Management of the Airway in the Pediatric Patient
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OBJECTIVES
• At the conclusion, the student will:
  - be able to describe the differences between the adult and pediatric airway
  - choose the appropriate methods for the managing the airway in the injured child
  - describe advanced airway procedures for the injured child

Airway Management
• Follows a continuum from a spontaneously breathing patient able to maintain their own airway up to an intubated, ventilator-dependent patient.
• It is a dynamic process.
• Many choices must be made.
• You can make GOOD ONES or BAD ONES!

Children Are Not “Little Adults”
The Management Priorities in the primary survey are The Same for Children as they are for ADULTS!

MANAGEMENT OF AIRWAY IN CHILDREN
Produces Anxiety In Responders

Priority Scheme
Circulation
Breathing
Airway
Level of Consciousness
Pediatric Assessment Triangle: Management Priorities

- Scene Safety
- Mechanism of Injury
- AIRWAY
- BREATHING
- CIRCULATION
- HAVE AN ACTION PLAN

Airway Compromise
- Is the most common cause of arrest in the Pediatric Patient
- Limited Respiratory Compensatory Mechanisms
- Anatomic Differences
- Less Experience

PEDIATRIC AIRWAY ANATOMY

Differences with the Adult

- Child’s face smaller and flatter than adult
- Nasal passages smaller
- Young infants obligate nose breathers
- Occiput is larger, forces head forward

Anatomy of the Pediatric Airway

- Pharynx smaller – More easily obstructed
- Tongue is proportionately larger

- Epiglottis large and floppy – obstructs with hyperextension
- Trachea shorter
- Larynx is higher – C 3-4 versus 4-5 in adult

Anatomy 2

- Trachea diameter 4mm versus 20mm in adult
- Tracheal rings softer – easily compressed
- Subglottic area is narrowest part of airway

Figure 4.1: Unique features of the pediatric airway.
Effects of Edema

Adult Airway

Pediatric Airway

1/3rd of edema

Gastric Distention
• From aerophagia or
• Ventilatory support
• Compromises diaphragmatic excursion
• Decompress with NG only after airway is secure

Upper Airway Injury Causes
• Foreign body
• Blunt force
• Chemical or thermal burns
• Penetrating injury

Respirations
• Rate increases
• Depth does not increase
• Slowing rate is not always a good sign

Upper Airway Injury Signs & Symptoms
• Abnormal breath sounds
  – Stridor
  – Crowing
  – Whistling
• Nasal flaring
• Cyanosis

Vital Signs

<table>
<thead>
<tr>
<th>Age</th>
<th>Weight</th>
<th>Resp</th>
<th>Pulse</th>
<th>Sys BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>3 - 4 kg</td>
<td>30 - 50</td>
<td>120 - 160</td>
<td>60 - 80</td>
</tr>
<tr>
<td>6mo – 1yr</td>
<td>8 - 10</td>
<td>30 - 40</td>
<td>120 - 140</td>
<td>70 - 80</td>
</tr>
<tr>
<td>2 – 4 yr</td>
<td>12 – 16</td>
<td>20 – 30</td>
<td>100 – 110</td>
<td>80 – 100</td>
</tr>
<tr>
<td>5 – 8 yr</td>
<td>16 – 20</td>
<td>18 – 24</td>
<td>90 – 105</td>
<td>90 – 110</td>
</tr>
<tr>
<td>8 – 12 yr</td>
<td>20 – 30</td>
<td>12 – 24</td>
<td>80 – 100</td>
<td>100 – 110</td>
</tr>
<tr>
<td>&gt; 12 yr</td>
<td>&gt; 50</td>
<td>12 – 16</td>
<td>80 – 85</td>
<td>100 – 110</td>
</tr>
</tbody>
</table>

BLS COMES BEFORE ALS
Have Appropriate Equipment Available

- Suction
- ETTR
- Laryngoscope
- BVM
- Broselow® Tape

**Oxygenation**

- Never withhold oxygen
- Avoid high flow blowing on child’s face
- Nasal cannula provides high concentration (preferred nose breathers)
- Use mask for highest concentration
- \( O_2 \) toxicity not a pre-hospital concern

**Airway**

- Open AIRWAY Manually
- Protect C-Spine
- Sniffing position in small children
- CHECK FOR FOREIGN BODIES
- Suction Available
- Use of Adjuncts

**Ventilations**

- Bag Mask
  - Correct size mask
- Tidal Volume of 10 cc / kg
- Do NOT Over Ventilate
  - Allow time for exhalation

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**Cuffed versus Uncuffed Tubes**

- Size 5 or less uncuffed
- Traditional Teaching
- Smallest point of Ped Airway
  - Subglottic
- Recent Studies
  - Newth et al. [J. Peds 144(3) 333-337, 2004]
  - Low pressure cuffed tubes work well
  - Less Air Leak

**INTUBATION**

- Orotracheal preferred over Nasotracheal
- Proper Equipment for age
- Length Based System for Equipment and Doses
- Medications if RSI allowed
- Pre-oxygen for 60-70 sec
- Use of drugs prior to RSI
- Pulse Ox
- PROTECT C-SPINE!

**The 6 T's** of Intubation

- Prepare
  - Proper Equipment
  - "Har”
  - Pre-oxygenate
  - Pre-medicate
  - Paralyze and Sedate
  - Pass the Tube
  - Placement Confirmation
Cole Formula

ETT size = Age / 4 + 4

Uncuffed tube

If using a cuffed tube, choose cuffed tube ½ size smaller than calculated in the formula.

Confirmation of Tube Position

- Continuous Capnography
- Information about Perfusion

The Capnogram

- Represents the Respiratory Cycle
- Exhalation: A to D
- Inhalation: D to E
**Pre-Hospital Capnometry**
- Becoming a standard of care.
- Easy to use
- Good measure of Pulmonary Perfusion
- Relative end to PaCO₂
- Nice save: limitations

**Lighted Stylet**
- Hockey stick configuration
- Light shadow
  - If bright?
  - If dull?
- Problems with ambient light
- Not overly popular technique in EMS

**Alternative Airway Techniques**

**Is Intubation Always Needed?**
- Effect of Out-of-Hospital Pediatric Endotracheal Intubation on Survival and Neurological Outcome: A Controlled Clinical Trial
  - Marianne Gausche, MD; Roger J. Lewis, MD, PhD; Samuel J. Stratton, MD, MPH; Bruce E. Haynes, MD; Carol S. Gunter, BSN, MPA; Suzanne M. Goodrich, RN, MSN; Pamela D. Poore, RN; Maureen D. McCollough, MD, MPH; Deborah P. Henderson, PhD, RN; Franklin D. Pratt, MD; James S. Seidel, MD, PhD

**Bag Valve Mask Ventilation**
- Master the Art of BVM Before Attempting the Skill of Intubation
- Correct Mask
- Good seal on face
- Effective Ventilation
- 100% FiO₂
- 10-12 cc per kg
- 800-1200 cc per breath
- EMPTY the BVM!
- Low pressure: <40 cm H₂O
- Slow flow: 1.5-2.0 sec. for each inhalation
- Allow exhalation
- Cricoid Pressure

**Facial Contact Points**
- Bridge of Nose
- Both Malar Prominences
- Mental Process (chin)
- Avoid the Eyes and Orbits

**Difficult to Bag Valve Mask**
- Facial Hair
- Obesity
- Edentulous (leave dentures in)
- Upper airway obstruction
- Small Chin
- Large tongue
Bag Valve Mask
• Use both hands to make a seal
• Lift the jaw
• Align the axes

Bag Valve Mask
• Use adjuncts
• Nasopharyngeal Tube
• Oropharyngeal Tube

Bag Valve Mask
• Continuous Firm Pressure
  - Want to minimize barotrauma
• Allow time to exhale
  - Watch Chest
  - Listen for exhalation

Adult: Once every 5
Pediatric: Once every 3-4

Blind Insertion Airway Device (BIAD)
• Combitube
  - Double lumen system
  - Passed blindly into Pharynx
  - Position determined by auscultation of lungs & epigastrium
• Contraindications
  - < 45 Kg
  - Esophageal Injury

Laryngeal Mask Airway (LMA)
• European device; possibly in OR - Allows "light" sedation
• Moves the mask seal to the hypopharynx
• "Easy" to perform
• Does NOT totally protect airway from aspiration

King LT Airway
• Single lumen airway
• Ventilation in patients with low risk for aspiration
• Two ports on tube
  - Ventilation
  - Bronchoscope or tube exchange catheter
• Reusable up to 50 times with autoclaving
King LT

Size 2 thru 6 available in US

Lighted Stylet

- Hockey stick configuration
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TRANESLARYNGEAL JET VENTILATION (TLJV)

- "Field Surgical Airway"
- Quick and safe
- Will oxygenate patient
- Temporary method
  - Gives about 20 minutes to establish better airway
- Commercial kits - Seldinger method

Oxygen Delivery With Needle Cricothyrotomy

Room Air
- 21% Oxygen
- Tidal Volume = 500cc
- Respiratory Rate = 12
- 3 liters/min x 21% = 1.5 liters

Needle Cricothyrotomy
- 15 LPM 100% O2
- 1 second on/ 4 seconds off
- 15 x 1/5 = 3 liters

21% = 7.5 liters/minute
Cricothyroid Needle Placement

- Perforate the membrane with a needle
- Aspirate air
- Insufflate or pass the wire
- Place final airway device

**SURGICAL AIRWAY**

- Needle Cricothyrotomy for < 12 Years Old
- Landmarks not easily found

**REMEMBER**

**WITHOUT AN AIRWAY THE PATIENT IS DEAD!**

**Percutaneous Cricothyrotomy**

**AIRWAY COMPROMISE IS A CRITICAL TRAUMA SITUATION**

**LOAD AND GO = HAUL ASS**

**SUMMARY:**

Pediatric Trauma Airway
- Differences between adult and child increase the challenge
- Signs of Airway Compromise often subtle
- Mechanism of Injury provides clue
- Aggressive Approach
- Anticipate Problems