Medical Emergencies in the Pediatric Population A

Cathleen M. Tichy-Dreher, RN CNNP CPNP
Pediatric Critical Care Medicine
The Children’s Hospital
Cleveland Clinic Foundation

© Cleveland Clinic 2012

Upper Respiratory Emergencies
Objectives

• Recognize the differences in adult vs. children airway anatomy

• Recognition and management of upper airway respiratory distress

Anatomy and Physiology

• During the first year of life, compliance of the respiratory system increases by as much as 150%

• An infant’s tongue is proportionately larger than the adult’s

• The infant is an obligate nose breather until the age of 6 months

• The narrowest part of the infant’s larynx is the undeveloped cricoid cartilage, whereas in the adult it is the glottis opening
Anatomy and Physiology

• The elastic recoil of an infants chest wall is close to zero and, with age, increases because of the progressive ossification of the rib cage and increased intercostal muscle tone.

• Oxygen consumption of infants (6ml/kg/min) is twice that of an adult (3ml/kg/min), greater oxygen consumption equals increased respiratory rate.

Case Presentation: Croup

• 2 y/o with 3 day h/o difficulty breathing and runny nose, now with barky cough
  – Making high-pitched sounds when he breathes in
  – Level of activity decreased
  – Appears anxious

• Exam:
  – Anxious toddler in mom’s lap
  – Working hard to breathe
  – T-37.5, HR-165, RR-55.
  – Audible, high-pitched inspiratory sounds
  – Intercostal and suprasternal retractions
  – Harsh, barky cough
What to do?

• ABC’s

• Keep the child in parent’s lap if possible

• Supplemental O₂ with pulse-oximetry

• Place on Cardiovascular/Respiratory monitor

Croup

• The para-influenza viruses are identified most frequently as the cause of this disease, with para-influenza type 1 as the major single agent.

• Occurs primarily in children between 3 months and 3 years of age and accounts for approximately 10 -15% of respiratory tract disease in children.

• Peak incidence of croup between 6 and 24 months.

• Highest incidence of hospitalization in first year of life.
Differential Diagnosis

- Viral croup needs to be differentiated from the two bacterial causes of stridor, bacterial tracheitis and epiglottitis, which may be fatal without immediate therapy.

Differential Diagnosis

- Croup
  - Viral cause
  - Fever present but low
  - Seal bark cough
  - Gradual onset of symptoms
  - Symptoms worsen at night
  - Most common in children 2-4 years of age
Differential Diagnosis

• Epiglottitis
  – Bacterial cause
  – High fever
  – Rapid onset of symptoms
  – Drooling
  – Tripod position
  – Most common in children 4-6 years of age

Differential Diagnosis

• Bacterial Tracheitis
  – Onset is acute with respiratory stridor
  – High fever
  – Copious purulent secretions
  – Often occurs after an episode of viral croup
  – Affects children of any age
Treatment

• Supportive Care
  – Mostly keeping the child comfortable
  – Avoid anxiety and fatigue

• Fluids and antipyretics may be given

• Home remedies

Treatment

• When to admit:
  – Child appears toxic, lethargic, in respiratory distress and dehydrated
  – Onset of illness was sudden with rapid progression of symptoms
  – Signs of respiratory distress are unresponsive to outpatient drug therapy
Treatment

- Heliox

- Corticosteroid therapy

- Nebulized epinephrine

- Antibiotics

Heliox

- Helium/oxygen gas mixture significantly less dense than air

- Improved air flow can decrease work of breathing and improve ventilation

- As density decreases, the turbulent flow decreases creating more laminar flow through small obstructed airway

- Can be used in pediatric patients with upper airway obstruction due to airway compression, post-extubation stridor and croup
Treatment

• Corticosteroids therapy
  – Management of both ambulatory and hospitalized children with viral croup is the use of systemic or nebulized corticosteroids
  – Dexamethasone and budesonide show clinical benefit as early as 6 hours after administration

Treatment

• Antibiotics
  – Croup is viral etiology; antibiotics not used
Lower Respiratory Emergencies

Objectives

- Discuss the management of asthma
- Discuss the management of bronchiolitis
Case Presentation: Asthma

• 5 y/o male brought to ED by mom with 1-week h/o cough, denies fever but does admit to decreased oral intake

• Exam
  – T-37, HR-130s, RR-40, sats on RA 89%
  – Child is awake, showing significant WOB
  – Auscultation of lungs
    – Expiratory wheeze in upper lobes
    – Poor air entry in lower lobes
  – Speaks in 1 to 2 word sentences

• No h/o previous hospitalizations

• Family h/o asthma

• Patient treated for eczema by PCP

What do you do?

• Leave patient in most comfortable position, may be left in mom arms if younger

• ABC’s!

• Start O₂, usually with NRB along with inhaled steroids. Atrovent, anticholinergics may be added.

• Start IV access for fluids with the insensible losses and administering IV steroids if severe enough
  – Methylprednisolone 1-2mg/kg IV or prednisolone 2mg/kg PO
Asthma

• Most common chronic illness in childhood, represents 3-7% of children in the USA

• 3rd leading cause of hospitalization among children < 15 y/o

Asthma

• Causes vary, often associated with allergy, stress, and strenuous activity

• Airways become inflamed and edematous

• Mucous in airways becomes thickened and cause obstruction of lower airways

• Bronchospasms of the airway

• Develop air trapping and lung hyperinflation
**Risk Factors for ICU Admission**

- Previous ICU admission
- Rapidly progressive and sudden respiratory deterioration
- Seizure or syncope during exacerbation
- Exacerbation precipitated by food allergens
- Use of > 2 β-agonists/month
- Poor perception of severity of illness

**Risk Factors for Death**

- History of Severe Exacerbations
  - Past history of sudden, severe exacerbations
  - Prior intubation for asthma
  - Prior admission for asthma to an ICU

- Asthma Hospitalizations and Emergency Visits
  - >2 hospitalizations in the past year
  - >3 emergency care visits in the past year
  - Hospitalization or emergency visit in past month
Risk Factors for Death

• Beta 2-Agonist and Oral Steroid Usage
  – Use of > 2 canisters per month of short-acting inhaled beta 2-agonist
  – Current use of oral steroids or withdrawal from oral steroids

• Complicating Health Problems
  – Co-morbidity cardiovascular disease or COPD
  – Psychiatric disease
  – Illicit drug use

Clinical Manifestation

• Neuro status
  – Anxious
  – Lethargic
  – Obtunded

• Respiratory
  – Tachypneic, increased WOB-grunting, flaring, retracting or paradoxical respirations

• Auscultation
  – Prolongation of expiratory phase, wheezing-duration, biphasic, or absent (ominous sign)
  – Hypoxic

• CVS
  – Tachycardia, pulsus paradoxis (difference between SBP during inspiration and exhalation)
Treatment

• ABC’s
• Supplemental O₂ with placement of pulse-oximetry
• Inhaled B-agonists and anticholinergics
• Obtain IV access
• IV corticosteroids
• IV fluids
• Magnesium Sulfate 25-50mg/kg IV
• Obtain CXR, no labs needed initially
• Consider the use of heliox

Treatment

• Non Invasive Ventilation

• Mechanical Ventilation
  – Respiratory or cardiac arrest
  – Altered mental status
  – Unresponsive hypoxia
  – Progressive hypercarbia
  – Significant metabolic acidosis
  – Exhaustion
  – Hemodynamic instability
Summary

• Prevention of exacerbations
• Patient Education
• Environmental control of allergies and irritants
• Aggressive pharmacological therapy
• Maintain normal, or near-normal, pulmonary functions

Case Presentation: Bronchiolitis

• 2 month-old (former 36-wk premie)
  – 3-day h/o fussiness
  – Decreased oral intake
  – Mom is an 18 y/o, poor historian, felt baby may have been warm to touch
  – States the baby has had difficulty breathing
• Exam
  – Baby sleeping in mom arms
  – T-38, HR-160s, RR-60-70
  – Baby lethargic with stimulation, noted increased WOB with tachypnea, grunting, flaring and retracting ++

“Saving the Tiniest Babies in Kosovo”
Member // AmeriCares , December 12, 2011
What to do?

• ABC’s!
• Place O by NC
• Place on Cardiovascular/Respiratory monitor (if available)
• Place pulse-oximeter (if available)
• Continue assessment of circulation
  – Determine when last fed, last wet diaper for assessing hydration status and the need for IV access
• Obtain CXR

Bronchiolitis

• Acute viral lower-respiratory tract infections of infants and children occurring during the first 2 years of life were initially thought to be bacterial cause; viruses are now the major agent of bronchiolitis

• RSV most frequent cause (50-80%); paraflu 3 next most common

• Affects children between the ages of birth to 24 months
Bronchiolitis

• Epidemic peaks: January thru March
  – Peak rate of attacks occur between 1 and 10 months of age and in hospitalized children between 2 and 6 months of age

• Increased risk of developing bronchiolitis
  – Predisposing factors
    – Prematurity
    – LBW
    – Cardiovascular disease
    – Immunodeficiency
  – Typically severe and require hospitalization

Bronchiolitis

• Viral infection
  – Causes increased mucous production, edema and necrosis of bronchiolar epithelium, with the small diameter of the airway leading to obstruction

• Develop increased resistance to airflow during both inspiration and expiration

• Causes air trapping with hyperinflation, interstitial and alveolar infiltration and atelectasis
Clinical Manifestations

• Bronchiolitis occurs in 30-70% of infants on their first exposure

• Symptoms:
  – Begin with nasal discharge
  – Fever for the first 2-4 days (38-40°C)
  – Cough
  – Tachypnea
  – Can appear irritable, lethargic or anxious
  – Can develop increased WOB-grunting, flaring and retractions

Clinical Manifestations

• Exam reveals prolonged expiratory phase, wheezing and rales

• Pulse-oximeter show saturations <90%

• In 10-20% of infants, apnea may be the first clinical manifestation of respiratory illness
**Treatment**

• Management of most infants consist of:
  – Supportive therapy: including O, nasal suctioning, hydration
  – May need to be NPO depending on WOB or NG feeds with a PIV in place

• Severely affected infants need to be admitted to a hospital for supplemental O
  – AAP recommend initiating O if saturations consistently <90%

• Admit to hospital when
  – Poor oral intake
  – Toxic appearing
  – Respiratory distress rapidly progressing
  – h/o apneic episodes

**Treatment**

• Controversy with use of corticosteroids, bronchodilators and anti-virals

• AAP recommends bronchodilators not routinely used, corticosteroids not be used with the first episode of bronchiolitis
Predictors of Severe Disease

• Toxic appearance

• Saturations < 95%

• Gestation age < 34 weeks

• RR > 70

• Atelectasis on x-ray

• < 3 months of age and frequent apneic episodes

Risk for Severe Disease

• Congenital heart disease, particularly cyanotic heart disease

• Chronic lung disease

• Cystic fibrosis

• Immunodeficiency

• < 6 weeks of age and neurological pathologies
Prognosis

• Most frequent sequelae of bronchiolitis, especially RSV, is recurrent wheezing (30-50%)

• Episodes of recurrent wheezing tend to occur most frequently during first 2 years of life after initial episode

• Lung function abnormalities may persist beyond 10 years, however most at school age have no greater risk of RAD

Summary

• Recognition of a sick child with impending respiratory failure

• Aggressive medical management – ABCs!

• Intensive monitoring

• Counseling parents
**Conclusion**

- Prevention and education
- Recognition of severity of illness
- Aggressive supportive/pharmacological therapy
- Avoidance of harmful therapy

**Shock States**
Objectives

• Identify the classes of shock

• Discuss the identification, definition and management of septic shock

Shock - Definition

• “A clinical syndrome of general insufficiency of tissue perfusion that results in deranged homeostasis and irreversible cell damage”

• Circulatory function depends on blood volume, vascular tone and cardiac function. At some level, all shock states derive from abnormalities in one of these factors.
Shock

- Hypotension is not an absolute indicator of shock, nor does a normal blood pressure preclude the diagnosis of shock.

- Most patients (particularly children and adolescents) in shock have normal blood pressure.

- Blood pressure typically does not fall until half the circulatory volume has been lost.

Shock - Types of Shock

- Hypovolemic shock
- Distributive shock
- Cardiogenic shock
- Septic shock
Shock - Hypovolemic Shock

- Most common cause of shock in children

- Results from decreased intravascular volume which leads to decreased venous return and decreased cardiac output.

- May be due to fluid and electrolyte losses, hemorrhage, plasma losses

Shock - Distributive Shock

- Abnormalities in vascular tone can cause maldistribution of circulatory volume

- Classic causes
  - Anaphylaxis
  - Drug toxicity
  - Neurologic injury or hemorrhage
    - Spinal shock or subarachnoid bleed
**Shock - Distributive Shock**

- Anaphylaxis causes shock by the release of histamine and other mediators which lead to profound vasodilation, vascular pooling and decreased venous return.

- Spinal shock occurs with cord injuries above T1 causing loss of sympathetic vascular tone.

**Shock - Cardiogenic Shock**

- Actually occurs very rarely in children.

- Obstructive congenital heart lesions
  - HLHS, Critical Aortic Stenosis, Coarctation

- Chronic congestive failure

- Myocarditis

- Cardiomyopathies
Sepsis and Septic Shock

• Sepsis is the syndrome of a systemic response to infection expressed as tachycardia, tachypnea, hyperthermia or hypothermia, and evidence of inadequate perfusion. This is seen with altered mental status, acidosis and oliguria.

• Septic shock is present when sepsis is accompanied by hypotension unresponsive to fluid therapy.

Shock - Septic Shock

• A clinical syndrome characterized by acute disruption of circulatory function and tissue perfusion resulting in inadequate provision of oxygen and other nutrients to meet the metabolic demands of the tissue.
Shock – Septic Shock

• Warm shock
  – Decreased perfusion manifested by altered/decreased mental status, flash capillary refill and bounding pulses

• Cold shock
  – Decreased perfusion manifested by altered/decreased mental status, capillary refill > 2 sec and mottled, cool extremities

• Fluid refractory shock
  – Shock persists despite > 60 mL/kg fluid resuscitation (when appropriate)

Shock – Septic Shock

• Dopamine resistant shock
  – Shock persists appropriate fluid resuscitation and dopamine at 10 mcg/kg/min

• Catecholamine resistant shock
  – Shock persists despite appropriate fluid resuscitation and use of direct acting catecholamines (epinephrine and norepinephrine)

• Refractory shock
  – Shock persists despite goal-directed use of inotropic agents, vasopressors, vasodilators and maintenance of metabolic (glucose and calcium)
Case Presentation: Septic Shock

• 14 y/o female present with h/o peritonsillar abscess drained by ENT and sent home on antibiotics.
  – Return the following day with inability to swallow and upper airway stridor.
  – ENT performs T and A, sent patient home with continued antibiotics.
  – Brought into OSH-ED by parents with worsening upper airway obstruction and fever.
  – Given 4 liters of fluid and transferred to CCF

Case Presentation: Septic Shock

• Patient arrives to your ED
• Vital signs
  – T-39, HR-130, RR-30-40, B/P-80/40
• Patient lethargic but responding to questions appropriately
• Breathing labored with nasal flaring, suprasternal retractions
• On auscultation stridor present in neck area, moving air to upper lobes, but diminished in lowers
• Palpation – cool extremities with line of demarcation below elbows and knees
Case Presentation: Septic Shock

• Auscultation of heart reveals tachycardia with a gallop over apex.

• Pulses peripherally weak, +1/= 

• Capillary refill 3-5 seconds

Management of Septic Shock

• ABCs!!!

• Airway and Breathing
  – Make certain airway is clear. Mental status may impair airway protective reflexes
  
  – Start O₂ in this patient beginning with NRB, connect to pulse-oximetry
  
  – If not ventilating well, consider non-invasive ventilation or intubation
Management of Septic Shock

- Circulation: Fluid Resuscitation
  - Rapid fluid boluses (<15 minutes) of 20ml/kg normal saline or lactated ringers solution should be given while observing for development of rales, gallop rhythm, hepatomegley and increased work of breathing.
  - If these signs do not develop, fluid should be given until normal perfusion is obtained or a max of 60ml/kg

Management of Septic Shock

- If normal perfusion is not rapidly established by fluid infusion alone, and central access or IO is available, Dopamine gtt is started at 5-10mcg/kg/min
- If hemodynamics are resistant to effects of Dopamine, consider Epinephrine 0.1-0.5mcg/kg/min for cold shock and Norepinephrine 0.1-0.5mcg/kg/min for warm shock
Management of Septic Shock

• Consider possibility of steroid deficiency in catecholamine resistant shock

• Administer hydrocortisone 1-2mg/kg as a bolus for stress coverage.
  – May give as much as 50 mg/m2/d for refractory shock

Management of Septic Shock

• Lab studies
  – Cultures (blood, urine and CSF when stable)
  – CBC
  – ABG
  – CMP
  – Coags

• CXR

• ECG / ECHO
Management of Septic Shock

- Broad-spectrum empiric antibiotics within the first hour of recognition of shock
- In the neonate start the Acyclovir for suspected HSV infection
- Identifying site of infection, abscess drainage if necessary

ACCM-PALS Guidelines For Children In Septic Shock

0 min
- Recognise decreased mental status and perfusion
- Maintain airway and establish access according to PALS guidelines
- Push 20 ml/kg isotonic saline or colloid boluses up to and over 60 ml/kg
- Correct hypoglycaemia and hypocalcaemia

5 min
- Fluid refractory shock
  - Establish central venous access, begin dopamine therapy and establish arterial monitoring

15 min
- Fluid refractory-dopamine resistant shock
  - Titrate epinephrine for cold shock, norepinephrine for warm shock

Observe in PICU
- Catecholamine-resistant shock
  - At risk of adrenal insufficiency?
    - Not at risk?
      - 60 min
        - Give hydrocortisone
        - Do not give hydrocortisone
      - PICU management - not audited
  - Titrated volume and noradrenaline
    - Low dose vasopressin or angiotensin?
Supportive Therapy

- Glycemic control
  - Hyperglycemia > 178mg/dL is associated with increased mortality

- Renal replacement therapy

- Correction of metabolic acidosis

- DVT prophylaxis

- Stress ulcer prophylaxis

Summary

- Early recognition is essential

- Caregivers can make a significant difference in the outcomes of children in shock

- The diagnosis of shock is clinical, based on mental status, tachycardia and peripheral perfusion
Cleveland Clinic

Every life deserves world class care.