The Pediatric Airway in Health and Disease I

EMC 420: Maternal & Child Emergency Care

D. Trigg, MD

Objectives for Airway and Respiratory Emergencies I

- Compare the anatomical and physiological differences between the adult and pediatric airway.
- Distinguish respiratory distress from respiratory failure.
- Describe clinical features, diagnosis, and management of upper and lower airway obstruction and diseases of the lung.

modified from APLS

Case Study 1: "Choking"

- Mother of 13-month-old boy found him choking and gagging next to container of spilled nuts.
- Paramedics noted appearance is alert; work of breathing is increased with audible stridor; subcostal retractions; color is normal.

Initial Assessment (1 of 2)

PAT:

– Normal appearance, abnormal breathing, normal circulation

Vital signs:

– HR 160, RR 60, BP 88/56, T 37.1°C, O_2 sat 93%, Wt 11 kg

Initial Assessment (2 of 2)

A: Stridor
B: Tachypneic with retractions, reduced tidal volume
C: Color is normal, skin is warm and dry, pulse is rapid but strong and regular.
D: Alert with no focal neurologic signs; GCS 15
E: No obvious signs of injury

Question

What is your general impression of this patient?

General Impression

- Respiratory distress:
  - Upper airway obstruction
  - Foreign body aspiration

What are your initial management priorities?

Management Priorities

- Patient is monitored and allowed to remain in position of comfort.
- Supplemental oxygen (blow-by or by partial nonrebreather mask) is provided.
- IV access is deferred to avoid agitation.
- Once in the ED, specialists will be contacted.

Modified from APLS

Your First Clue: Foreign Body Aspiration

- A history of choking is the most reliable predictor of FB aspiration.
- Other signs and symptoms include:
  - Upper airway: Stridor, respiratory or cardiopulmonary arrest
  - Lower airway: Coughing, wheezing, retractions, decreased breath sounds, cyanosis

Discussion: Foreign Body Aspiration

- Background:
  - 150-300 fatalities in young children each year.
  - 2/3 of cases are in children 1-2 years of age.

Background: Foreign Body Aspiration (1 of 2)

- Food items are the most commonly aspirated FB.
- Balloons are the most common FB to result in death. (Two deaths have been reported from "blown-up" latex gloves acting like a balloon.)

Background: Foreign Body Aspiration (2 of 2)

- Foreign objects can be lodged in the upper or lower airway, or esophagus.
- Differences in the pediatric airway make evaluation and management of foreign body aspiration challenging.

Location of Foreign Body Aspiration (Modified from APLS)

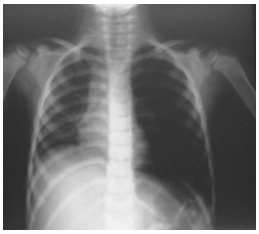
- 80% of FBs : lodged in lower airway:
  - Right mainstem bronchus: 30%
  - Left mainstem bronchus: 23%
  - Right bronchus: 21%
  - Left bronchus: 5%
- 20% of FBs : lodged in upper airway:
  - Larynx: 7%
  - Trachea: 14%
  - can be immediately life threatening

TABLE 3-1 Comparison of Infant and Adult Airways[1–3]

	Infant	Adult
Head	Large prominent occiput resulting in sniffing position	Flat occiput
Tongue	Relatively larger	Relatively smaller
Larynx	Cephalad position, opposite C2 and C3 vertebrae	Opposite C4 to C6
Epiglottis	Ω shaped, soft	Flat, flexible
Vocal cords	Short, concave	Horizontal
Smallest diameter	Cricoid ring, below cords	Vocal cords
Cartilage	Soft, less calcified	Firm, calcified
Lower airway	Smaller, less developed	Larger, more cartilage

Radiology [FYI]

- In this chest radiograph, FB aspiration is suggested as the left side of the chest is hyperlucent from air trapping.



Management (1 of 6)

- Upper airway FB:
  - If patient is able to cough or speak:
    - Leave in a position of comfort.
    - Provide supplemental oxygen.
    - Consider heliox.
    - Priority to get patient to operating room for removal

Management (2 of 6)

- Upper airway:
  - With severe partial or complete airway obstruction, management depends on age.
  - Management options can be divided into basic life support (BLS) and advanced life support (ALS).

Management (3 of 6)

- BLS:
  - Infant: 5 back blows/5 chest thrusts

Management (4 of 6)

- BLS:
  - Child: 5 abdominal thrusts

Management (5 of 6)

- ALS:
  - Laryngoscopy and removal with pediatric Magill forceps

Management (6 of 6)

- Lower airway FB:
  - Heliox may be tried as a temporizing measure prior to removal for patients in severe respiratory distress.
  - Bronchoscopy and removal of FB in operating room
    - FB retrieval rate approaches 100%.

Case Study 2: "Barking Cough"

- 15-month-old boy with a history of cold for 2 days develops a barking cough.
- He tracks you with his gaze as you approach.
- He has stridor at rest, retractions, and has cyanosis around his lips.

Initial Assessment (1 of 2)

PAT:

- Normal appearance, abnormal breathing, normal circulation

Vital signs:

- HR 180, RR 60, T 38.4°C [101.1 F], O_2 sat 91% on blow-by oxygen, Wt 10 kg

Initial Assessment (2 of 2)

A: Stridor at rest

B: Tachypnea, retractions

C: Slight cyanosis around the lips, otherwise color is normal, capillary refill <2 seconds, skin warm and dry, pulse strong and rapid

D: Alert

E: No signs of injury, no rash

Question

What is your general impression of this patient?

General Impression

- Respiratory distress:
  - Upper airway obstruction
  - Croup

What are your initial management priorities?

Management Priorities

- Leave patient in a position of comfort.
- Place patient on cardiorespiratory monitor.
- Administer nebulized epinephrine
  (Either : L-epi or racemic epi may be used)
- Administer corticosteroids IM.

Your First Clue: Croup

- Prodromal symptoms mimic upper respiratory infection.
- Fever is usually low grade (50%).
- Barky cough and stridor (90%) are common.
- Hoarseness and retractions may also occur.

Background: Croup

- Croup, or laryngotracheobronchitis, is common in infants and children.
  - Affects children 6 months to 6 years
  - Incidence 3-5/100 children
  - Peak in second year of life
  - Seasonal: Occurs in fall and early winter
  - Viral etiology most common: Parainfluenza virus

TABLE 3-5 Clinical Croup Score*

	0	1	2
Cyanosis	None	In room air	In 40% O_2
Inspiratory breath sounds	Normal	Harsh with rhonchi	Delayed
Stridor	None	Inspiratory	Inspiratory and expiratory or stridor at rest
Cough	None	Hoarse cry	Bark
Retractions and flaring	None	Flaring and suprasternal retractions	Flaring and suprasternal retractions plus subcostal and intercostal retractions

*A score of ≥4 indicates moderately severe airway obstruction. A score of ≥7, particularly when associated with $PaCO_2$ of >45 and PaO_2 of <70 (in room air), indicates impending respiratory failure.

Steeple Sign [FYI]

Differential Diagnosis: What Else?

- Epiglottitis (rare)
- Bacterial tracheitis
- Peritonsillar abscess
- Uvulitis
- Allergic reaction
- Foreign body aspiration
- Neoplasm

Management Options: Croup
(1 of 3)

- Humidified oxygen
  - Theoretical benefit – literature suggests NO significant benefit
- Steroids
  - Faster improvement with croup score, decrease in endotracheal intubation, and shorter hospital stays

Management Options: Croup
(2 of 3)

- Steroids
  - No significant difference in outcome between dexamethasone and budesonide
  - Dexamethasone *(Decadron)*
    - Doses 0.15-0.6 mg/kg PO or IM are effective.
  - Budesonide *(Pulmicort)*
    - Dose 2mg/2mL nebulized

Management Options: Croup
(3 of 3)

- Epinephrine
  - Begin epinephrine for signs of moderate to severe respiratory distress.
    - Racemic 0.05 mL/kg (max 0.5 mL)
    - L-***epinephrine*** (**1:1,000 sol**) 0.5 mL/kg (max 5 mL)
  - Observe patients receiving epinephrine for a minimum of 3 hours before discharge.

Case Study 3: “Wheezing”

- 5-year-old boy is sent home from school after an acute asthma episode during show-and-tell after a classmate brought in a new kitten.
- He was given albuterol by the school nurse because of diffuse wheezing.

Case Progression

- He is brought to pediatrician's office by his mother where he is found to be alert, shows increased work of breathing with nasal flaring and retractions, and has normal skin color.

Initial Assessment (1 of 2)

PAT:

– Normal appearance, abnormal breathing, normal circulation

Vital signs:

– HR 130, RR 50, BP 120/80, axillary temp 36.6ºC, O_2 sat 89% on room air

Initial Assessment (2 of 2)

A: No audible wheezing or stridor

B: Tachypnea, poor air entry, and decreased breath sounds throughout

C: Color normal, tachycardia, pulse strong and regular, no diaphoresis

D: Alert but anxious, GCS 15

E: No signs of injury, no rash

Focused History

S: Shortness of breath

A: Allergy to cats, otherwise none

M: Medications – albuterol and Singulair®

P: History of asthma

L: Last meal was 3 hours ago

E: Exposure to cats

Question

What is your general impression of this patient?

General Impression

- Respiratory distress
  - Lower airway obstruction
  - Asthma exacerbation

What are your initial management priorities in the office and how should this patient be transported to the ED?

Office Management

- Monitor pulse oximetry.
- Provide oxygen by mask.
- Begin albuterol 5 mg by HHN or MDI.
- Contact EMS for ALS transport to the ED.

Prehospital Management

- Administer albuterol nebulized or by MDI.
- Provide oxygen.
- Administer epinephrine SQ for patients with poor inspiratory effort.
- Support ventilation if in respiratory failure.

Initial Management

- Place on cardiorespiratory monitor.
- Begin albuterol 5 mg and ipratropium bromide 250 mcg nebulized.
- Place an IV and give 2 mg/kg methyl prednisolone.
- Consider administration of magnesium IV Mg (25-50 mg/kg) [40 mg / kg in 100 mL of NS ; over 20 min - Ciarallo, et al. … children with moderate to severe acute asthma. Arch Pediatr Adolesc Med Oct. 2000;154:979-83]

Modified from APLS

Case Discussion: Asthma

- Background:
  - Characterized by inflammation, airway obstruction, increased mucous production, and airway edema.
  - Common: 7% of American children
    - Greater than 867,000 ED visits per year
    - Children <4 years are at highest risk.

Background: Asthma

- Genetics and environment play important role in development of disease.
- Factors associated with increased rate of asthma:
  - Exposure to cigarette smoke
  - Urban and low income environment
  - Preteen obesity in girls
- Risk factors for severe disease [notes: "ASAP 1,2,3"] :
  - Rapid onset of symptoms (<3 hours)
  - Previous need for mechanical ventilation

Your First Clue: Asthma

- Cough
- Wheeze
- Chest congestion
- Difficulty breathing

Documentation of Signs

- Position
- Respiratory rate
- Quality of air exchange
- Presence of:
  - Grunting
  - Nasal flaring
  - Retractions
  - Wheezing
  - Rhonchi
  - Rales

Diagnostic Studies

- Pulmonary function studies are a mainstay of asthma management.
  - Peak expiratory flow meters are difficult to use in children <5 years of age.
- Pulse oximetry
- Arterial blood gas (rare)
- Chest radiographs not routinely recommended

Differential Diagnosis: What Else?

- URI
- Bronchiolitis
- Pneumonia
- FB aspiration
- Congestive heart failure
- Anaphylaxis

Management: Asthma (1 of 2)

- Management pathways are available from the National Institutes of Health.
- Every patient should receive:
  - Supplemental oxygen
  - Cardiorespiratory monitoring
  - Short-acting bronchodilators
- Management strategies divided into mild, moderate, and severe exacerbation

Management: Asthma (2 of 2)

- Mild:
  - Short-acting β-2 agonist given up to 3 times the first hour; corticosteroids begun if >1 treatment necessary
- Moderate:
  - Short-acting β-2 agonist, systemic corticosteroids, oxygen
- Severe:
  - As above, add anticholinergic and consider magnesium, or systemic β-2 agonist

Summary

- Respiratory emergencies are common.
- Respiratory assessment begins with the PAT and ABCDEs.
- Management priorities include oxygen and specific therapy geared to optimize oxygenation and ventilation.