

Pediatric Respiratory Emergencies

Winter Refresher Course for Family Medicine
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Disclosures

- Sadly, I have no relevant financial relationships to disclose

Objectives

- Review pediatric respiratory anatomy and physiology
- Discuss the presentation and evaluation of pediatric respiratory distress
- Discuss common pediatric respiratory complaints and diagnoses

Who Am I?

- University of Cincinnati, M.D., 2006
- Loyola Medicine, Pediatrics, 2009
- MCW/CHW Pediatric Emergency Medicine, 2012
- Husband, Father of 3
- Beer snob
- Triathlete



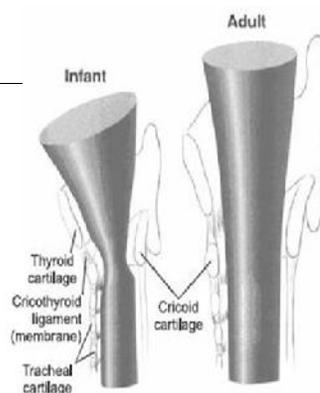
Pediatric Airway

Pediatric Airway

- Key pediatric difference
 - more anterior airway
 - subglottic narrowing
 - large tongue
 - large occiput
- Airway positioning
 - “sniffing” position is optimal

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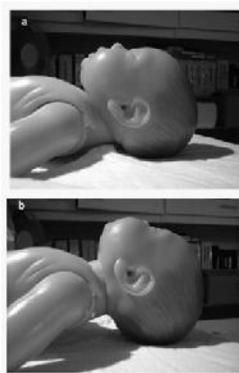
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Pediatric Respiratory Physiology

Pediatric Respiratory Physiology

- Children breath faster and have higher minute ventilation than adults
- Children have an increased capacity to compensate in respiratory disease
 - increased respiratory rate
 - increased accessory muscle use
- As in adults, maintaining oxygenation and ventilation is key in pediatric management

Assessment

- Appearance
 - level of activity (awake, somnolent, crying)
 - degree of interaction (scared, consolable)
 - mental status (awake, confused, agitated)
 - skin color (pallor, mottling, cyanosis)



Assessment

- Skin coloring
 - pallor _____
 - mottling
 - cyanosis
- general paleness
- sign of anemia or blood being shunted away from the surface of the skin

Assessment

- Skin coloring
 - pallor _____
 - mottling
 - cyanosis
- irregular discoloration of the skin
- caused by constriction of the superficial blood vessels
- not specific to respiratory distress



Assessment

- Skin coloring
 - pallor
 - mottling
 - cyanosis _____
- 
- generalized blue or dusky color
 - caused by circulation of deoxygenated blood
 - typically a later finding in pediatric respiratory insufficiency

Assessment

- Skin coloring
 - pallor
 - mottling
 - cyanosis _____
- 
- blue hands, feet and mucous membranes is **acrocyanosis**
 - not a sign of desaturation
 - common in neonates

Assessment

- Posture
 - upper airway obstruction
 - sniffing position
 - upright, neck flexed, head extended
 - lower airway obstruction
 - tripod position
 - sitting up
 - leaning forward



Assessment

- Work of breathing
 - retractions
 - grunting
 - nasal flaring
 - tachypnea



Assessment

- Work of breathing

Assessment

- Work of breathing
 - retractions
 - grunting
 - nasal flaring
 - tachypnea
- accessory muscle use in the chest and neck
- characterized as
 - mild, moderate, or severe
 - supraclavicular, suprasternal, subcostal, intercostal



Assessment

- Work of breathing
 - retractions
 - grunting
 - nasal flaring
 - tachypnea
- audible grunt at the beginning of exhalation
- a physiologic attempt to increase the pressure in order to facilitate oxygen transfer



Assessment

- Work of breathing
 - retractions
 - grunting
 - nasal flaring
 - tachypnea
- external sign of diaphragmatic exertion

Assessment

- Work of breathing
 - retractions
 - grunting
 - nasal flaring
 - tachypnea
- an attempt to increase ventilation when normal respiratory patterns are insufficient
- not specific to respiratory distress, also can be present in pain, anxiety, or fever

Assessment

- Vital signs
 - tachycardia - early sign of respiratory compromise
 - tachypnea
 - bradypnea
 - apnea
 - hypoxia

Assessment

- Vital signs

Group	Age	Respiratory Rate	Heart Rate
Newborn	Birth-6 weeks	30-50	120-160
Infant	7 weeks-1 year	20-30	80-140
Toddler	1-2 years	20-30	80-130
Preschool	2-6 years	20-30	80-120
School age	6-13 years	12-30	60-100
Adolescent	13-16 years	12-20	60-100

Assessment

- Pulse oximetry
 - assesses degree of oxygenated blood
 - transcutaneous measurements accurate +/-4%
 - pulse ox changes with
 - amount of oxygenated hemoglobin
 - amount of blood in the tissue being measured
 - normal pediatric ranges typically adult ranges ($\geq 92-93\%$ acceptable)

Assessment

- Auscultation
 - stertor
 - upper airway obstruction
 - inspiratory and expiratory
 - transmitted in both lungs
 - hoarse voice or cry
 - laryngeal obstruction, swelling, or dysfunction

Assessment

- Auscultation
 - stridor
 - high-pitched noise
 - associated with upper airway obstruction
 - typically inspiratory, but can be expiratory
 - wheeze
 - high- or low-pitched whistling noise
 - intrathoracic obstruction
 - typically expiratory, but can be inspiratory



General Interventions

- Ensure adequate oxygenation
 - provide supplemental oxygen as indicated for hypoxemia or respiratory distress
- Reduce oxygen demand
 - keep the child warm
 - keep the child calm
- Ensure adequate ventilation
 - provide respiratory support and assisted ventilation as indicated

Wheezing 2 year old

- You are seeing a 2 year old who is having difficulty breathing. 2-day history of cough and cold symptoms, has been breathing hard since last night.
- T: 38.0 P: 150 R: 55 SpO₂: 88%
- Agitated, bilateral wheezing, subcostal, intercostal retractions, nasal flaring
- Thoughts? What do you want to do?

Asthma

- 9 million children with asthma in US
 - each year, 1 of 3 will have an asthma-related ED visit
 - 17% of all pediatric ED visits are for asthma
 - 10-30% of all admissions to children's hospital (500,000+ each year)
- Bronchospasm is common in younger children
 - 15% will have a wheezing episode before age 5

Asthma

- Presentation
 - wheezing, difficulty breathing
 - variable degrees of shortness of breath
 - may or may not have a history of previous wheezing episodes
 - typically triggers include colds, allergies, and weather changes

Asthma

- Physical findings
 - wheezing may be mild, moderate, severe, or absent
 - decreased air movement
 - variable amount of respiratory distress
 - mental status may be normal or altered

Asthma

- Intervention
 - ABCs
 - supplemental oxygen as indicated
 - Administer β -agonists and steroids
 - IM epinephrine can be used for refractory cases

Asthma

- Albuterol (inhaled B₂ agonist)
 - relax bronchial smooth muscles
 - onset < 5 min, peak 15 min, duration 4-6 hours
 - rapid sequential treatments result in bronchodilation and sustained improvement
 - can cause transient ventilation-perfusion mismatch and worsen hypoxemia
 - broad range in optimal dosing
 - <10% of dose reaches the lungs

Asthma

- Ipratropium (Atrovent®)
 - derivative of atropine
 - onset 15 min, peak 1 hour, duration 4-6 hours
 - indicated for moderate/severe asthma exacerbations
- IM Epinephrine
 - rapidly causes bronchodilation
 - > 30kg: 0.3 mg, 15-30 kg: 0.15 mg, < 15 kg: 0.1 mg/kg
 - side effects include tachycardia, flushing, headache

Asthma

- Corticosteroids
 - decrease pulmonary inflammation
 - can be given oral or IV
 - onset 2-6 hours
 - early administration can decrease hospitalization rates by 37% at 4 hours

Asthma Pearls

- Beware the child with a history of wheezing who is in respiratory distress but not wheezing
- The presence of adequate air exchange is just as (maybe more) important as the presence of wheezing
- Children may become hypoxic with albuterol treatments...add oxygen and reassess their respiratory distress

2 year old with trouble breathing

- You are seeing a 2 year old with acute onset of difficulty breathing. No significant history.
- T: 37.5 P: 160 RR: 45 SpO₂: 92%
- Awake, severe retractions, lungs sounds normal, audible stridor
- Thoughts? What do you want to do?

Airway Foreign Bodies



Airway Foreign Bodies

- Epidemiology
 - 2/3 cases are 1-2 year olds
- Presentation
 - coughing
 - sore throat
 - difficulty swallowing or drooling
 - variable respiratory distress
 - history of aspiration event may not be present

Airway Foreign Bodies

- Physical examination
 - large oropharynx
 - supraglottic/proximal esophagus
 - lower airways
 - respiratory distress
 - mouth breathing
 - refusal to eat
 - irritability
 - drooling

Airway Foreign Bodies

- Physical examination
 - large oropharynx
 - supraglottic/proximal esophagus
 - lower airways
- stridor
- prolonged expiratory phase
- head bobbing
- drooling

Airway Foreign Bodies

- Physical examination
 - large oropharynx
 - supraglottic/proximal esophagus
 - lower airways
- respiratory distress
- wheezing
- decreased or absent unilateral lung sounds

Airway Foreign Bodies

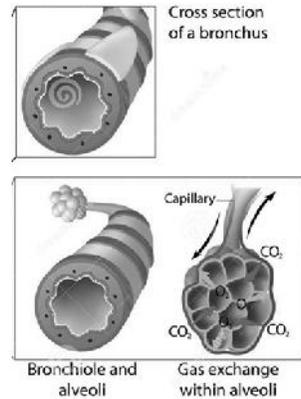
- Intervention
 - ABCs
 - keep the child calm
 - if severe respiratory distress, apnea, or altered mental status - call 911
 - laryngoscopic evaluation, if available, and removal of the foreign body may be necessary
 - ensure the foreign body is not pushed further distally
 - needle cricothyroidotomy can temporize
 - 16-18 gauge needle with catheter, 3 way stopcock, high pressure oxygen source

10 month old with wheezing

- You are seeing a 10 month old with difficulty breathing. She has had a cold for 2 days and has been inconsolable, breathing hard, and wheezing since this morning
- T: 38.1 P: 170 RR: 75 SpO₂: 89%
- Tired-appearing, moderate retractions, nasal flaring, grunting; diffuse wheezing
- Thoughts? What do you want to do?

Bronchiolitis

- Lower airway viral infection
 - peribronchiol inflammation
 - congested bronchioles
 - obstruction causing air trapping
- High morbidity, low mortality
 - 1/3 children by 2 years of age
 - 1:10 hospitalized
 - 90,000 annual admissions
 - 100-200 deaths annually in US



Bronchiolitis

- Epidemiology
 - can present at any age or season
 - young infants (< 12 mo) are most severe
 - winter predominance
- etiology
 - RSV 50-80% of cases
 - parainfluenza, influenza, human metapneumovirus
 - specific viral etiology is clinically irrelevant - we treat them all the same

Bronchiolitis

- Presentation
 - increased work of breathing and wheezing
 - typically preceded by cold symptoms for 1-4 days
 - cough worsens with onset of wheezing
 - fever, respiratory distress, decreased oral intake may be present

Bronchiolitis

- Physical examination
 - nasal congestion, rhinorrhea
 - moist, frequent cough
 - diffuse wheezing
 - variable amount of respiratory distress
 - variable degree of interactivity

Bronchiolitis

- Interventions
 - ABCs
 - supplemental oxygen as indicated
 - nasal suctioning
 - nasopharyngeal suctioning
 - nasal aspirator
 - NoseFrida!
 - albuterol?

Bronchiolitis

- Interventions
 - ABCs
 - supplemental oxygen as indicated
 - nasal suctioning
 - nasopharyngeal suctioning
 - nasal aspirator
 - NoseFrida!
 - albuterol?
- improves oxygen delivery
- Goal: > 92%

Bronchiolitis

- Interventions
 - ABCs
 - supplemental oxygen as indicated
 - nasal suctioning
 - nasopharyngeal suctioning
 - nasal aspirator
 - NoseFrida!
 - albuterol?
- relieves upper airway obstruction
- stimulates cough reflex
- addition of saline drops improves results

Bronchiolitis

- Interventions
 - ABCs
 - supplemental oxygen as indicated
 - nasal suctioning
 - nasopharyngeal suctioning
 - nasal aspirator
 - NoseFrida!
 - albuterol?
- conflicting evidence of effectiveness
- not all children respond well
- subset of infants appear to benefit modestly
- not routinely recommended
- a treatment may be considered

Bronchiolitis

- Risk factors for severe disease
 - age < 3 months
 - history of prematurity (< 34 weeks)
 - unrepaired congenital heart disease
 - chronic lung disease
 - airway abnormalities
 - immune deficiencies

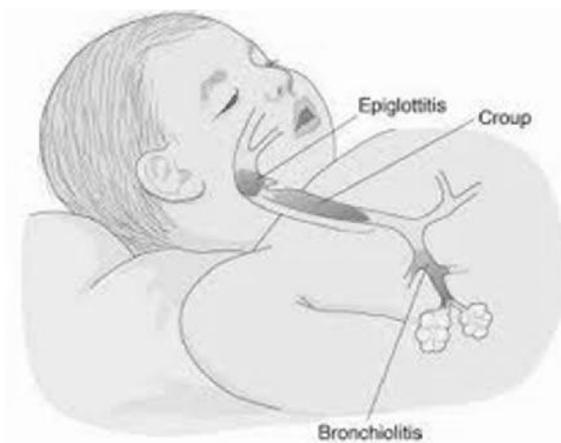
3 year old with noisy breathing

- You are called by the family of a 3 year old who awoke abruptly in the middle of the night with noisy and distressed breathing.
- T: 38.3 P: 140 RR: 50 SpO₂: 94%
- Awake, leaning forward with his hands on knees, audible stridor and frequent harsh cough, lungs sounds are clear.
- Thoughts? What do you want to do?

Croup

- Laryngotracheobronchitis
 - viral-induced inflammation of almost the entire respiratory tree
 - symptoms of upper airway swelling predominate
- Younger children are more severely affected
 - children have smaller airways
 - airway resistance = $1/(\text{radius})^4$
 - inflammation exponentially increases airway resistance in small airways

Croup



Croup

- Epidemiology
 - incidence 18/1,000 children annually
 - 15% of ED visits due to respiratory illness
 - caused by many viruses
 - parainfluenza causes the most severe disease (late fall- early spring)
 - predominately affects children 6 months - 4 years

Croup

- Presentation
 - respiratory distress is typically preceded by cold symptoms
 - hoarse voice
 - sore throat
 - “barky” or “seal-like” cough
 - variable fever, stridor, respiratory distress, dehydration
 - symptoms worse in the middle of the night

Croup

- Physical examination
 - “barky” cough
 - stridor - mild, moderate, severe
 - usually inspiratory, expiratory in more severe cases
 - nasal congestion, rhinorrhea
 - lung sounds usually normal



Croup

- Intervention
 - ABCs
 - supplemental oxygen as indicated
 - keep child calm - agitation worsens symptoms
 - cold air helps alleviate symptoms, so you might see an improvement in transit
 - assist ventilation as indicated
 - albuterol does not help

Other Diagnoses

- Pneumonia
 - fever, respiratory distress, crackles, hypoxia
- Epiglottitis
 - fever, ill-appearing, tripodging, difficulty breathing
- Tracheitis
 - fever, stridor, ill-appearing, respiratory distress
- Pneumothorax
 - chest pain, difficulty breathing, asymmetric breath sounds

Summary

- Pediatric respiratory complaints are common
- Pediatric respiratory anatomy and physiology affect the way children respond to these illnesses
- Asthma, bronchiolitis, and croup cause the majority of respiratory distress cases
- ABCs, oxygen and assisting ventilation as indicated are universal in treatment

Thanks

- Questions?