Airway Anatomy through the ages.

Dr Alex Donaldson
Staff Specialist LCCH
Wickham Terrace Anaesthesia.
Anatomy through the ages.

- Why is it important to understand the differences.
- Anatomy: historical teaching vs contemporary evidence.
- Airway devices: cuffed vs uncuffed ETT’s
- Physiology
- Positioning and face mask ventilation techniques.
Anatomy through the ages

• Why is understanding the differences in anatomy important?
• Airway and respiratory complications are a common cause of morbidity.
• Most unfamiliar, “non-adult” are those less 1 year of age.
Anatomy

• Large occiput
• Neonates are obligate nasal breathers
• Large tongue
• Epiglottis shape
• Relatively small internal diameter of airways.
• Larynx located higher
• Glottis location premature babies C3, newborns C3-4, adults C5
Poiseulles Law

- \( Q = (\Delta P \pi r^4)/(8 \eta L) \)
- \( Q = \) flow
- \( \Delta P = \) pressure gradient from one end of the airway to the other.
- \( r = \) the radius of the airway
- \( \eta = \) viscosity of air
- \( L = \) length of airway
<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Edema 1 mm</th>
<th>Decreased X-sectional area</th>
<th>Resistance Laminar flow ($R \propto \frac{1}{\text{radius}^4}$)</th>
<th>Resistance Turbulent flow ($R \propto \frac{1}{\text{radius}^5}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant</td>
<td><img src="Image" alt="Image" /></td>
<td>$4 \text{ mm}$</td>
<td>$\sim \downarrow 75%$</td>
<td>$\sim \uparrow 16x$</td>
<td>$\sim \uparrow 32x$</td>
</tr>
<tr>
<td>Adult</td>
<td><img src="Image" alt="Image" /></td>
<td>$8 \text{ mm}$</td>
<td>$\sim \downarrow 44%$</td>
<td>$\sim \uparrow 3x$</td>
<td>$\sim \uparrow 5x$</td>
</tr>
</tbody>
</table>
Narrowest part of airway??

- Classical teaching – cricoid ring up to 6-8 years of age.
- Contemporary studies – bronchoscopic and MRI/CT – find the narrowest point is the transverse diameter at the level of the vocal cords, and diameters throughout the airway increased linearly with age.
REVIEW ARTICLE

Pediatric airway anatomy may not be what we thought: implications for clinical practice and the use of cuffed endotracheal tubes

Joseph D. Tobias\textsuperscript{1,2,3}

1 Department of Anesthesiology & Pain Medicine, Nationwide Children’s Hospital, Columbus, OH, USA
2 Department of Anesthesiology & Pain Medicine, The Ohio State University College of Medicine, Columbus, OH, USA
3 Department of Pediatrics, The Ohio State University College of Medicine, Columbus, OH, USA
Uncuffed vs Cuffed ETT’s

• Historical indication for uncuffed ETT’s under 8yrs
• The glottis is the narrowest part of the airway.

• “Checking for a leak” likely inaccurate.
ETT in circular vs elliptical shaped airway.
Advantages of cuffed ETT’s

• Reduction in post extubation stridor.
• Reduced need to change ETT’s.
• More reliable ventilation and oxygenation.
• More precise endtidal capnography tracing.
• Decreased consumption of inhalational agents.
• Prevention oropharyngeal contamination of inhaled agents.
Microcuff ETT
Physiological changes

- Infants and children are predisposed to hypoxaemia.
- Increased oxygen consumption and reduced FRC.
- Increased CO2 production – need to increase minute ventilation.
Positioning and Face mask ventilation techniques

• Correct size
• Backwards head tilt – noting that hyperextension can cause obstruction in infants.
• Chin tilt/ jaw thrust
• CPAP
Slightly extended
Flexed