Respiratory Management in Pediatrics

Children’s Hospital Omaha Critical Care Transport

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Objectives

• Examine the differences between the pediatric and adults airways.
• Recognize respiratory distress and impending respiratory failure.
• Discuss management of respiratory distress and respiratory failure.
• Case Scenarios.
Children are not small adults…

Children are still growing in every way. Their bodies are different, they perceive things and communicate differently, and the long term implications of treatment are not the same.
Respiratory Emergencies

Pediatric Respiratory Emergencies

• #1 reason for pediatric hospital admissions.
• #1 cause of death during the first year of life with the exception of congenital abnormalities.
Early Intervention is Critical

Respiratory Distress

Respiratory Failure/Shock

Cardiopulmonary Failure

Cardiopulmonary Arrest
Most pediatric cardiopulmonary arrests begin as respiratory failure or respiratory arrest.

Decrease respiratory reserve + Increased O2 demand =

Increased respiratory failure risk
Respiratory Emergencies in Pediatrics

**Airway Diseases**
- Croup, epiglottitis, asthma, bronchiolitis, foreign body aspiration, bronchopulmonary dysplasia.

**Lung Tissue Diseases**
- pneumonia, ARDS, aspiration, pulmonary contusion

**Non-respiratory causes**
- CNS depression, musculoskeletal disorders, thoracic disorders or injuries, shock
Why are children more vulnerable?

- Obligate nose breathers until 6 months
- Large tongue
- Lymphoid tissue achieves adult size at 2
- Large, anterior epiglottis
- Narrow subglottic region
- Fewer alveoli
- Smaller airways: Hagen-Pouiselle’s Law
- Decreased cartilage in airways
- Increased chest wall compliance
- Increased metabolic rate, increased O2 consumption

Typical oxygen consumption 6-8 ml/kg/min in a child vs. 3-4 ml/kg/min in adult
Pediatric Airway

Figure 26: Pediatric Airway
Anatomy of pediatric airway

- Epiglottis (floppier, u-shaped)
- Tongue
- Hyoid bone
- Airway (more anterior and higher)
- Vocal cords
- Thyroid cartilage
- Cricoid ring (Narrowest)
- Trachea (more flexible)
- Funnel

Posterior
Anterior

SUSAN GILBERT
Airway Resistance

**Full Term Newborn Airway**

1mm of edema, the diameter will be 44% of normal.

**Adult Airway**

1mm of edema, the diameter will be 81% of normal.

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**Poiseuille’s law**

*If radius is halved, resistance increases 16fold*

\[
R = \frac{8 \pi l}{\Pi r^4}
\]

Resistance increases 3x in an adult and 16x in an infant.
Adult Airway VS. Pediatric Airway

Adult

Pediatric
The Licorice Airway…

• Please bite a small piece off to top and bottom of your licorice. We will now perform a test on your airway.
  – Breath in and out of the licorice for 30 seconds.
Airway Management

Position

Position

Position
Airway Positioning

“Sniffing Position”
In the child older than 2 years

Towel is placed under the head
Airway Position - Children
Airway Position - Children <2yrs
Pediatric Respiratory Management

Airway

Breathing

Circulation

“Without an “A” you will not get a “B”.”
Airway Management

• “A” Open it correctly!
• Position the patient in the neutral, supine position.
• Use the head tilt, chin lift to open the airway and place the patient in a “sniffing” position. Use a shoulder role.
• If you can not open the airway: Reposition!
• Clear the airway by suctioning any secretions within the mouth or nose.
Airway Assessment

OPEN and CLEAR

Able to Maintain

Unable to Maintain
Maintaining the Pediatric Airway

• Nasal Airway
• Oral Airway
• Bag Masking
• Intubation
Foreign Bodies

- **ALWAYS** consider a foreign body as a cause of Respiratory Distress.
- Usually will have a SUDDEN onset.
Signs of Respiratory Distress

- Tachypnea
- Tachycardia
- Grunting
- Stridor
- Head bobbing
- Flaring
- Inability to lie down
- Agitation
- Retractions
- Accessory muscles
- Wheezing
- Sweating
- Prolonged expiration
- Apnea
- Cyanosis
Signs of Impending Respiratory Failure

- Reduced air entry
- Severe work
- Irregular breathing or apnea
- Cyanosis despite Oxygen delivery
- Altered Level of Consciousness
- Diaphoresis
Respiratory Failure

• Respiratory Failure is the inability of the airway and lungs to meet the metabolic demands of the body.

Hypoxic Respiratory Failure
*Inadequate oxygenation*
Can’t Get Oxygen in

Hypercarbic Respiratory Failure
*Inadequate ventilation*
Can’t Get CO2 out
Nasopharyngeal Airway

Contraindications:

- Basilar skull fracture
- CSF leak
- Coagulopathy

Length: Nostril to Tragus
Endotracheal tube as nasal airway

A regular ETT can be cut and used as a nasal airway
Adjuncts: Oral Airway

Wrong size: Too Long
Adjuncts: Oral Airway

Wrong size: Too Short
Correct size
Bag Mask Ventilation
Intubation: Indications

- Failure to oxygenate
- Failure to remove CO$_2$
- Increased WOB
- Cardiovascular failure
- Neuromuscular weakness
- CNS failure
Laryngoscope Blades

Macintosh

Miller
Airway

- Open?
- Able to maintain?
- Position and Assess?
- Bag/Mask?
- Intubation?

Pediatric Airway with inflammation
A Closer Look
Normal Pediatric Airway
A Closer Look
Abnormal Pediatric Airway
## ET Tube Sizing

<table>
<thead>
<tr>
<th>Age</th>
<th>kg</th>
<th>ETT</th>
<th>Length (lip)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>3.5</td>
<td>3.5</td>
<td>9</td>
</tr>
<tr>
<td>3 mos</td>
<td>6.0</td>
<td>3.5</td>
<td>10</td>
</tr>
<tr>
<td>1 yr</td>
<td>10</td>
<td>4.0</td>
<td>11</td>
</tr>
<tr>
<td>2 yrs</td>
<td>12</td>
<td>4.5</td>
<td>12</td>
</tr>
</tbody>
</table>

**Children > 2 years:**

- **ETT size:** \((\text{Age} + 16)/4\)
- **ETT depth (lip):** Length of tube x 3 (Approximately)
Intubation Technique

**Straight Laryngoscope Blade** – used to pick up the epiglottis

Better in younger children with a floppy epiglottis
Rapid Sequence Intubation

• When: Intubation is emergent and there is concern for aspiration
• Why: Obtain airway control rapidly and minimize aspiration risk
• How:
  – All necessary intubation equipment and personnel
  – Preoxygenate
  – Rapidly acting sedative, analgesic and neuromuscular blocking agent are administered simultaneously
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Deterioration after Intubation

- Displaced tube
- Obstructed tube
- Pneumothorax
- Equipment
Respiratory Case Scenarios

Let’s manage some patients together...
Case scenario 1

• 3 month old is admitted to the hospital with a runny nose, poor appetite, and frequent coughing.

Classify patient
Scenario 1 Assessment

[Image of a baby with a feeding tube]
Scenario 1 Assessment

**Vitals**

H.R. = 136

R.R. = 60

WOB = Intercostal and subcostal retractions

B.S. = Noisy breathing (crackles and wheezing)

SpO2 on Room Air = 88%

**Diagnosis**
Respiratory Syncytial Virus (RSV)

- RSV is a very common virus that infects half the children during their first year of life.
- Symptoms include wheezing, nasal congestion, rapid breathing, cough, irritability, retractions, poor feeding, sluggishness, and fever.
- Synagis is given as a prophylactic treatment to children with the highest risk for severe RSV.
RSV in the Airway

Mature lung

Immature lung

Premature lung with RSV

- Reduced diameters
- Increased cells
- Increased muscle
- Mucus plugging
- Increased airway constriction
Scenario 1 Treatment

- “A” Airway Management
  - Secretion Management
    * Suction before all feeds.

- “B” Breathing
  - Oxygen Therapy

- “C” Circulation
  - Hydration
  - Treat symptoms
  - Prophylaxis (Synagis)
The Nose

• Nose is responsible for 50% of total airway resistance at all ages

 Infant: blockage of nose = respiratory distress
Case Scenario 2

- A 2 year old patient is admitted to the ED with lethargy, poor appetite for 3 days, fever, increasing respiratory distress.

Classify Patient
Scenario 2 Assessment
Case Scenario 2

Vitals
H.R. = 172
R.R. = 58
WOB = substernal retractions
B.S. = rales, diminished bases
SpO2 on Room Air = 80%

Diagnosis
Scenario 2 Treatment

• “A” Airway Management
  • Position child to Open Airway
  • Clear Airway

• “B” Breathing
  • Oxygen Therapy

• “C” Circulation
  • Hydration
Case Scenario 2

• 30 minutes later:

**Vitals**

H.R. = 186  
R.R. = 66  
WOB = substernal and intercostal retractions  
B.S. = diminished  
SpO2 on 10 liter O2 mask = 90%  
X-ray = hyperinflation, right lower lobe atelectasis  
Cap gas results:  
pH = 7.26, CO2 = 75, O2 = 53
Case Scenario 2

- Chest X-ray
What is plan B?

L aryngeal
M ask
A irway
Needle Cricothyrotomy

- A “quick” fix, buys some time…
- Used when you can’t intubate or ventilate…
King Airway

• Backup Airway…
• Inserted Blind….
Case Scenario 3

- 7 year old child is brought to the Emergency Department with a chief complaint of SOB.

Classify
Case Scenario 3

**Vitals**
H.R. = 132
R.R. = 28
WOB = substernal and intercostal retractions
B.S. = decreased
SpO2 on Room Air = 87%

**Diagnosis**
Asthma Statistics

- 23 million Americans currently have Asthma.
- *Number of children who currently have Asthma: 7.0 million.*
- Students with Asthma miss nearly 13 million school days every year due to illness.
Scenario 3 Treatment

• “A” Airway Management
  • Oxygen
  • Sitting Position, Position of Comfort

• “B” Breathing
  • Albuterol 0.5 ml and more bronchodilators
  • Steroids
  • Encourage Coughing

• “C” Circulation
  • Hydration
Special Populations

• Tracheotomies
  – Stay “CALM”!!
Special Populations

- Cystic Fibrosis
  - SUCTION, Position of Comfort, Cough
  - SUCTION
  - SUCTION
It is all about the ABC’s…

• Airway
• Breathing
• Circulation

Recognize the signs of respiratory distress and use your ABC’s.
Questions?
Thank You!!!