
</tr>
<tr>
<td>Difficult direct laryngoscopy</td>
<td>0.4%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Post-op airway obstruction</td>
<td>0.07%</td>
<td>1.6%</td>
</tr>
</tbody>
</table>
Common Syndromes (with distinct airway implications)

Anesthesia for Generic, Metabolic, and Dysmorphic Syndromes of Childhood
2007 by LIPPINCOTT WILLIAMS & WILKINS

Common Syndromes (with distinct airway implications)

Down Syndrome (trisomy 21)
Goldenhar Syndrome
(Developmental anomaly of 1st-2nd branchial arches)
- Limited mouth opening
- Deviation of mandible
- Micrognathia
- Abnormal tongue/palate function
- May have laryngeal anomaly (i.e. TE Fistula)
- Possible OSA
- Difficult airway may become worse with age.

Common Syndromes (with distinct airway implications)

Down Syndrome (trisomy 21)
Goldenhar Syndrome
(Developmental anomaly of 1st-2nd branchial arches)
Pierre-Robin Syndrome
(in-utero mandibular hypoplasia)
- Severe Micrognathia
- Glossoptosis
- Cleft Soft Palate
- Mandible growth may catch-up with age

Common Syndromes (with distinct airway implications)

Down Syndrome (trisomy 21)
Goldenhar Syndrome
(Developmental anomaly of 1st-2nd branchial arches)
Treacher-Collins Syndrome
(Autosomal Dominant)
- Hypoplastic malar bones
- Cleft zygoma may be absent
- High-arched palate
- Small mouth & Malocclusion
- Mandibular & Pharyngeal hypoplasia

Pediatrics and failed intubation

Fewer options and fewer seconds: kids desaturate faster!
FRC lower
Metabolic rate higher

Pediatrics and failed intubation

Fewer options and fewer seconds:
- kids desaturate faster!
Rescue airways:
LMA available for neonates and children
KingLT: pediatric reports
Combitube: must be > 4'

Pediatric airway in resuscitation

80% of pediatric cardiac arrest is of respiratory cause (not intrinsic cardiac cause)
Progression to CV collapse is subtle
- fixed stroke volume
- baseline sympathetic tone
Can maintain BP in face of 30% volume loss
Pediatric airway in resuscitation

80% of pediatric cardiac arrest is of respiratory cause (not intrinsic cardiac cause)
Progression to CV collapse is subtle

Early attention to airway compromise is crucial

Pediatric airway in resuscitation

Intubation: don’t miss the forest for the trees
in the child tracheal intubation may not be "value added"!
Gaushe et al., JAMA2000, 283, 783-90
800 children "in the field" Neuro-trauma management
Bag-valve-mask vs. Tracheal intubation

<table>
<thead>
<tr>
<th></th>
<th>Survival</th>
<th>Good neuro outcome</th>
<th>Complication rate</th>
<th>Time to hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>30%</td>
<td>23%</td>
<td>17%</td>
<td>shorter</td>
</tr>
<tr>
<td>Child</td>
<td>26%</td>
<td>20%</td>
<td>39%</td>
<td>longer</td>
</tr>
</tbody>
</table>

Emergency airway rescue maneuvers

Rigid bronchoscope

Rigid stainless steel tube
Proximal end:
- Viewing port
- Ventilation port
- Instrument port
- Light source

Emergency airway rescue maneuvers

Rigid bronchoscope

Rigid stainless steel tube
Proximal end:
- Viewing port
- Ventilation port
Distal end
- Blunt tip

(e) Rigid bronchoscope, Prophageal Tracheal Combitube or transtracheal jet ventilation

Pediatric airway in resuscitation

Basic assessment & maneuvers are the same as the adult
- assure gas exchange
- assure an open airway (chin lift, jaw thrust, oral airway)
Emergency airway rescue maneuvers
Rigid bronchoscope
Bypasses obstructive lesions from oropharynx to tracheobronchial tree
- Direct visualization of lesions
- Ventilation / oxygenation
- Treatment / resection

Emergency airway rescue maneuvers
Rigid bronchoscope
Common pediatric lesions
- Cysts
- Subglottic hemangiomas
- Macroglossia
- AV malformations
- Papillomas
- Anterior mediastinal masses
- Granulomas
- Foreign bodies

Emergency airway rescue maneuvers
Rigid bronchoscope
Technique
- Provide adequate anesthesia
- Maintain spontaneous ventilation
- Inhalation technique
  - Halothane (for historic perspective)
  - Sevoflurane

- Inhalation technique
  - Halothane (for historic perspective)
  - Sevoflurane
Highly soluble
  - Does not require "uninterrupted" administration
  - Long onset
  - Cardiac depressant / arrhythmogenic
  - Sevoflurane
Low solubility
  - Non-irritating
  - Rapid onset
  - Requires continuous administration
  - In addition to anesthetic induction

Emergency airway rescue maneuvers
Rigid bronchoscope
Technique
- Provide adequate anesthesia
- Maintain spontaneous ventilation
- Inhalation technique
- TIVA technique
  Propofol 200u/k/min
  Rapid acting opioid
- Maneuvers to facilitate bronchoscopy
  - Head extension
  - Neck flexed
  - Cricoid pressure