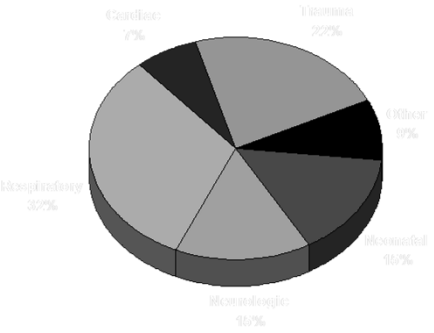
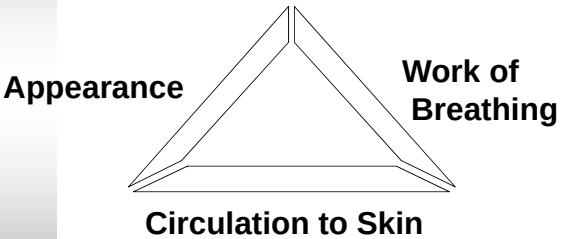
Pediatric Emergencies:
Assessment and Transport

Carroll King JD, MD
St Vincent Healthcare
Medical Director/PICU

Diagnostic Categories Of Children Transported



Pediatric Assessment Triangle

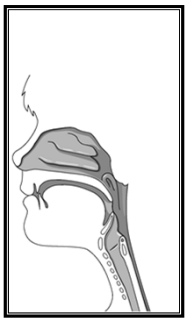


Pediatric Assessment Triangle

- Appearance
  - Alertness
  - Distractibility
  - Consolability
  - Eye contact
  - Speech/cry
  - Spontaneous motor activity
  - Color

Pediatric Respiratory System

- Large head, small mandible, small neck
- Large, posteriorly-placed tongue
- High glottic opening
- Small airways
- Presence of tonsils, adenoids



Pediatric Assessment Triangle

- Appearance
- Work of breathing

- Abnormal position
- Abnormal breath sounds
- Retractions
- Nasal flaring

Pediatric Respiratory System

- Poor accessory muscle development
- Mobile thoracic cage
- Horizontal ribs, primarily diaphragm breathers
- Increased metabolic rate, increased O_2 consumption

Pediatric Assessment Triangle

- Appearance
- Work of breathing
- Circulation

- Color
- Temperature
- Capillary refill time
- Pulse quality

Anatomical Differences

A child's anatomy differs in four significant ways from an adult's.

- Smaller airway
- Less blood
- Bigger head
- Vulnerable internal organs

Anatomical Differences

- smaller airway

- Large tongue in relation to a small oropharynx
- Distal airways are markedly smaller.
- Trachea is not rigid and will collapse easily
- Back of the head is rounder and requires careful positioning to keep airway open

Anatomical Differences,

- smaller airway
- less blood

- Relatively smaller blood volume
- Approximately 70 cc of blood for every 1kg (2 lbs) of body weight
- A 20 lb child has about 700cc of blood—about the volume of a medium sized soda cup

Anatomical Differences

- smaller airway
- less blood
- bigger head

- Head size is proportionally larger
- Prominent occiput and a relatively straight cervical spine
- Neck and associated support structures aren't well developed
- Infants and small children are prone to falling because they are top heavy

Anatomical Differences

- smaller airway
- less blood
- bigger head
- internal organs

- Internal organs are not well protected
- Soft bones and cartilage and lack of fat in the rib cage make internal organs susceptible to significant internal injuries
- Injury can occur with very little mechanism or obvious signs

Kids Don't Tolerate

- Hypoxia
- Hypovolemia
- Hypoperfusion → Acidosis
- Hypotension
- Hypothermia

Respiratory Distress

- Tachycardia (May be bradycardia in neonate)
- Head bobbing, stridor, prolonged expiration
- Abdominal breathing
- Grunting—maintains end expiratory volume

Early Shock

- tachycardia
- delayed capillary refill > 3 seconds
- tachypnea
- anxiousness, combativeness, agitation
- peripheral constriction, cold clammy extremities

Late Shock

- Weak or absent pulses
- Diminished LOC
- Hypotension
  - LATE LATE LATE shock
  - VERY VERY VERY bad sign

Debunking the Myths

- Kids don't get sick
- "He's young, he will heal better"
- It's a kid, less is best
- "He fell off the couch."
- It's a kid, use D5 .2NS
- It's nap time or he has been up all night- maybe he is just tired.

Assessment

- Listen to the parents- they are trying to tell you something
- LOOK FIRST!
- Never trust a neonate!
- Zebras occur in the first year of life
- Difficult parts of the physical exam
  - Heart exam, palpation of the liver
  - Nuchal rigidity?

Evaluation

- Various conditions may lead to respiratory failure and/or shock
- Allow assessment and evaluation to quickly direct intervention
- Avoid progression to cardiopulmonary failure and arrest
- Survival markedly better with respiratory arrest vs. cardiopulmonary arrest

Cardiopulmonary assessment

- Evaluation of general appearance
  - Mental status, tone, sick or not sick
- Physical exam- ABC's
- Classification of physiologic status

  - Adapted from PALS

General Appearance

- "Looks bad"
- Mental status, responsiveness
- Tone and activity
- Age-appropriate response
- Reaction to painful procedures

Physical Exam- Airway

- Clear
- Maintainable- positioning, suctioning, nasal airway, bag mask
- Not maintainable without intubation
  - Avoid respiratory arrest

Physical exam- Breathing

- Respiratory rate- fast and slow
- Effort and mechanics- retractions and grunting
- Breath sounds- wheezing and stridor
- Skin color- red is good, blue is bad, gray is worse
- Pulse oximetry- reliable. Don't blame the probe- use with CBG

Physical Exam- Circulation

- Cardiovascular function
  - Heart rate
  - Pulses, capillary refill
  - Blood pressure
- End-organ perfusion
  - Brain
  - Skin
  - Kidneys

Cardiovascular Function

- Heart rate- tachycardia is the first and most consistent response to inadequate cardiac output.
  - Don't ignore tachycardia- fever, pain, fear
  - Shock is much more common than SVT
  - Use heart rate to gauge progress or decline
- Pulses- everyone has them
- Capillary refill- < 2 seconds is normal
- Blood pressure- A late sign of shock

End Organ Perfusion

- Brain- level of alertness
- Skin- temperature and color
- Kidneys- history of urine output

- Useful to direct and assess success of interventions

Critical Interventions

- Airway
- Volume
- Volume
- Volume
- Vasopressor/cardiac drugs
- Antibiotics
- Exceptions- cardiogenic shock

Interventions

- Volume- aggressive early resuscitation
  - Isotonic fluids only, 20 ml/kg < 20min
  - "Some and more"- 60ml/kg in first hour
- Vasopressors- seldom required in field
- Antibiotics- Vanco and Ceftriaxone
- Cardiogenic shock- special circumstance
  - Age and history
  - Murmur, Liver, Chest X-ray

Scenario-1

- A 7 month old presents to the clinic after a 3 day history of fever, vomiting, and then diarrhea. Parent relates the child is limp and sleeping all the time.
- Lethargic child, VS HR 210, BP 80/50, RR 50, Temp 39.
- What do you do?

Scenario 1 continued

- Airway- patent
- Breathing- RR 50 unlabored and rapid
- Circulation- HR 210, cool peripherally, central pulses 1 +, peripheral pulses not palpable, capillary refill > 6 seconds
- 3 stools during the exam
- What do you do? What is the likely DX?

Scenario 1 continued

- Hypovolemic shock
- Apply oxygen
- Obtain IV or IO access
- 20 ml/kg crystalloid over < 20 minutes and reassess
- Pulses diminished, slightly warmer, still lethargic
- What do you do?

Scenario 1 continued

- Repeat crystalloid boluses of 20 ml/kg
- Use pulses, extremity temp, capillary refill, level of alertness to guide therapy
- Place foley catheter
- Reassess and re-examine

Scenario 2

- 5 year old with history of frequent impetigo presents with a 1 day history of fever and lethargy and cough for 3 days. This morning had to be awakened and has remained drowsy and at times acts "goofy."
- Lethargic child, VS: HR 190, RR 70, BP 65/30, temp 38.8

Scenario 2

- Airway- patent
- Breathing- Tachypniec, grunting, retractions, poor BS on right
- Circulation- Tachycardic, no peripheral pulses, cool to elbows and knees, clammy skin, capillary refill > 5 seconds
- What do you do? What is the likely DX?

Scenario 2

- Presumed septic shock (compensated?)
- Apply oxygen, bag mask, prepare intubation
- Obtain IV access and begin aggressive fluid resuscitation with isotonic fluids
- Use physical exam to guide therapy
- Obtain labs
- Antibiotics, fever therapy, foley catheter, transport

Scenario 3

- 2 month old, former 35 week premature infant with cold symptoms now having difficulty breathing. Parents relate toddler in house with "bad cold." Infant has felt warm and not eating well. Brought to clinic because she is breathing funny.
- Anxious appearing child, VS: HR 180, Temp 38.5, BP 80/40, RR 100
- What do you do?

Scenario 3

- Airway- patent
- Breathing- moderate retractions, expiratory wheeze throughout all fields
- Circulation- warm and well perfused, capillary refill < 2 seconds, palpable pulses
- What do you do? What is the likely DX?

Scenario 3

- Clinical bronchiolitis- presumed RSV
- Apply oxygen
- What works- time, oxygen, IV fluids
- What might work- aerosolized epinephrine, albuterol
- What doesn't work- corticosteroids, ribavirin
- When do you intubate?

Scenario 3

- Intubate if:
  - Marked hypoxemia
  - Apnea
  - Excessive work of breathing
  - Impending respiratory failure
- As with asthma, no single blood gas result should determine need for intubation
- Counsel parents disease worsens on ventilator

Scenario 3

- The many faces of RSV
  - Bronchiolitis
  - Pneumonia
  - Apnea
  - Shock
- Usually preceded by URI prodrome except when presents with apnea

Scenario 4

- 8 year old presents with vomiting for 2 days, history of weight loss, fatigue and poor energy.
- Sick appearing thin child. Notable weight loss. VS; HR 150, BP 110/70, Temp 37, RR 50.
- What do you do?

Scenario 4

- Airway- patent
- Breathing- minimal retractions, deep respirations with tachypnea
- Circulation- diminished peripheral pulses, delayed capillary refill, cool
- CNS- lethargic but arousable
- Labs- Glucose 800, Na128, HCO3 5, pH 7.05 What do you do? DX?

Scenario 4

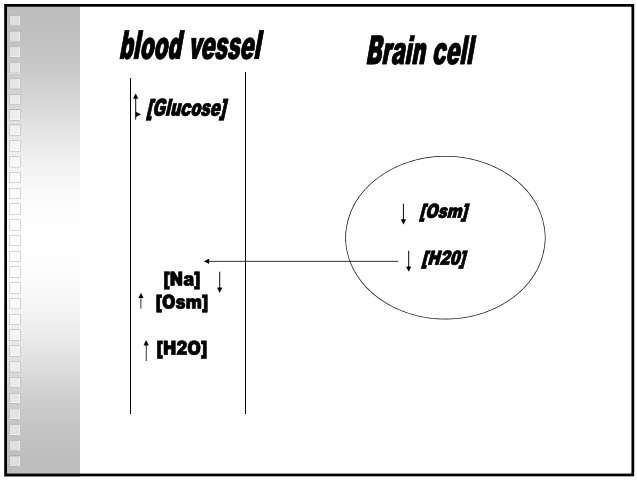
- Probable DKA
- Obtain IV access
- Bolus with isotonic fluids if in shock
- Isotonic fluids at maintenance + deficit (over 48hours)
- Add dextrose early eg D10% 0.9NS + K+ acetate
- Insulin @ 0.1 units/kg/hr

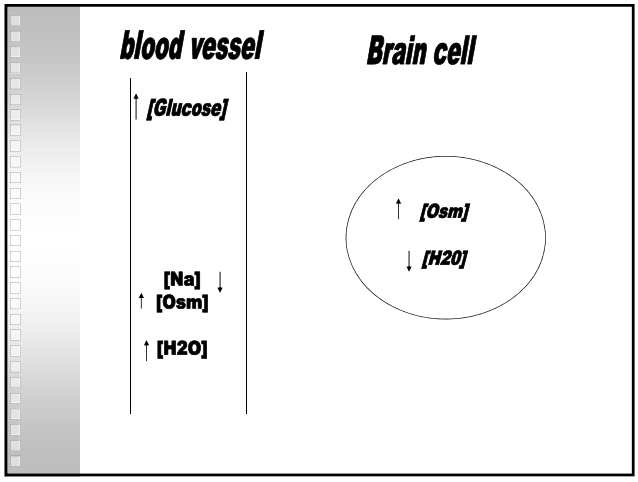
Scenario 4

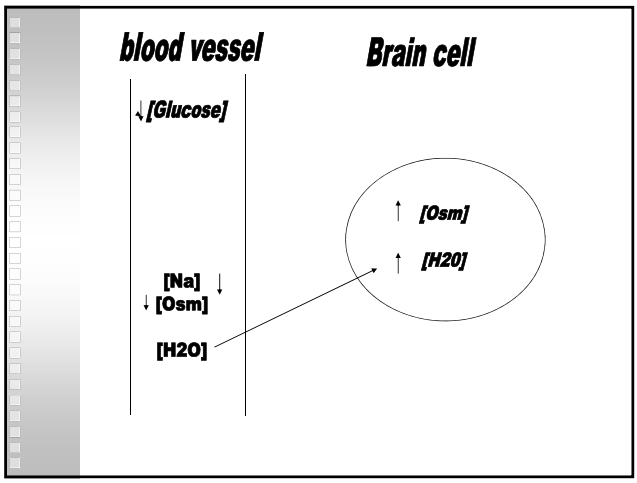
- 6 hours into therapy patient complains of headache and then becomes obtunded
- What do you do? What is the DX?

Scenario 4

- Probable cerebral edema with impending herniation
- Control airway and hyperventilate
- Mannitol 0.5- 1 gram/kg IV
- Consider 3% NACL
- Call for help
- Do all of the above before CT
- Some degree of cerebral edema exists in many children with DKA- accounts for nearly all of DKA mortality







Scenario 4

- Differences between adult and peds DKA
- No insulin boluses
- Fluid boluses if in shock only
- Isotonic fluids – monitor [Na] closely
- No bicarbonate
- Insulin will clear acidosis, dextrose early will allow consistent insulin dosage
- Watch for signs of cerebral edema and react swiftly

Scenario 5

- 2 week old full term infant presents with feeding difficulties and lethargy. Parents relate a rapid progression from poor feeding to pallor to breathing difficulties. Parents brought the child to the clinic because the grandmother said "something's wrong."
- Pale, lethargic, and gray. HR 200, RR 60, BP 70/40, Temp 36.5

Scenario 5

- Airway- patent
- Breathing- retractions and grunting, rales
- Circulation- cold, only palpable pulse is carotid, capillary refill 10 seconds
- Liver- extends to pelvis
- CXR- shows large heart
- What do you do? DX?

Scenario 5

- Cardiogenic shock, left sided obstruction
- Control Airway
- Judicious volume
- Prostaglandin E
- Dobutamine, milrinone, dopamine early
- Transport to heart center

Scenario 5

- Cardiogenic shock in neonates is common presentation of left sided obstructive lesions.
- First symptoms are vague-feeding difficulties, with rapid progression to extremis.
- Newborn exam may be normal
- Careful when triaging neonates

The level of care received during initial stabilization and transport significantly effects the hospital course and ultimate outcome of the critically ill pediatric patient.

Primary consideration should be given to the level of care a transport team can deliver.

from *"Pediatric Emergency Medicine", Barkin et al.*

Conclusion

- Kids get sick
- Assess and evaluate
- Critical interventions
- Airway, Volume, volume, volume, then drugs
- Never trust a neonate
- Prepare, practice, and transport

Respiratory Emergencies

- #1 cause of
  - Pediatric hospital admissions in otherwise healthy children.
  - Death during first year of life in otherwise healthy children.

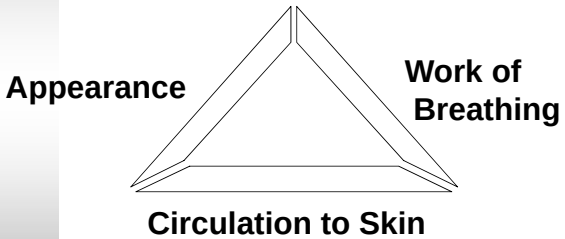
Respiratory Emergencies

Most pediatric cardiac arrest begins as respiratory failure or respiratory arrest

Pediatric Respiratory System

Decreased respiratory reserve +
Increased O_2 demand =
Increased respiratory failure risk

Pediatric Assessment Triangle



Respiratory Distress

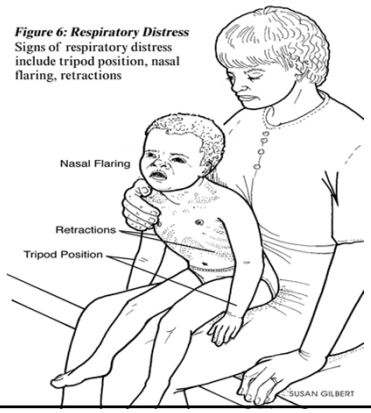


Figure 6: Respiratory Distress
Signs of respiratory distress include tripod position, nasal flaring, retractions

Respiratory Distress

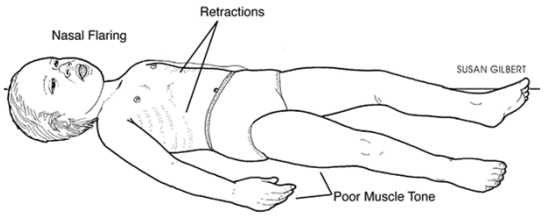


Figure 4: Child, Poor First Impression
Sick child with poor muscle tone, nasal flaring, retractions

Respiratory Emergencies

- Croup
- Epiglottitis
- Asthma
- Bronchiolitis
- Foreign body aspiration
- Bronchopulmonary dysplasia

Laryngotracheobronchitis

Croup

Croup: Pathophysiology

- Viral infection (parainfluenza)
- Affects larynx, trachea
- Subglottic edema; Air flow obstruction

Croup: Incidence

- 6 months to 4 years
- Males > Females
- Fall, early winter

Croup: Signs/Symptoms

- "Cold" progressing to hoarseness, cough
- Low grade fever
- Night-time increase in edema with:
  - Stridor
  - "Seal bark" cough
- Recurs on several nights

Croup: Management

- Mild Croup
  - Reassurance
  - Moist, cool air

Croup: Management

- Severe Croup
  - Humidified high concentration oxygen
  - Monitor EKG
  - IV tko if tolerated
  - Nebulized racemic epinephrine
  - Anticipate need to intubate, assist ventilations

Epiglottitis

Epiglottitis: Pathophysiology

- Bacterial infection (Hemophilus influenza)
- Affects epiglottis, adjacent pharyngeal tissue
- Supraglottic edema

Complete Airway Obstruction

Epiglottitis: Incidence

- Children > 4 years old
- Common in ages 4 - 7
- Pedi incidence falling due to HiB vaccination
- Can occur in adults, particularly elderly
- Incidence in adults is increasing

Epiglottitis: Signs/Symptoms

- Rapid onset, severe distress in hours
- High fever
- Intense sore throat, difficulty swallowing
- Drooling
- Stridor
- Sits up, leans forward, extends neck slightly
- One-third present unconscious, in shock

Epiglottitis

Respiratory distress+
Sore throat+Drooling =
Epiglottitis

Epiglottitis: Management

- High concentration oxygen
- IV not advisable
  - Keep IO handy and OUT OF SIGHT
  - Keep IM meds handy
- Rapid transport
- Do not attempt to visualize airway

The less you do… the better

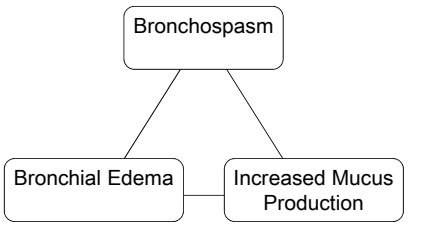
Immediate Life Threat
Possible Complete Airway Obstruction

Asthma

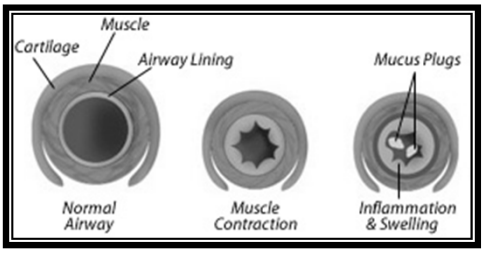
Asthma: Pathophysiology

- Lower airway is hypersensitive to:
  - Allergies
  - Infection
  - Irritants
  - Emotional stress
  - Cold
  - Exercise

Asthma: Pathophysiology

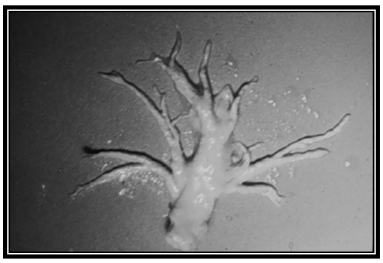


Asthma: Pathophysiology



Asthma: Pathophysiology

Cast of airway produced by asthmatic mucus plugs



Asthma: Signs/Symptoms

- Dyspnea
- Signs of respiratory distress
  - Nasal flaring
  - Tracheal tugging
  - Accessory muscle use
  - Suprasternal, intercostal, epigastric retractions

Asthma: Signs/Symptoms

- Coughing
- Expiratory wheezing
- Tachypnea
- Cyanosis

Asthma: Prolonged Attacks

- Increased evaporative water loss
- Decreased fluid intake
- Dehydration

Asthma: History

- How long has patient been wheezing?
- How much fluid has patient had?
- Recent respiratory tract infection?
- Medications? When? How much?
- Allergies?
- Previous hospitalizations?

Asthma: Physical Exam

- Patient position?
- Drowsy or stuporous?
- Signs/symptoms of dehydration?
- Chest movement?
- Quality of breath sounds?

Asthma: Risk Assessment

- Prior ICU admissions
- Prior intubation
- >3 emergency department visits in past year
- >2 hospital admissions in past year
- >1 bronchodilator canister used in past month
- Use of bronchodilators > every 4 hours
- Chronic use of steroids
- Progressive symptoms in spite of aggressive Rx

Asthma

Silent Chest = Danger

Golden Rule

ALL THAT WHEEZES IS NOT ASTHMA

- Pulmonary edema
- Allergic reactions
- Pneumonia
- Foreign body aspiration

Asthma: Management

- Airway
- Breathing
  - Sitting position
  - Humidified O2 by NRB mask
    - Dry O2 dries mucus, worsens plugs
  - Encourage coughing
  - Medications

Asthma: Management

- Nebulized Beta-2 agents
  - Albuterol
  - Terbutaline
  - Metaproterenol
  - Isoetharine

Asthma: Management

- Nebulized anticholinergics
  - Atropine
  - Ipatropium

Asthma: Management

- Subcutaneous beta agents
  - Epinephrine 1:1000--0.1 to 0.3 mg SQ
  - Terbutaline--0.25 mg SQ

POSSIBLE BENEFIT IN PATIENTS WITH VENTILATORY FAILURE

Asthma: Management

- Use EXTREME caution in giving two sympathomimetics to same patient
- Monitor ECG

Asthma: Management

- Avoid
  - Sedatives
    - Depress respiratory drive
  - Antihistamines
    - Decrease LOC, dry secretions
  - Aspirin
    - High incidence of allergy

Status Asthmaticus

Asthma attack unresponsive to β-2 adrenergic agents

Status Asthmaticus

- Humidified oxygen
- Rehydration
- Continuous nebulized beta-2 agents
- Atrovent
- Corticosteroids
- Magnesium sulfate (controversial)
- Heliox (controversial)

Status Asthmaticus

- Intubation is a LAST RESORT
- Mechanical ventilation
  - SLOW rate

Asthma: Management

- Circulation
  - IV TKO
  - Assess for dehydration
  - Titrate fluid administration to severity of dehydration
  - Monitor ECG

Bronchiolitis

Bronchiolitis: Pathophysiology

- Viral infection (RSV)
- Inflammatory bronchiolar edema
- Air trapping

Bronchiolitis: Incidence

- Children < 2 years old
- 80% of patients < 1 year old
- Epidemics January through May

Bronchiolitis: Signs/Symptoms

- Infant < 1 year old
- Recent upper respiratory infection exposure
- Gradual onset of respiratory distress
- Expiratory wheezing
- Extreme tachypnea (60 - 100+/min)
- Cyanosis

Asthma vs Bronchiolitis

- Asthma
  - Age - > 2 years
  - Fever - usually none
  - Family Hx - positive
  - Hx of allergies - positive
  - Response to Epi - positive
- Bronchiolitis
  - Age - < 2 years
  - Fever - positive
  - Family Hx - negative
  - Hx of allergies - negative
  - Response to Epi - negative

Bronchiolitis: Management

- Humidified oxygen by NRB mask
- Monitor EKG
- IV tko if Hx includes poor feeding, high fever, decreased UOP.
- Possible trial of bronchodilators
- Anticipate need to intubate, assist ventilations

Foreign Body Airway Obstruction

FBAO

FBAO: High Risk Groups

- > 90% of deaths from FBAO: children < 5 years old
- 65% of deaths from FBAO: infants

FBAO: Signs/Symptoms

- Suspect in any previously well, afebrile child with sudden onset of:
  - Respiratory distress
  - Choking
  - Coughing
  - Stridor
  - Wheezing

FBAO: Management

- Minimize intervention if child conscious, maintaining own airway
- 100% oxygen as tolerated
- No blind sweeps of oral cavity
- Wheezing
  - Object in small airway
  - Avoid trying to extract in field

FBAO: Management

- Inadequate ventilation
  - Infant: 5 back blows/5 chest thrusts
  - Child: Abdominal thrusts

Bronchopulmonary Dysplasia

BPD

BPD: Pathophysiology

- Complication of infant respiratory distress syndrome
- Seen in infants with Hx of prematurity
- Results from prolonged exposure to high concentration O_2, and mechanical ventilation of the immature lung.

BPD: Signs/Symptoms

- Require supplemental O2 to prevent cyanosis
- Chronic respiratory distress
- Retractions
- Rales
- Wheezing
- Possible cor pulmonale with peripheral edema

BPD: Prognosis

- Medically fragile, decompensate quickly
- Prone to recurrent respiratory infections
- About 2/3 gradually recover

BPD: Treatment

- Supplemental O2
- Assisted ventilations, as needed
- Diuretic therapy, as needed