CASE TWO

Short case number: 3_20_2
Category: Children & Young People/Respiratory & ENT Systems
Discipline: Paediatrics Medicine
Setting: General Practice
Topic: Child with wheeze

Case

Angelo Sophocleous, is a 10 month old boy who presents with his mother. You notice that Angelo is an alert and active baby who is in no distress but is wheezing.
His mother informs you that the noisy breathing started a few weeks ago and it seems to come and go.

Questions

1. What is a wheeze and what is the underlying pathophysiology?
2. The most common cause of wheeze in children under 12 months is viral infection, what are the key features of history and examination that will assist you in determining whether the cause is viral bronchiolitis or something else?
3. Outline the causes of wheeze in infants and toddlers and detail the key clinical features of each.
4. What are the key pathogens in viral bronchiolitis? Briefly outline the principles of management of an infant with bronchiolitis.
5. Angelo's mother explains that his older sister was playing with beads near him and is concerned that Angelo may have inhaled one. What physical examination findings and CXR features would support a diagnosis of inhalation of a foreign body?
6. In exploring the history further you discover that Angelo's 6 year old brother has asthma. What features of Angelo's history and examination would support a diagnosis of asthma?

Suggested reading:

- Thomson K, Tey D, Marks M, editors. Paediatric Handbook. Staff of the Royal Children's Hospital Melbourne, Australia. 8th edition. Chichester: Wiley-Blackwell; 2009.

ANSWERS

1. **What is a wheeze and what is the underlying pathophysiology?**
   Wheeze is typically a high-pitched, musical whistle heard during expiration. The term wheeze refers to the noise heard either with or without a stethoscope.

   In the normal situation, a child's breathing is inaudible without a stethoscope because the velocity of airflow in the airways is too low to produce a sound. When the airways narrow, turbulence occurs. Wheeze may occur when the velocity of airflow increases as a consequence of the airways narrowing. In diseases such as asthma and bronchiolitis, the pathology is in the small airways. This sometimes leads to the erroneous assumption that the wheeze is due to air whistling through narrowed small airways. Theoretically, the velocity of airflow in the smaller airways is far too low to cause a wheeze, even when there is significant narrowing. The wheeze is generated in the trachea and major bronchi, which are made narrower by secondary compression during expiration. The physiological explanation is that the small airways obstruction leads to a forced expiration with positive (rather than the usual negative) intrapleural pressure. This positive intrapleural pressure exceeds the pressure within the lumen of the trachea and other large airways, resulting in compression of these airways during expiration and producing a wheeze in these dynamically narrowed larger airways

   Although obstruction in the small airways is the usual reason for wheeze generated in the large airways, obstructive lesions in the trachea or main bronchi can also cause wheeze. In this case, the wheeze may be generated by the increase in velocity of airflow at the level of the obstruction. Thus, foreign bodies in the intrathoracic part of the large airways or large airway compression from tuberculous lymph nodes may manifest themselves as wheeze.

2. **The most common cause of wheeze in children under 12 months is viral infection, what are the key features of history and examination that will assist you in determining whether the cause is viral bronchiolitis or something else?**

   Acute viral bronchiolitis is the most common significant respiratory infection in the first year of life. It is less common but not rare after 1 year of age. In most locations, bronchiolitis occurs in winter epidemics but, in climates with more precipitation in summer than winter, this situation can be reversed. Important risk factors include maternal smoking, congenital heart disease, chronic lung disease of prematurity, immunodeficiency and cystic fibrosis.

   Clinical features are usually sufficient to allow a clinical diagnosis to be made and consist of an illness with a gradual onset over several hours to a day or two, low-grade or no fever, expiratory wheeze, dry cough, tachypnoea, hyperinflation of the chest and fine inspiratory crackles. Respiratory distress can vary from minimal to severe. Bronchiolitis usually lasts for 2-3 days but more severe episodes last longer. If the condition has not resolved within 2 weeks, an underlying risk factor is likely to be present. The principal differential diagnosis is early-onset asthma. The presence of inspiratory fine crackles is more indicative of bronchiolitis than asthma, but the two conditions can be similar clinically and precipitated by the same viruses.

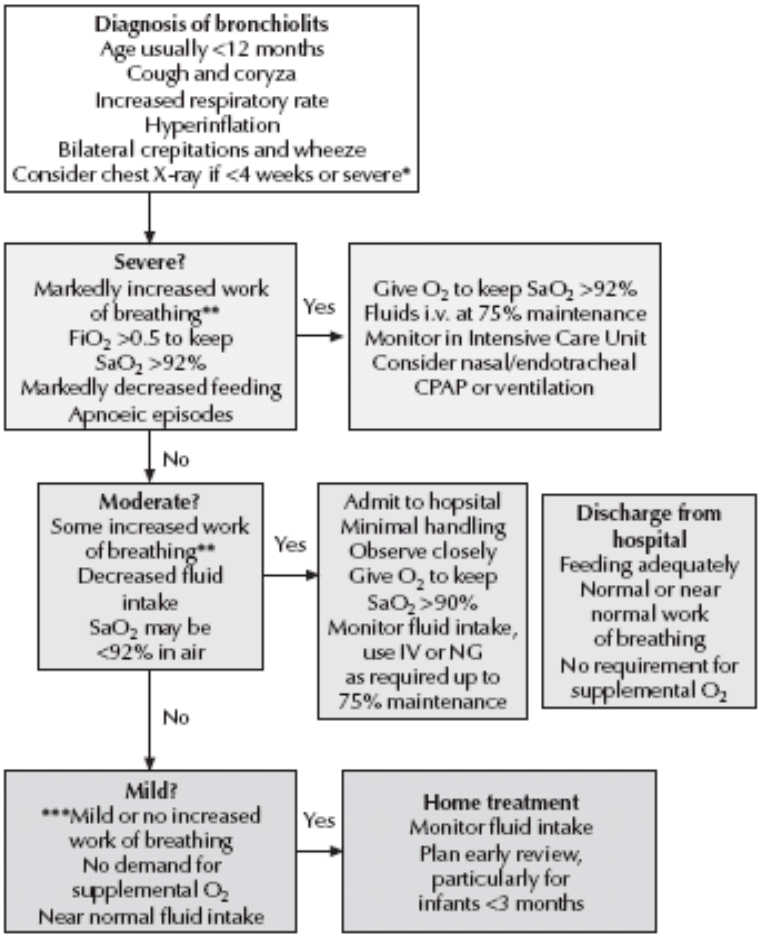
3. **Outline the causes of wheeze in infants and toddlers and detail the key clinical features of each.**
   Since wheeze can develop because of narrowing of either the small or large airways, there are many potential causes.

Obstruction of small airways	
Acute viral bronchiolitis	• Gradual onset over several hours to 1-2 days • Low-grade or no fever • Expiratory wheeze • Dry cough • Tachypnoea • Hyperinflation of the chest and fine inspiratory crackles. • Respiratory distress can vary from minimal to severe. • Bronchiolitis usually lasts for 2-3 days (but may be longer)
Transient infant wheeze	• Transient infant wheezing is a benign condition. • Appear to have airways that are of relatively small calibre and may be floppy. • Maternal smoking is a risk factor but neither a personal nor family history of atopy is more common than in children who do not wheeze.
Asthma	
Aspiration	• Recurrent or persistent lower respiratory symptoms, including cough and wheeze. • Aspiration is usually due to gastro-oesophageal reflex or incoordinate swallowing (may rarely be tracheo-oesophageal fistula)
Chronic lung disease of prematurity	• The preterm infant who develops hyaline membrane disease and requires ventilation and high concentrations of supplemental oxygen may develop chronic lung disease • Persistent cough and wheeze for the first year or two of life is common • When these children develop acute viral bronchiolitis, it is likely to be a particularly severe disease.
Bronchiectasis	• Familial forms of suppurative lung disease that may present in infancy with cough and wheeze include cystic fibrosis, immunodeficiences such as X-linked hypogammaglobulinaemia and primary ciliary dyskinesia (immotile cilia syndrome). • Acquired bronchiectasis may occur after bronchiolitis or pneumonia. Well recognized causes include adenovirus and measles. Ongoing aspiration may also lead to bronchiectasis. Often the aetiology is unknown.
Obstruction of large airways	
Airway malformations	**Tracheomalacia/ bronchomalacia** A primary malformation of either tracheal or bronchial cartilage resulting in excessive floppiness of the central airways. This causes wheeze and a brassy cough, likened to the 'bark' of a seal. Children who have had a repaired tracheo-oesophageal fistula (TOF) have tracheomalacia. Their cough is referred to as a 'TOF cough'. Tracheomalacia may be complicated by sudden, very severe obstructive episodes known as 'dying spells'. These are due to transient total apposition of the anterior and posterior tracheal walls. **Congenital lobar emphysema** Congenital deficiency of cartilage in a lobar bronchus, which causes obstruction to the bronchus, over distension of that lobe and subsequent displacement of

	the adjacent lung and mediastinum. Generally, these infants present in the neonatal period with respiratory distress accompanied by wheeze and over distension of the chest. **Subglottic / tracheal haemangioma** These lesions are absent at birth (as are haemangiomas of the skin) but appear during the first few months of life. The symptoms of expiratory wheeze, inspiratory stridor and respiratory distress typically occur between the ages of 6 weeks and 6 months. The actual noise produced depends upon the anatomical site of the mass. Laryngeal or subglottic lesions cause inspiratory stridor; and intrathoracic tracheal lesions cause expiratory wheeze. **Congenital tracheal / bronchial stenosis** This may occur anywhere in the central tracheobronchial tree, resulting in varying degrees of obstruction. Normally, these infants will present with breathlessness, expiratory wheeze and/or inspiratory stridor, depending upon the site and extent of the narrowing.
Vascular malformations	**Vascular ring** The true vascular ring is usually due to a double aortic arch malformation. This results in early onset of wheeze and stridor, cough and recurring lower respiratory tract infections. Other vascular malformations that may cause symptoms include innominate artery compression of the trachea (often associated with localized tracheomalacia), aberrant subclavian artery and rare forms of pulmonary artery sling. **Large left to right cardiac shunt** External compression of the bronchi can occur in the presence of enlarged, hypertensive pulmonary arteries, particularly when there is associated left atrial enlargement. The left atrium lies immediately adjacent to the tracheal bifurcation and infants with this combination seem particularly prone to bronchial compression, e.g. ventricular septal defect and persistent ductus arteriosus. Clinically, this obstruction results in over distension of one or both lung fields with associated wheeze and breathlessness.
Mediastinal cysts/masses	Compression of the central airways may occur from cystic hygroma/ lymphangioma, bronchogenic cysts, oesophageal duplication cysts, neurenteric and gastroenteric cysts, teratomas and mediastinal lymphadenopathy
Inhaled foreign body	The most common foreign bodies are nuts, but other food material and small objects (e.g. plastic toys, grass seeds, leaves) can be inhaled into the airways. Only one-third of children present with the classic diagnostic triad of choking, asymmetrical air entry and abnormal chest X-ray. Many children present with acute onset of wheeze, accompanied by cough and breathlessness.
Ingested foreign body	Quite large foreign bodies (coins, toys, bones) may be swallowed and may fail to pass through the relatively narrow upper oesophagus. If these foreign bodies are large or irregularly shaped, they may cause significant obstruction to the adjacent extrathoracic trachea. In most cases this will produce inspiratory stridor, but expiratory wheeze may also be audible. These children will have difficulty swallowing of recent onset, plus persisting fever and malaise as a consequence of inflammation of the oesophagus from the large foreign body.

4. **What are the key pathogens in viral bronchiolitis? Briefly outline the principles of management of an infant with bronchiolitis.**

   Recent evidence suggests that for bronchiolitis in the community, rhinovirus is the most common causative organism rather than respiratory syncytial virus (RSV). For children admitted to hospital, RSV is the most common causative organism. Bronchiolitis can also be caused by parainfluenza 1-3, influenza A and B, adenovirus and HMV (Human metapneumovirus). It is rarely due to bacteria and secondary infection with bacteria is also rare.



Notes:
* Routine CXR is not required for children with typical clinical features.
** Use the respiratory rate, accessory muscle use and recessions to judge the work of breathing.
*** Very young infants and infants with a co-morbidity (e.g. cardiac disease, Down syndrome, chronic lung disease etc.) are at greatest risk of severe disease. These infants may need admission for observation even if they have mild bronchiolitis. Administration of β2 agonists may be distressing for young infants and is of no proven value.

Fig. 36.1 Assessment and management of acute viral bronchiolitis

5. **Angelo's mother explains that his older sister was playing with beads near him and is concerned that Angelo may have inhaled one. What physical examination findings and CXR features would support a diagnosis of inhalation of a foreign body?**

   Signs:
   - There may be no physical signs or alternatively reduced breath sounds over the whole or part of one lung.
   - Wheeze

   Chest X-ray:
   - Air trapping from a ball valve obstruction, particularly if both inspiratory and expiratory views are taken, although this is not often possible in a young child.
   - Atelectasis and radiopaque foreign bodies
   - Approx 1/3 normal

   If a foreign body is suspected, then bronchoscopy should be considered.

6. **In exploring the history further you discover that Angelo's 6 year old brother has asthma. What features of Angelo's history and examination would support a diagnosis of asthma?**

   Establishing the diagnosis and pattern of asthma
   The two main components of asthma pathology include:
   • Airway inflammation.
   • Reactive airways (bronchoconstriction).

   The important clinical features are:
   • Wheeze.
   • Shortness of breath.
   • Chest tightness.
   • Cough.
   • Response of symptoms to short acting bronchodilators.
   • Ask also for interval symptoms, e.g. symptoms at night (waking the patient), early in the morning, at rest during the day, during physical activity/sport.
   Note: Cough alone, in the absence of wheeze, is rarely asthma.
   Common triggers of asthma are:
   • Upper respiratory tract infections (URTIs).
   • Exercise.
   • Exposure to cold air.
   • Allergen exposure.

   Important clinical settings where asthma is more common:
   • Individuals with allergic disease (perennial rhinitis, hay fever, eczema).
   • First-degree relatives with asthma and/or atopic disease.
   There may be few physical findings between acute attacks. Undertreated or chronic asthma may be associated with:
   • Hyperinflation.
   • Chest wall abnormalities, e.g. pectus carinatum or flaring of the lower ribs (Harrison's sulci).
   • Expiratory wheeze (generalised).
   • Slowed growth parameters.
   • Side effects of medication (e.g. oral candidiasis in those taking inhaled steroids).

Keep in mind other diagnoses if there are atypical findings, such as digital clubbing (suppurative lung disease), tracheal shift (mediastinal mass) or localised wheeze (inhaled foreign body).
In most cases the diagnosis of asthma in children is a clinical diagnosis.

- Although wheezing is a cardinal feature of asthma, there are a number of other causes for wheeze. In particular, wheeze in young children is common and may be due to small airway calibre rather than asthma. Infant and preschool patterns of wheeze include transient early wheeze and viral-associated wheeze. Most children with these patterns have stopped wheezing by 6 years of age.
- The natural history for most children with intermittent (infrequent or frequent) asthma is that it will improve over time.
- The diagnosis of asthma is not always straightforward and a therapeutic trial of bronchodilator is sometimes required. In this case it is important that the treating doctor, referring doctor and family recognise that the trial of treatment does not lead to an inappropriate diagnostic label of asthma. An apparent response to therapy may be the natural course of the underlying disease as improvement occurs. An escalating requirement for treatment should trigger the need for reassessment (e.g. pneumothorax).