PedsCases Podcast Scripts

This is a text version of a podcast from Pedscases.com on "Evaluation of Stridor." These podcasts are designed to give medical students an overview of key topics in pediatrics. The audio versions are accessible on iTunes or at www.pedcases.com/podcasts.

Evaluation of Stridor

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Introduction

This is Dr. Melanie Lewis, a general Pediatrician at the Stollery Children's Hospital in Edmonton, Alberta, Canada. This podcast will be discussing 5 common causes of acute stridor, as well as the appropriate management for each cause.

Stridor is a very common presenting complaint in children. Although it is common, stridor scares patients, their families and healthcare personnel alike, as it can be the result of a condition that can be life threatening. The airway in children, especially young children, is small so any compromise in the diameter of that airway, such as with edema, a foreign body or purulent exudate can be dire. Prompt recognition of the underlying problem and treatment is crucial, and can mean the difference between life and death.

Stridor is the term used to describe the harsh, high-pitched sound of air passing through a partially obstructed airway. While it is most common during inspiration, stridor can also occur during expiration. It is important to recognize that the presence of stridor only indicates that the airway is obstructed and does not provide information regarding the underlying mechanism of airway obstruction.

The most common causes of acute stridor include: foreign body, anaphylaxis, epiglottitis, croup, and bacterial tracheitis.

Foreign Body

Foreign body inhalation is more common in younger children, but can present at any age. The ingested material lodges in the airway, thus obstructing the normal airflow path, leading to turbulent flow, and ultimately stridor, depending on the severity of the

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September 29, 2009

obstruction. Children who have an obstruction due to a foreign body also typically present with, or have a history of, coughing, gagging, drooling and wheeze.

It is important to keep foreign body inhalation, or aspiration, on a differential diagnosis, as it is often easily correctible if diagnosed. There are no physical exam findings that are diagnostic of foreign body inhalation, unless the ingested material can be visualized while examining the pharynx. In these children, it may be possible to remove the foreign body, however care must be taken not to stress the child, as it's possible to cause the foreign body to move further down the airway, and cause complete obstruction. In children where a foreign body is suspected, but cannot be seen directly, special X-ray views are required. This is due to the fact that upright, inspiratory views may be entirely normal; hence both inspiratory and expiratory films need to be ordered. And, if expiratory films are not possible due to the child's age or level of cooperation, lateral decubitous films may be substituted. If there is a foreign body in the right main-stem bronchus for instance, the upright PA view will likely be normal, and the expiratory film will show air trapping in the form of hyperinflation on the right side, in keeping with a ball-valve mechanism. Air can go in, as the airway expands on inspiration, but as the airway narrows on expiration, air gets trapped behind the foreign body. On decubitous views, normally the mediastinum shifts towards the dependent side. If there is a foreign body in the right main-stem, you will not see the shift due to the air trapping. If X-rays are negative, and there is still high clinical suspicion of a foreign body, you'll need to explore the airway directly via bronchoscopy under a general anesthetic.

Anaphylaxis

Another entity that should be considered when presented with acute stridor is Anaphylaxis. Anaphylactic reactions are classifieds as Type I hypersensitivity reaction between an antigen and IgE bound to mast cells in the body. This reaction causes mast cells to degranulate and release large amounts of histamine and other immunologically active agents throughout the body. The release of these chemicals stimulates eosinophils and neutrophils, resulting in systemic vasodilation, increased vascular permeability and smooth muscle spasms.

Most anaphylactic reactions occur as a result of a food or drug allergy, especially nuts, shellfish and antibiotics. When a child presents to an emergency department with anaphylaxis, their complaints are often systemic. They may include numbness of oral mucosa, flushing and pruritis of skin, urticaria, nausea and vomiting, shortness of breath, lightheadedness, stridor, cough, and tightness of the throat. Without proper treatment complete airway obstruction and hypotension can develop, which is potentially a lethal complication.

The presentation of anaphylaxis is usually readily apparent, as the presenting symptoms often occur within minutes of food consumption or another noteworthy event, such as a bee sting. In an atypical presentation, a child may present with stridor

as their prominent symptom. So at least consider anaphylaxis on your differential when acute stridor presents to your office or emergency department.

Epiglottitis

Epiglottitis is a bacterial infection of the epiglottis causing inflammation and edema of the epiglottis and surrounding structures. This inflammation leads to airway obstruction, which produces the stridor that is heard late in the disease presentation. The infection is usually due to *Streptococcus pneumoniae*, *Streptococus pyogenes* and *Staphylococcus aureus*. Prior to Haemophilus type B immunization, this was a common cause of epiglottitis. So in an unimmunized population, it should always be considered as a causative agent.

A child with epiglottitis usually presents to the emergency department with a sudden onset of a fever and a sore throat. Epiglottitis usually progresses quickly from this point, and the child usually looks increasingly unwell over the next one to two hours. As the inflammation of the airway ensues, breathing may become more difficult, and the child may extend their neck sub-consciously as method of maintaining a patent airway. The child will often have difficult swallowing, and as a result may be drooling. The classic picture of epiglottitis is an unwell child leaning forward in a tripod position, bracing their arms against their legs and drooling. As the airway obstruction progresses, the child will look increasingly cyanotic, and stridor may be heard. When a patient presents with suspected epiglottitis, care must be taken not to stress the child, as any amount of agitation can lead to complete airway obstruction. Treatment must begin immediately, as the airway may soon become completely obstructed leading to coma and death. Although not recommended in suspected epiglottitis, direct visualization of the upper airway will reveal a swollen and "cherry red" epiglottis.

Initial treatment of a patient presenting with airway obstructing epiglottitis is to establish an artificial airway in controlled setting, such as a surgical suite. Ideally, a physician skilled in airway management, such as an anesthetist or ENT surgeon would intubate the patient, and should accompany them at all times until the artificial airway is in place and the airway is secure. If there are no signs of obstruction in the patient, they can be closely observed in the intensive care environment, as any progression of airway obstruction must be treated quickly. Once an artificial airway has been established, intravenous access can be obtained, as well as a CBC and blood culture, which may help identify the causative agent. Treatment of epiglottitis should begin immediately after establishing an artificial airway and with broad-spectrum IV antibiotics. Corticosteroids can also be administered to control inflammation of the epiglottis and surrounding tissues. Treatment usually continues for 7-10 days. Direct visualization of the epiglottis 24-48 hours after initiation of treatment will help determine when it is appropriate to extubate the patient.

If a clinician is unsure of the diagnosis, a lateral neck X-ray may be of benefit, as epiglottitis usually shows an enlarged epiglottis that extends into the airway. This is classically referred to as the "Thumb Sign."

Croup

Croup is the most common cause of acute stridor in children. Croup is also known as laryngotracheobronchitis, and is usually caused by a viral infection of the larynx, trachea and occasionally the bronchioles, resulting is inflammation and edema of these subglottic structures. The parainfluenzae virus is responsible for most cases of Croup, however other viruses including the influenza virus, RSV, rhinovirus, and corona virus have also been implicated in causing this disease. Croup is most common in children between the ages of 6 months and 3 years, however it can occur in any age, and occurs most commonly during the late autumn and early winter months.

Clinically, the patient with croup will present with a 1-3 day history of low-grade fever, rhinorrhea, pharyngitis and cough. As inflammation of the larynx and trachea worsens, the cough will quickly progress into the characteristic seal like cough, along with hoarseness and stridor. The symptoms are usually described as being worse at night and may improve throughout the day. An increase in respiratory rate and an erythematous pharynx can also be found on physical exam, along with combination of symptoms noted in the history. The child generally does not appear toxic at any time, however, during the height of a fever, most children will appear quite unwell.

The obstruction of the subglottic structures results in poor air entry into the lungs, which is combated by generating extra force in the thorax. This force creates large negative pressures within the lungs, which are transmitted throughout the airway, and cause the supraglottic structures to collapse on inspiration. This collapse, along with the initial obstruction, creates turbulent airflow throughout the airway resulting in the seal like cough and inspiratory stridor.

The severity of croup is quite vast, and relates to the amount of airway obstruction. The Alberta Clinical Practice Guideline Working Group created 4 broad categories to aid clinicians in determining the severity. Mild croup presents with an occasional barky cough with no stridor at rest, and mild, if any, suprastemal or intercostal indrawing. Moderate croup presents with a frequent barky cough, audible stridor at rest, as well as suprasternal and sternal wall retraction at rest, but no or little distress or agitation. Severe croup presents with frequent barky cough, audible inspiratory stridor, occasional expiratory stridor, marked sternal wall retraction, as well as significant distress and agitation. Impending respiratory failure is the fourth category of croup and is characterized by a barky cough, audible stridor, sternal wall retraction, lethargy or decreased level of consciousness and occasionally a dusky appearance.

The diagnosis of croup is most often clinical and no other testing or imaging needs to be conducted. In cases that are not as clinically suggestive however, a lateral and

Anterior Posterior radiograph of the neck may prove useful in distinguishing croup from other causes of stridor. On AP radiograph, croup classically presents with the "steeple sign" due to the inflammation and edema of the subglottic structures. In these radiographs, the trachea narrows superiorly, creating the appearance of a point or steeple. Lateral X-rays will also help to distinguish croup from epiglottitis, bacterial tracheitis, and retropharyngeal abscess.

The management of croup depends on the severity of the presentation. All patients that present with croup receive a single dose of corticosteroids, regardless of the severity of their disease. One dose of oral dexamethasone is often sufficient to reduce symptoms of airway obstruction, and most children do not need subsequent doses. The benefits are generally seen after 4 hours after the dose is administered, and last for approximately 1 to 2 days. When impending respiratory failure is presumed however, a physician skilled in airway management must be consulted, as complete obstruction and hypoxia can arise quickly. Epinephrine should also be given to patients presenting with severe respiratory distress, via a nebulized dose, as it allows for immediate bronchodilation. Patients in respiratory distress will also benefit from the administration of oxygen delivered by blowing it in the vicinity of the nose and mouth. This method is preferred as other methods may agitate the child, thereby worsening the obstruction.

Regardless of the treatment given, the patient should remain in the emergency department for a minimum of three hours to ensure that the treatment is effective, and that the obstruction is not worsening. Patients with severe respiratory symptoms may warrant hospital admission for prolonged observation.

Bacterial Tracheitis

Bacterial tracheitis is caused by an acute bacterial infection of the trachea, resulting in a narrowing of the upper airway. Unlike epiglottitis however, bacterial tracheitis does not involve the epiglottis, only the structures of the trachea. Bacterial tracheitis is caused by a number of bacteria, including *Staphylococcus arueus*, *Streptococcus pyogenes, Streptococcus pneumoniae* and other Streptococcal species, as well as *Moracella catarrhalis* and *Haemophilus influenzae type B*. Other bacteria have been found to also cause bacterial tracheitis, however they are less common. This disease commonly occurs after a viral infection of the upper respiratory tract, and as such may be viewed as a bacterial complication of a viral infection rather than an independent infection.

Bacterial tracheitis most commonly affects children between the ages of 4 and 7 years, however it can occur anywhere between three weeks of age to 16 years. Once the bacteria has colonized the larynx and trachea, the mucosa of the upper airway becomes inflamed and edematous. Pseudomembranes begin to form, which are layers of thick, purulent secretions, as well as sloughed off epithelial cells. This process substantially reduces the diameter of the airway, thereby creating stridor, cough and

respiratory distress. The majority of swelling and inflammation in the airway occurs at the level of the cricoid cartilage, which is the narrowest part of the airway in pediatric patients.

A patient who presents with bacterial tracheitis will often appear toxic, and will likely be febrile, tachycardic, tachypnic, as well as have stridor and bark-like cough. Bacterial tracheitis shares some similarities with epiglottitis in the patient presentation, as they both have a fever and may be in respiratory distress. Unlike epiglottitis however, patients with bacterial tracheitis do not drool or complain of pharyngitis. Tracheitis can also easily be mistaken for croup, as both present with stridor and a barking cough, and the patients often endorse a preceding upper respiratory tract infection that worsened into the current symptoms. Because of these similarities, bacterial tracheitis is often treated as croup, and it is only after there is no response to the treatment of croup that tracheitis is diagnosed.

The definitive way to diagnose bacterial tracheitis is by laryngotracheobronchoscopy, whereby the trachea can be visualized and the secretions cultured. This can also be therapeutic, as it may remove some of the membranes that are obstructing the airway, resulting in a greater diameter for airflow. When a child presents with bacterial tracheitis, however, they may already be in respiratory distress and care must be taken not to agitate the child. Consultation of otolaryngologist or anesthetist for airway management in a controlled setting must be done urgently. During intubation, mucopurulent secretions and psuedomembranes may be visible, thereby providing a diagnosis of bacterial tracheitis.

For patients who do not present in respiratory distress, the diagnosis may not be made as easily, as patients may resemble croup due to the barky cough and preceding viral prodrome. These patients will not respond to oral dexamethasone, and their condition may worsen as they are observed in the emergency department, some requiring intubation, with frequent suctioning to ensure patency of the endotracheal tube.

Once the status of the airway has been established, the next step in treatment is to establish IV access and begin immediate antibiotic therapy. Cefuroxime is an appropriate initial therapy, however often other antibiotics are given in addition, such as clindamycin, and depend greatly on the prevalence of bacteria and drug resistance in any given area. Once treatment has started, it is often beneficial to obtain bacterial cultures from blood and tracheal secretions, as well as to obtain a Gram stain from the secretions in order to identify the causative agent. Antibiotics can then be given tailored towards the responsible bacteria and sensitivity pattern.

Roughly half of all patients with bacterial tracheitis require intubation, with most recovering from the disease if airway management and antibiotic administration occur promptly. Extubation usually occurs when the volume of secretions

suctioned from the trachea begin to decrease and the inflammation appears to be resolving. The patient must remain on a full course of antibiotics to ensure that the bacterial infection has been eliminated.

Take-home Points

This podcast has discussed the five most common causes of acute stridor in children. The take home points include:

1. Remember, this has been a review of acute causes of stridor, the most common cause of chronic or congenital stridor, which lasts for approximately the first 18 months of life, is laryngomalacia.
2. When confronted with an acute case of stridor, consider the full differential diagnosis, including the possibility of anaphylaxis. This is an entity that you do not want to miss and need to manage in a timely manner.
3. Do not lay a child down with a tenuous airway or try to directly visualize the airway. You may inadvertently cause the child to completely obstruct. Often when children are sent for lateral neck X-rays, they are laid down, hence the old adage "Death begins in radiology."
4. Sometimes even minimally invasive interventions such as removing a child from a parents lap may result in loss of a patent airway. Use your common sense. If croup is on the top of your differential, and the child is working hard to breath, keep the child with the parent,defer investigations and placement of monitoring devices and start with nebulized epinephrine.
5. Any entity that compromises a child's airway is frightening, not only to the child and parents, but the health care personnel. If you need more experienced help, get it sooner rather than later. Leave your ego at the door. Call your colleagues in anesthesia or ENT if you suspect a tenuous airway.

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