# Pediatric Respiratory Problems

EMC 360
Lecture 35
Cline - chap. 72; 81



## Objectives

Upon completing this lecture you should be able to discuss :

- Common and uncommon pediatric respiratory disorders.
- Frequency and mortality of certain pediatric respiratory emergencies.
- Pathophysiology and clinical presentation of pediatric respiratory disorders.
- Which intervention is contraindicated in a patient with epiglottitis.
- And you should be able to compare and contrast asthma, FB, croup, bronchiolitis, and epiglottitis



## Epidemiology

- Respiratory presentations are common
  - 17% of all pediatric ED visits
    - Difficulty breathing
    - Minor respiratory infections
  - Leading cause of pediatric EMS activations
- Respiratory failure
  - Common cause of cardiopulmonary arrest in children



## Pathophysiology

- Common pathway of respiratory distress
  - Obstruction
    - Upper or lower airway
  - Inflammation
    - Upper or lower airway
  - Respiratory mechanical derangement
- Fear of emergency clinicians
  - Well child who quickly progresses to respiratory failure



## Anatomic Differences in Children

- Differences in children (compared to adults)
  - More susceptible to respiratory difficulty
  - Size of the airway
  - Tongue is relatively large
  - Soft, pliable epiglottis
  - Narrow upper airway more susceptible to adverse effects of edema and turbulence
  - Chest wall is more pliable
    - Negative inspiratory pressure making inspiration more difficult



## Compensatory Physiology

- Rate
- Grunting
  - An upper airway sign of lower airway disease
  - Grunting: Uniquely seen in small children
  - Thought to represent a form of self-induced, instinctive, auto-PEEP
  - Allows infants to keep their smaller airways and alveoli open
- Accessory muscle use : chest and diaphragm

## Differential Diagnosis of Difficulty Breathing

- Upper Airway
  - Tonsillitis
- Laryngeal
  - Croup
- Lower
  - FB



## Upper Airway Difficulty

- Nose
  - Congestion
  - Foreign Body
  - Adenoid hypertrophy
- Mouth / posterior pharynx
  - Peritonsillar abscess
  - Retropharyngeal abscess



## Difficulty Breathing - Tracheolaryngeal

- Upper Airway
  - Larynx
    - Croup
    - Epiglottis
    - Trauma
  - Trachea
    - Foreign body



## Upper Airway Airflow Resistance

- Upper Airway
  - Resistance to airflow is inversely related to the radius of the airway.
  - Upper airway obstructions :
    - produce ***stridor*** [turbulence]
      ( in contrast to lower airway disorders :
      wheezing, rales, or rhonchi)
  - Nasal congestion ***alone*** in a small infant can result in significant symptoms of distress



## Differential of Difficulty Breathing due to Lower Airway

- Lower Airway
  - Mainstem bronchi
    - Foreign body
  - Bronchiolos
    - Asthma
    - Bronchiolitis
  - Aleveoli / interstitial
    - Pneumonia Pulmonary edema



## Lower Airway Pathology

- Lower airway inflammation, bronchoconstriction, and mucous plugging
  - Asthma
  - Bronchiolitis
- Chest Wall / Pleural Cavity
  - Pneumothorax
  - Diaphragmatic hernia

## Dyspnea and Work of Breathing

- Cardiac
  - Wheezing and tachypnea
  - Acquired myocarditis and heart failure
- Other
  - Metabolic
    - Acidosis
    - Sepsis
    - Dehydration
    - Toxicologic syndrome



## Review of Unusual Causes of Difficulty Breathing

- Neurologic
  - Brain and brainstem
    - Infection
  - Spinal cord
    - Guillain-Barre syndrome
  - Neuromuscular
    - Botulism
    - Muscular dystrophy
- GI
  - Gastroesophageal reflux
    - can cause a reflex bronchoconstriction : can be mistaken for asthma



## Initial Evaluation of Children with Difficulty Breathing

- Prehospital Assessment
  - Accuracy rate of 81.5% for EMS field diagnosis
- History
  - Timing / Clues to the diagnosis
    - Abrupt onset : FB, anaphylaxis.
    - Mild symptoms, then fever and acute decompensating suggest: epiglottitis , bacterial tracheitis, or myocarditis
    - Getting worse over course of several days: asthma and bronchiolitis



## Assessment

- Past Medical History
  - Premature infants
  - Having subglottic stenosis
- Physical Examination
  - Work of breathing
    - How fast?
      - Fever is associated with increase in RR of about 4 breaths per minute
        - » for each1 degree rise in degree Celsius ( or for each 1.8° F rise ) [T ° : 104 °, or 40 ° C : RR incr or 12]
    - Laboring ?
      - Poor respiratory effort may be a sign of impending respiratory failure.



## Physical Examination

Work of breathing

- How loud?
  - Muffled or "hot potato"
    - peritonsillar abscess
  - Wheezing
    - worsening status
      - first loud
      - then soft wheezes
      - then *NO* wheezes - - Beware !!!



## Assessment Adjuncts

Capnometry

- End tidal $CO_2$ (Oral or nasal ) correlates well with capillary specimen $pCO_2$.
- Can be used to identify patients with obstructive disease

Pulse Oximetry

- Pulse oximetry : an isolated O2 sat is a ***poor*** predictor of clinical outcome.

## Bag-Valve-Mask / Assisted Ventilation

- Mask should make an airtight seal
- Mandible is pulled to mask by the "E-C-1,2,3 method"
- BVM technique and capability with the BVM procedure is much more important than the ability to intubate
  - Even in epiglottitis, 80% of children can be BVM ventilated [ a two-person-procedure]
- Common problems with the newborn BVM ventilation
  - pop-off valve
  - poor seal around nose and mouth ( just as with adults)



## Surgical Airways

Needle cricothyrotomy (rather than surgical) :

- Recommended for patients younger than 7 YO
- With a 14 gauge angiocath
  - attached to a syringe
  - at a 45 degree angle caudally
  - O2 tubing with a thumb-hole
  - connected to 100% oxygen , high pressure (50 psi)



## Croup

- Abrupt onset, at night
- Barking cough
- Inspiratory stridor, hoarseness
- Respiratory distress due to upper airway obstruction.
- Often preceded by symptoms of upper respiratory tract infection-like symptoms

- Spasmodic croup
  - No prior upper respiratory tract infection, are afebrile, have recurrent croup, and are thought to have more transient symptoms.



## Croup Etiology

- Viral invasion
  - Inflammation
  - Hyperemia
  - Edema
  - Narrowing of the subglottic region



## Incidence and Severity of Croup

- Incidence
  - 5% of emergent admissions in children under 6 YO
  - 5% experience recurrent croup (3 or more episodes)
- Prognosis
  - Only 1-3% intubated
  - Mortality is "relatively low; "
    - less than 0.5% of intubated children die
- Aims of Intervention
  - To minimize duration and severity
  - To prevent complications



## Croup DDx

Differential Diagnosis

- Most important diagnoses to differentiate from croup:
  - Bacterial tracheitis
  - Epiglottitis
  - FBAO / inhalation of a foreign body

## Grades of Croup

- Mild
- Moderate
- Severe
- Respiratory failure



## Mild and Moderate Croup

– Mild
  - Occasional barking cough
  - Stridor : minimal at rest
  - Indrawing retractions: none to mild

– Moderate
  - Frequent barking cough
  - Stridor : easily audible at rest
  - Retractions : suprasternal and sternal wall retraction at rest
  - LOC : still little distress or agitation



## Severe Croup

- Frequent barking cough
- Stridor : prominent inspiratory and occasionally expiratory
- Retractions : marked sternal wall retractions
- LOC : significant distress and agitation
- Auscultation : decreased air entry / B Sounds

Less than 1% have severe croup.



## Croup With Impending Respiratory Failure

- Barking cough : *less* prominent
- Stridor : occasionally can be hard to hear
- Retractions : retractions no longer marked
- LOC : usually lethargic or decreased level of consciousness
- Auscultation : markedly decreased B Sounds
- Skin : dusky complexion



## Croup Treatment

- Mild Croup
  – Dexamethasone (oral single dose
    - Oral dose of dexamethasone (0.15 mg/kg)
- Moderate to Severe Croup
  – Beneficial
    - Adrenaline (epinephrine) (nebulized)
    - Budesonide (Pulmicort), nebulized , 2 mg
    - Dexamethasone
      – A single oral or IM dose of dexamethasone 0.6 mg/kg
    - 15 minutes to deliver nebulized budesonide compared with 1-2 minutes with oral dexamethasone.



## $B_2$ Agonists in Severe Croup

- Severe Croup
  – Unknown effectiveness
    - Beta agonist Albuterol
- Impending Respiratory Failure due to Severe Croup
  – Beneficial
    - Epinephrine (nebulized)
    - Corticosteroids

## Impending Respiratory Failure Due to Severe Croup

- Epinephrine (nebulized)
  - Reduces pCO2 levels
  - Reduces both stridor and retractions
  - No significant difference in improvement between L-epi. (1:1000, 5ml) and racemic epinephrine (5 mL)
- Corticosteroids
  - Reduces the likelihood of endotracheal intubation
  - No significant difference between single oral doses of 0.6 mg/kg or 0.15 mg/kg
  - No significant difference between IM and oral dexamethasone(0.6 mg/kg)



## Problems with Older Children

- Unilateral wheezing
  - FB
    - Commonly found in ages 1 - 4 YO
    - ***Most common cause*** of at-home death in children aged 1 - 6 YO



## Older Children with Asthma-Like Presentation

- Bronchiolitis
  - Wheezing
    - Bilateral
  - Seasonal
  - Highly contagious



## Older Child with Acutely Ill Presentation

- Epiglottitis
  - Acutely ill older child
  - Drooling
  - Motionless
  - High fever
  - Immigrant children
    - Preventable by a vaccine (Caused by bacterium haemophilus)



## Epiglottitis

- When should a paramedic do direct laryngoscope in suspected epiglottitis
  - ***NEVER !***



## Acutely Ill Child with Sickle Cell Anemia

- Acute chest syndrome
  - Leading cause of sickle cell deaths
  - 1st or 2nd most common cause of HbSS hospitalization
  - Pneumonia / infection
  - Pulmonary infarction

## Controversies/ What's Changing

- Ketamine may become the recommended agent for procedural sedation in children
  - Protects airway reflexes
  - Has a bronchodilatory effect
- LMA , laryngeal mask airway : effective for pediatric airways in elective surgery.



## Bronchodilator Controversies

- Nebulized epinephrine in bronchiolitis
  - alpha and beta adrenergic properties
  - may be more efficacious than albuterol
    - Albuterol is still used as a first line agent for bronchiolitis.
- In the past, the disposition of croup or bronchiolitis treated with the nebulized epinephrine were thought to be at risk for "rebound" bronchospasm
  - recent studies have discounted this as a contraindication to prehospital epi.



## Children with Acute Respiratory Distress

| | Croup | Epiglottitis | Bronchiolitis | Asthma | FB |
|---|---|---|---|---|---|
| Etiology | Viral *Parainflu* | Bacterial *Haemophilus [vaccine avail.]* | Viral *RSV; Adeno.* | Allergic ,… | Food ( hot dog) |
| Age | 6 mo. - 2 yr | ? yr (median) | 0 - 24 mo (same as croup) | any | 1-4 yr |
| Season | Late fall - early winter | any | Winter - early spring | any | any |
| Onset | 3 days | 1-2 hr. | 2-7 days | hr.s to days | sudden |
| Clinical Features | I -stridor E - "seal-bark" | High fever Anxious Drooling | Mucus, fever, cough, WOB, wheezing | WOB, wheezing | Partial or total FBAO signs |



## Summary

We have discussed :

- A few common and uncommon pediatric respiratory disorders
- The frequency and mortality of upper respiratory infections
- That epiglottitis has a vaccine and may become an historical disease
- Discuss which intervention is contraindicated in a patient with epiglottitis.
- Discuss briefly the clinical presentation of several pediatric respiratory disorders - comparing and contrasting asthma, FB, croup, bronchiolitis, and epiglottitis