Pediatric Respiratory and Shock Assessment

Scottie B. Day, M.D.
Assistant Professor
Heinrich A. Werner Division of Pediatric Critical Care
Director, Pediatric Transport and Outreach
Kentucky Children’s Hospital/UK Healthcare

Background

• UK College of Medicine, 2002
• Indiana University Internal Medicine/Pediatrics Residency, 2006
• Riley Hospital for Children Transport Physician, 2004-2006
• Cincinnati Children’s Hospital Pediatric Critical Care Fellow, 2006-2009
• Kaiser Moanalua Hospital, Honolulu, HI
• Maui Memorial Medical Center, Wailuku, HI
Disclosures/Affiliations

- There are no financial relationships to disclose
- Member, American Academy of Pediatrics Section on Transport Medicine
- EMS-C Member, Kentucky Board of Emergency Medical Services
Objectives

- Are kids just small adults?
- Overall goal of an effective pediatric transport
- General Respiratory Assessment
- Upper airway disease and management
- Lower Airway Disease and management
- Early evaluation and management of Shock

What's the Goal?

- Reach persons in need quickly
- Stabilize patient’s condition
- Transfer to a facility with the ability of providing more extensive care that will improve outcomes.
Case #1

- 7 mo presents w/wheezing, stridor, and severe retractions. Poor tone and not responsive to surroundings. RR 80 HR 190 T:38.6 C (101.5F) SaO2: 80% on RA
- Former 28 week gestation; intubated at birth and on mech ventilation for 6 weeks before hospital discharge;
- Patient also has Pierre robin Syndrome

Case #1

- How would you assess and categorize airway?
- What special precautions would you take in airway management?
The Facts

- Primary Cardiac Arrest in Infants and Kids rare
- Usually preceded by respiratory failure and/or shock
- Septic Shock is the most common form of shock in pediatrics
- Terminal rhythm in children is usually bradycardia that progresses to PEA and asystole.

Development

- Children are just small adults. Right?
Pediatric Airway

- Small Short airway
- Large tongue
- Cephalad (towards the head) larynx
- Funnel shaped larynx
- Epiglottis is short, narrow, and angled away
- Large occiput
- Small peripheral airways

Resistance

- \[ R = \frac{8\eta L}{\pi r^4} \]

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Edema</th>
<th>Δ diameter</th>
<th>Δ resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>infant</td>
<td>4 mm</td>
<td>3 mm</td>
<td>↓ 50%</td>
<td>↑ 16 X</td>
</tr>
<tr>
<td>Adult</td>
<td>6 mm</td>
<td>6 mm</td>
<td>↓ 25%</td>
<td>↑ 1 X</td>
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</tbody>
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Resistance

• $R = \frac{(8\eta L)}{(\pi r^4)}$
• i.e. 1mm circumferential edema $\rightarrow$ reduce airway diameter by 2mm resulting in 16 fold increase in airway resistance in the pediatric airway vs adult.

• Why do airways in children collapse?
PHYSICS

- Venturi: flow of gas increases in velocity as it flows through a partially obstructed tube
- Bernoulli: increase in velocity is associated with a decrease in pressure (and vice versa)
- Cartilage in kids less developed

Pediatric Airway

- Small Short airway
- Large tongue
- Cephalad(towards the head) larynx
- Funnel shaped larynx (narrowest portion is cricoid not glottis)
- Epiglottis is short, narrow, and angled away
- Large occiput
- Small peripheral airways
Cephalad

- Tongue easily opposes palate
- Infants obligate nose breathers
- 50% of airway resistance is at nose

Pediatric Airway

- Small Short airway
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- Small peripheral airways
• What is the narrowest portion of the airway in pediatrics?

CRICOID not glottis

• Reason historically cuffed tubes were not used
Epiglottis

• Determines which laryngoscope blade used (miller better with floppy epiglottis)

Large Occiput

• Towel roll
  • Infant and children: under shoulders
  • Older children and adults: under head
Respiratory assessment

Across the room
As you approach patient
alert, pink, restless, combative?
Tired appearance/decreased LOC
Cyanosis not apparent until sats<88%
Stridor/snoring respirations
Head Bobbing
Classic Signs and Symptoms

- UPPER AIRWAY OBSTRUCTION
- Key Sx: INSPIRATORY STRIDOR

Pearls

- Croup: barking cough, hoarse voice, stridor within several days
- Foreign-body aspiration: choking, followed by stridor and decreased breath sounds, develop rapidly in minutes
- Retropharyngeal abscess: fever, neck pain/stiffness, drooling, and sore throat develop
Pearls

- Epiglottitis: fever, drooling, sore throat, **muffled voice**, and absence of cough, hours to days.
- Anaphylaxis: angioedema, stridor, wheezing, and shock develop minutes to hours.

Management

- Croup
  - Humidified oxygen (theoretical)
  - Keep child calm
  - Nebulized epinephrine (works on \( \alpha \) & \( \beta \) receptors (vasoconstrict, reduce mucosal edema, and relax smooth muscle)
    - 0.5mL/kg of 1:1000 concentration
Management

- Racemic epinephrine (0.05mL/kg to maximum of 0.5mL of 2.25% solution)
- Steroids (0.15 to 0.6mg/kg) orally or intramuscularly
- Intubation if at all possible avoided unless in a well equipped setting
- TRACHEAL TUBE SIZE \( \frac{1}{2} \) size normally would.

Foreign Body Aspiration

- Most cases will be partial airway obstruction
- Support oxygen and ventilation
- Keep Calm if possible
Retropharyngeal Abscess

- Fever, neck pain, and sore throat
- Hoarseness, drooling, cervical adenopathy
- Asymmetric pharyngeal bulge in ½ of cases

Retropharyngeal Abscess

- IV antibiotics
- Rare to intubate
- If severe and intubation necessary, preferable to occur in OR if at all possible.
Epiglottitis

- Drooling, fever, respiratory distress, muffled voice, and toxic appearance
- If severe respiratory distress, intubation in ER or OR.

Anaphylaxis

- Epinephrine, 0.01mL/kg of 1:1000 solution to a maximum of 0.3mL intramuscularly, repeat every 15 minutes if necessary
- Albuterol
- H1- and H2-antihistamines
- Methyprednisolone IV
- Epinephrine (1:10,000 or 1:100,000 solution IV if cardiopulmonary failure.)
Lower airway obstruction

• Expiratory Stridor
Bronchiolitis

• RSV (Respiratory Syncytial Virus)
• Risk factors
  • Prematurity
  • Complex congenital heart disease
  • Chronic lung disease
  • Immunosuppression
  • Neuromuscular disease
  • Metabolic disorder

Bronchiolitis

• Various symptoms
• Cough, wheezing, nasal congestion, fever, hypoxia, apnea, ALTE, etc.
Management

• Supportive care
• Oxygen, suctioning
• Hydration
• Agitation can make it worse
• *bronchodilators
  • Routine use not accepted but trial dose is o.k.
  and then continue if it works

Asthma

• Bronchodilators
• Steroids
• Magnesium
• Epinephine
Bronchopulmonary Dysplasia (BPD)

- Chronic lung disease
- Premies
- Tachypnea, wheezing, increased work of breathing, ALTEs
- Management: Bronchodilators, steroids, diuretics, and antibiotics
Airway Management

- 100% oxygen via NRB mask
- Provide bag mask for kids not breathing effectively
  - Unable to maintain O2 sats on oxygen
  - Cyanosis
  - Unable to protect airway
  - Bag with enough force to make chest rise
  - 1 breath every 3 seconds
  - DO NOT OCCLUDE AIRWAY WITH FINGERs

Airway Management

- Positioning (“Sniff”)
- Jaw thrust
- Nasopharynx/Oropharyneal Airways
- Tracheal Intubation
- Alternative Airways
Tracheal intubation

- Preoxygenate, preinduction, sellick maneuver, induction, neuromuscular blockade

Tracheal tube mm (uncuffed): age/4 + 4
- Tracheal tube mm (cuffed): age/4 + 3
- In trisomy 21, use tube 1 size down from calculation usually.

Tracheal intubation

- Length of tube as follows:
  - >1 yo of age: 13 + ½ pt’s age
  - <1yo: 3x ETT size
Mission Trip

Circulation

- Shock
  - Inadequate blood flow to tissues
  - Oxygen delivery is dependent on cardiac output
  - Tachycardia is earliest symptom
Compensated Shock (Early)

- Blood pressure is maintained
- Early Symptoms
  - Mild tachycardia
  - Mild tachypnea
  - Slightly increased capillary refill time
  - Weak peripheral pulses
  - Decrease in urine output and bowel sounds
  - Cool/mottled extremities

Circulation

- Decompensated
  - Blood pressure deteriorates
  - Tachycardia/tachypnea
  - Weak or absent pulses
  - Very delayed capillary refill and cold extremities
  - Poor or absent urine output
Badness

Management

- Venous Access
  - FLUIDS, FLUIDS, FLUIDS, FLUIDS, FLUIDS
  - Isotonic Normal Saline
  - Treat Hypothermia
  - Check glucose, treat hypoglycemia!!
  - Antibiotics
ENVIRONMENT

- A naked child is a cold child
  - Check temperature
  - Warm IV fluids if possible: room temperature fluids are about 20 degrees colder than normal body temperature
  - Warm blankets for transport

HYPOTHERMIA EXCERBATES ACIDOSIS

OVERCONFIDENCE
This is going to end in disaster, and you have no one to blame but yourself.
FAMILY PRESENCE

- Most clinicians are concerned that parents will interfere with care if allowed to be present
- Rarely, the case
- No evidence to suggest that legal risk increases with parental presence
- What would you want if it were your child?

SUMMARY

- Systematic Approach
- Prepare before you move and minimize interventions in route
- ABCs
Two Key decision points

1) Should the child be transported and which facility?

2) Who should transport the child?
Liability

- Once the pediatric critical care transport team arrives, it’s a consultant
- Once the pediatric critical care transport team leaves, responsibility and greater liability is assumed by this transport team

UK Healthcare/Kentucky Children’s Hospital
Acuity Trigger for Air Medical Auto-Launch

- <30 weeks gestation
- Abdominal Wall defect
- Suspected cyanotic heart defect
- Diaphragmatic Hernia
- Patient intubated <8 years of age

AUTO-LAUNCH
KCH Critical Care Transport Team

Thanks

- Any questions, advice, problems, or suggestions please feel free to contact me
- Scottie.Day@uky.edu
- Cell: 859-486-3168
- Pager: 859-330-8471