Adventitious Breath Sounds in the Pediatric Patient

Shailendra Das, DO
Assistant Professor
Department of Pediatrics
Baylor College of Medicine
Objectives

• Classify various breath sounds by timing, quality, and location
• Provide a differential diagnosis based on specific adventitious sound
• Discuss clues to help identify specific diagnosis
• Identify patients that need further workup, referral, treatment
Disclosures

• No financial disclosures
A little about me…

• Born/raised in Houston
• Aggie (whoop!!)
• Pulmonary fellowship at TCH
• Cook Children’s (2012-2014)
• Back at TCH
• Member of our Lung transplant and Aerodigestive teams
Normal pulmonary physical exam

• Consists of four parts:
  - Inspection
  - Auscultation
  - Percussion
  - Palpation

• Extrapulmonary exam:
  - Nasal flaring
  - Clubbing
  - Cyanosis
Pulmonary exam--Ascultation

• Five lobes usually (LUL, LLL, RUL, RML, and RLL)
  - Lingula—part of the left upper lobe

• Must account for upper airway, central (conducting) airways as part of exam
Factors important in distinguishing sounds and creating differential diagnosis

• Location

• Timing
  - Inspiratory, expiratory, or both
  - Same cycle vs varying cycle of breathing

• Monophonic vs polyphonic

• Low pitch vs high pitch
Noisy breathing

• Wheezing
  - Low pitch wheeze = rhonchi
• Stridor
• Stertor
• Crackles (rales)
• Grunting
Localizing sounds: Where is the obstruction?
Localizing sounds

• Inspiratory sounds = EXTRAthoracic obstruction
  - Eg primarily stridor

• Expiratory sounds = INTRAthoracic obstruction
  - Eg primarily wheezing
## Normal breath sounds

<table>
<thead>
<tr>
<th>Breath sound</th>
<th>Quality</th>
<th>I:E ratio</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracheal</td>
<td>Harsh, high-pitched</td>
<td>I = E</td>
<td>Above supraclavicular notch, over the trachea</td>
</tr>
<tr>
<td>Bronchial</td>
<td>Loud, high-pitched</td>
<td>I &lt; E</td>
<td>Just above clavicles on each side of the sternum, over the manubrium</td>
</tr>
<tr>
<td>Bronchovesicular</td>
<td>Medium in loudness and pitch</td>
<td>I = E</td>
<td>Next to the sternum, between scapulae</td>
</tr>
<tr>
<td>Vesicular</td>
<td>Soft, low-pitched</td>
<td>I &gt; E</td>
<td>Remainder of lungs</td>
</tr>
</tbody>
</table>

[https://dev-journals2013.lww.com/nursingmadeincrediblyeasy/Citation/2007/01000/Every_breath_you_take__Making_sense_of_breath.2.aspx](https://dev-journals2013.lww.com/nursingmadeincrediblyeasy/Citation/2007/01000/Every_breath_you_take__Making_sense_of_breath.2.aspx)
Bronchial breath sounds

• Also known as tubular breath sounds
  - Sound moving through a tube or straw

• NORMAL when heard over the manubrium

• NOT NORMAL when heard anywhere else
  - ***sometimes heard in peripheral lung fields—importantly, in consolidation
Adventitious sounds—wheezing
What is “wheezing?”

• Defined as a continuous musical expiratory sound caused by INTRATHORACIC airway obstruction
• Produced by oscillation of opposing walls of an airway that are narrowed to the point of closure

a. Normal airway

b. Slightly narrowing
   Velocity increases
   Pressure decreases

c. Greater narrowing
   Velocity decreases
   Pressure increases

d. Alteration of slight and great narrowing (flutter)
All that wheezes is not asthma
What is “asthma”?

• Characterized by:
  - Hyperresponsiveness of the airways to various stimuli, leading to reversible airway obstruction
  - Airway obstruction result of bronchospasm and inflammation/mucosal edema
  - Recurrent wheezing—*POLYPHONIC*
  - Reversibility with treatment a key component
Wheeze—exam findings

- Asthma/Lower airway obstruction: classically demonstrate high-pitched musical expiratory sounds, varying in tone and timing ("polyphonic")

- Localized bronchial narrowing: single pitch, begins/ends at same time ("monophonic")
Therapeutics

• Bronchodilator therapy in asthma—
  - Helps relax smooth muscle, with immediate goal of relieving small airway obstruction

• However, in other diseases, bronchodilators may have no effect, or in the case of airway malacia, worsen the problem
What else could it be?

When symptoms persist despite conventional asthma therapy, or when classic symptoms do not exist, one must consider other diagnoses.
Differential diagnosis of wheezing

- Asthma
- Bronchiolitis
- GER
- Chronic aspiration
- Tracheomalacia/Bronchomalacia
- Foreign body aspiration
- Cystic fibrosis
- Primary ciliary dyskinesia
- Immunodeficiency
- Cardiac disease/Vascular compression
- Bronchiolitis obliterans
## Findings to suggest other etiologies

<table>
<thead>
<tr>
<th>History</th>
<th>Exam and Other findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Onset early in infancy</td>
<td>• Clubbing</td>
</tr>
<tr>
<td>• Neurologic dysfunction</td>
<td>• Murmur</td>
</tr>
<tr>
<td>• Wheezing with/after feeds</td>
<td>• Stridor or crackles on exam</td>
</tr>
<tr>
<td>• Diarrhea</td>
<td>• Focal signs-- exam/CXR</td>
</tr>
<tr>
<td>• Poor weight gain</td>
<td>• Recurrent/prolonged cyanosis or hypoxemia</td>
</tr>
<tr>
<td>• O2 requirement &gt;1 week after onset</td>
<td>• Anemia</td>
</tr>
<tr>
<td></td>
<td>• Irreversible airflow obstruction</td>
</tr>
</tbody>
</table>

Fakhoury KF. *Up to date* 2012.
Differential diagnosis of wheezing

• Vocal cord dysfunction (paradoxical vocal fold movement)
  - Occurs at the onset of activity, “type A”, difficulty getting air in
  - Can co-exist with asthma

• Chronic aspiration
  - Daily wheezing/choking/coughing with feeds

• Tracheomalacia/Bronchomalacia
  - Monophonic low pitch wheeze, can get worse with Albuterol; barky cough
  - H/o cardiac disease, genetic mutation, or TEF
Differential diagnosis of wheezing

• Foreign body aspiration
  - Acute onset wheezing/cough—*Usually focal wheezing*
  - H/o choking incident

• Cystic fibrosis
  - Recurrent purulent cough, poor weight gain, clubbing

• Primary ciliary dyskinesia
  - Recurrent ear infections, daily purulent rhinitis

• Bronchiolitis obliterans
  - H/o infection (esp Adenovirus), with onset of dyspnea 4-8 weeks later, unrelenting, wheezing not improved by Albuterol
Crackles
Crackles

• “velcro fastening” “rubbing a strand of hair between two fingers close to your ears”

• Relates to opening of airways that are collapsed, or filled with pus/fluid

• Can be heard throughout respiratory cycle
Crackles

• Fine crackles
  - Soft, higher pitch, brief
  - Sounds similar to cellophane being crumpled
  - Usually associated with interstitial process

• Coarse crackles
  - Louder, longer, low pitch
  - Sounds similar to running a hair strand between two fingers
  - Associated with airway/alveolar disease (atelectasis, bronchiectasis)
Crackles—Differential diagnosis

• Fine crackles
  - Pulmonary edema
  - Lung fibrosis
  - Interstitial lung disease

• Coarse crackles
  - Bronchiectasis
  - Pneumonia
  - Atelectasis
Stridor

• High-pitched turbulent sound
• Can be inspiratory, expiratory, or bi-phasic
• Most commonly inspiratory
Causes of stridor

• Layngomalacia
• Croup
• Epiglottitis
• Vocal fold paralysis
• Subglottic stenosis
• Vascular ring
• Glottic web
• Papillomas
Laryngomalacia

• Most common cause of stridor in infants
• Congenital softening of the laryngeal tissues (results in omega shape epiglottis)
• Usually benign (~90% of the time)
Laryngomalacia—the other 10%

• Things to watch out for/warning signs for parents:
  - Cyanotic events
  - Apneic events (ALTE/BRUE)
  - Failure to thrive
  - Significant work of breathing (retractions, nasal flaring)
  - Choking with feeds

• Surgical management possible (Supraglottoplasty)
# Stridor and associated findings

<table>
<thead>
<tr>
<th>Associated findings</th>
<th>Most common Diagnosis(es)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stridor worse when supine, worse with crying</td>
<td>Laryngomalacia</td>
</tr>
<tr>
<td>Worse with feeding</td>
<td>Vascular compression, tracheomalacia</td>
</tr>
<tr>
<td>Choking</td>
<td>Foreign body, tracheo-esophageal fistula</td>
</tr>
<tr>
<td>Brassy cough</td>
<td>Croup</td>
</tr>
<tr>
<td>Hoarseness, muffled cry</td>
<td>Vocal cord paralysis</td>
</tr>
<tr>
<td>Anxiety (older child)</td>
<td>Vocal cord dysfunction (better known as paradoxical vocal fold movement)</td>
</tr>
</tbody>
</table>
Biphasic stridor

• Indicates glottic or subglottic narrowing

• Etiologies include:
  - Croup
  - Vascular ring
  - Subglottic stenosis
  - Vocal cord paresis
  - Tracheal mass

• NOT normal
Videos--stridor

- Laryngomalacia
  - https://www.youtube.com/watch?v=XTyNhbJAwQ

- Biphasic stridor from croup
  - https://www.youtube.com/watch?v=nwYHryiy3HY
Other sounds

• Grunting: deep sound heard during expiration, caused when a child exhales against a partially closed glottis to try and keep the bronchioles open to prevent alveolar closure; can be late sign of respiratory distress

• Stertor: “awake snoring”—results from vibration of the pharyngeal tissues due to obstruction of the upper airway
When to refer/Consider urgent management

• Stridor
  - Apneic/Cyanotic events, choking with feeds, failure to thrive
  - Biphasic stridor
  - Workup can include: CXR (croup), esophagram or CT angio; laryngoscopy and/or bronchoscopy

• Wheezing
  - When symptoms don’t improve with bronchodilator
  - Monophonic or localized wheezing

• Crackles (if chronic, CXR not conclusive of pneumonia/atelectasis)
Question 1

• You are evaluating a 3 year old child in your clinic with cough for 1 week. On exam, you hear wheezing, but only in the right lower lobe. The wheezing appears to have the same time in expiration with every breath. Of the choices, what is your next step in management?

- A. Administer bronchodilator (albuterol) therapy
- B. Emergent referral to ENT for bronchoscopy
- C. Swallow function study
- D. Chest physiotherapy
Question 2

• You are seeing a 2 month old for their checkup and vaccines. Mom notes her baby is having “abnormal breathing sounds” and fussiness. She describes a high pitch sound on inspiration, worse when the baby is fussy and hungry. It gets better when her child is held upright. She denies any cyanotic or apneic episodes, and you note the patient is >75%ile for weight. What is your best recommendation to mom?

  - A. ENT needs to do a surgical procedure to correct the issue
  - B. Reassure mom and observe
  - C. Start a trial of GER medication
Question 3

• A 2 week infant is brought to your urgent care center for repeat episodes of spitting up/choking on feeds, along with noisy breathing. He has not yet regained his birth weight. On exam, you note biphasic stridor. Of the choices listed below, what is the most likely cause of this patient’s symptoms?
  - A. Asthma exacerbation
  - B. Laryngomalacia
  - C. Vascular ring
  - D. Paradoxical vocal fold movement
https://medlineplus.gov/ency/article/007318.htm
Take home points

• Adventitious breath sounds vary in timing, location, pitch/tone. Using these differences to classify helps obtain a more precise differential diagnosis.

• Inspiratory sounds are caused by extrathoracic obstruction; expiratory sounds are caused by intrathoracic obstruction.

• All that wheezes is not asthma—using other clues may help lead to the alternative diagnosis.

• Know when to refer (to a pulmonologist, or ER setting)
  - …also know that it’s OK to refer
Questions??

• **All sounds used in this presentation come from www.easyascultation.com**