Differential Diagnosis of Stridor in Children

A young patient's noisy breathing may be due to a structural problem, an ingested foreign body, an abscess, or one of several types of acute infection. The authors explain where to look for key diagnostic clues and how to stabilize and manage the child's condition as needed in the meantime.

Leigh Spear, MD, and Sandra A. Deane, MD

Stridor is defined as noisy, vibratory breathing that signifies obstruction along the upper airway. It is a fairly common symptom in children presenting to the emergency department and is a symptom of both emergent and nonemergent conditions.

Urgent airway management may be required for a child who is in obvious distress, cyanotic, or poorly responsive. If the child is stable, a detailed history should be obtained. The age of the child and the duration of the stridor are the most important items in terms of narrowing the differential diagnosis. Other information includes the presence of cough, rhinorrhea, choking, or recent play with small objects that could indicate foreign body aspiration. The child should always remain with the parent and in a position of comfort while the history is obtained, as agitation may cause increased secretions and hypoxia.

Stridor can be evaluated in a number of ways. The presence or absence of fever has traditionally been used to identify infectious and noninfectious causes of stridor. It may also be useful to categorize stridor based on the age of the child. A young infant is more likely to have chronic stridor from a structural cause, such as congenital laryngomalacia or vocal cord pa-

Dr. Spear is a resident in the department of emergency medicine at Eastern Virginia Medical School in Norfolk. **Dr. Deane** is an assistant professor and an assistant residency director in the department of emergency medicine at Eastern Virginia Medical School.

ralysis, that has been present for weeks to months. In children aged 6 months and older, stridor usually has an acute presentation. Etiologies include viral croup, foreign body aspiration, peritonsillar or retropharyngeal abscess, epiglottitis, and bacterial tracheitis.

STRUCTURAL CAUSES

Laryngomalacia is the most common cause of stridor in neonates (babies less than 29 days old). Boys are disproportionately affected. It is the result of a structurally weak larynx that obstructs during inspiration. The obstruction may worsen with supine positioning, neck flexion, or upper respiratory infection.[1] This disorder is usually not associated with feeding problems, respiratory distress, or failure to thrive. These children should be referred for fiberoptic laryngoscopy, which will confirm the diagnosis. Nearly all cases will resolve without intervention within 2 years.[2] The more caudal airway is less commonly affected (laryngotracheomalacia or tracheomalacia).

Vocal cord paralysis or paresis is usually encountered in neonates. Causes include birth trauma (from forceps), shoulder dystocia, or macrosomia. Fiberoptic laryngoscopy will confirm the diagnosis. In an unstable child who requires endotracheal intubation, a "difficult airway" should be anticipated.[3] The physician should be prepared to perform a needle cricothyroidotomy in the event that the patient cannot be intubated or ventilated. If bilateral vocal cord paralysis is evident on direct laryngoscopy, gently rotating the endotracheal tube may help pass it thorough the cords. Attempts to use a supraglottic rescue device such as the laryngeal mask airway will probably be unsuccessful because of the increased airway resistance.

VIRAL LARYNGOTRACHEOBRONCHITIS (CROUP)

The most common cause of acute stridor in childhood is croup, almost exclusively caused by viruses (parainfluenza, influenza, respiratory syncytial virus, rhinovirus).[4] Rarely seen in infants younger than 6 months, croup reaches its peak incidence during the second year of life.[5] By about 6 years of age, a child's airway is similar to that of an adult, and the effect of mucosal edema becomes negligible. It is therefore unusual for children to manifest stridor after about age 6 unless they have abnormal airway anatomy. Generally, children experience a prodromal upper respiratory infection with low-grade fever for several days before the onset of the barking cough.[6] Symptoms are usually worse at night and with agitation, with the inspiratory component of the stridor predominating. Intercostal retractions, tachypnea, and hoarseness are common. In more distal inflammation, wheezing or crackles may be present. The virus continues to shed for about 2 weeks and symptoms may not clear completely for a month or more.

Croup is diagnosed clinically, with radiographic assessment undertaken only if other causes are being considered. Lateral neck films may be indicated if there is concern for fixed obstruction or abscess. A chest film will be helpful if pneumonia or aspiration of a radiopaque foreign body is a consideration. The classic radiographic "steeple sign" of the trachea in croup may be seen on a chest film, but this finding is unreliable in both diagnosing and excluding croup.

Humidified oxygen, such as steam from a shower, has been used by parents for years and has traditionally been employed in the emergency department as well. No data have shown this practice to be effective, and the "croup tent" used to administer the mist may actually interfere with close observation of the patient.

Dexamethasone is the mainstay of croup treatment and is the steroid of choice due to its long half-life and potent anti-inflammatory effect. Some authors have found that a single dose of dexamethasone benefits all but the mildest cases of croup.[7] The route of administration does not matter, but the oral form is poorly tolerated due to the taste. Therefore, intramuscular or intravenous dosing may be preferred. The common dosage for any route of dexamethasone is 0.6 mg/kg; a few recent studies have found that a smaller dose of 0.15 mg/kg is equally efficacious.[8,9] Our clinical experience has shown that the intravenous formulation is actually better tolerated as an oral medication than the oral formulation because its higher concentration (10 mg/mL) allows a smaller volume of solution to be administered per dose.

>>FAST TRACK<<

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Treatment of croup with steroids is associated with decreased rates of intubation, hospital admission, and absence from school or day care.[10]

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Additionally, some studies have shown that steroids also decrease time spent in the emergency department for observation.[11] Antibiotics are not indicated in croup.

Racemic epinephrine prepared as 0.5 mL in 4 mL of normal saline may be added to the steroid regimen in moderate to severe croup.[4] Standard 1:1000 epinephrine may also be given via nebulizer in a dose of 1 mL epinephrine diluted in 3 to 5 mL of normal saline. The effects of epinephrine only last about 2 hours, so children should be observed for at least that long prior to discharge.

Children who are stridor-free 2 hours after their last dose of medication may be discharged with 24-hour follow-up. A child with respiratory distress (resting stridor, increased P_{CO_2}, decreased P_{O_2}, altered mental status) despite treatment with epinephrine and dexamethasone needs aggressive airway management. Inhaled heliox may be considered as a temporizing measure prior to intubation. When preparing to intubate, select an endotracheal tube that is 0.5 mm smaller than the predicted size for easier passage through the narrowed trachea.

FOREIGN BODY ASPIRATION

Stridor due to aspiration of a foreign body is most common in children aged 1 to 3 years. Usually the object is food or a small toy. Food particles are especially concerning as they may lead to pneumonitis or pneumonia. Parents may recall a recent choking episode, persistent asthma or croup symptoms, or the child complaining of throat pain.[1]

There may be a paucity of physical examination findings other than barking cough or wheezing. Plain films may reveal a radiopaque foreign body or segmental atelectasis. The involved lung may be hyperinflated due to the ball-valve effect of the foreign body.

>>FAST TRACK<<

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Complete obstruction should be treated with back blows in a child aged less than 1 year and abdominal thrusts in an older child. In a more stable child, provide supplemental oxygen and consult a physician skilled in laryngoscopy and bronchoscopy for removal of the foreign body.

Esophageal foreign bodies may also cause stridor. In these cases the child will often complain of dys-

Courtesy of Chris Jones, MD

FIGURE 1. Coin in the Esophagus. In the lateral view, coins appear on end (sagittal plane) when located in the esophagus versus en face (coronal plane) when in the trachea.

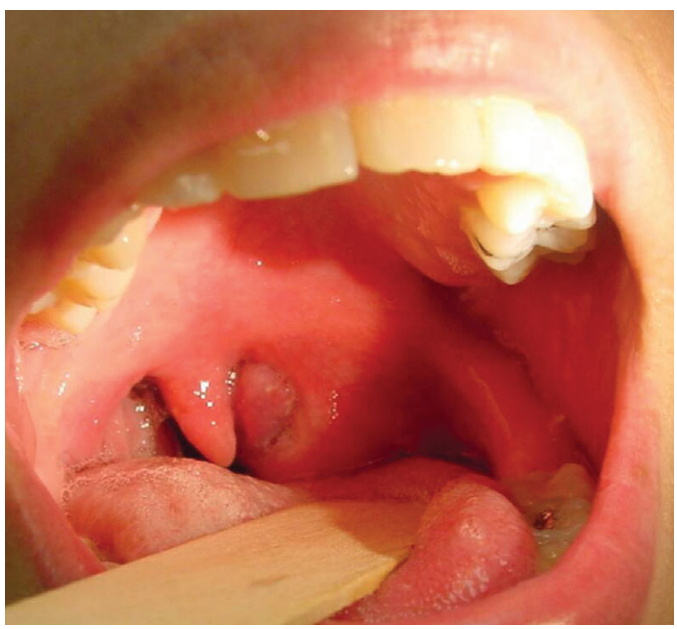

Photo courtesy of Bechara Y. Ghorayeb, MD/Otolaryngology Houston (ghorayeb.com)

FIGURE 2. Visualizing the Oral Cavity. This examination in a young patient with stridor can cause pain if the stridor is due to peritonsillar abscess, as seen here at an early stage. Swelling and erythema above the left tonsil as well as slight swelling of the uvula are apparent.

phagia or avoid swallowing. While some objects, such as coins, can be visualized on plain imaging, a negative film does not rule out a foreign body and a specialist should be consulted for endoscopy. A coin in the trachea will be seen on its edge in an anteroposterior view. In the esophagus, it will generally appear as a full circle (en face) in an anteroposterior oblique view.[12] For the lateral view, it is just the opposite, as seen in Figure 1.

ABSCESSES

Peritonsillar abscess is most common in adolescents with pharyngitis. Affected children often present with fever, chills, trismus, and a hoarse or muffled voice. There may be varying degrees of stridor, torticollis, or ear pain.

The oral cavity must be visualized (Figure 2), which can be challenging because of the child's pain and hesitation. Usually, bilateral tonsillar erythema and exudate will be present and one tonsil will be anteriorly and medially displaced. Localized fluctuance may be palpable. Imaging via CT or ultrasound may be needed to distinguish abscess from peritonsillar cellulitis.

>>FAST TRACK<<

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Clindamycin, penicillin, or a macrolide antibiotic is always indicated. Most abscesses can be treated on an outpatient basis with needle aspiration, antibiotics, and pain control.[3] In a cooperative child, needle aspiration may be undertaken by either the emergency physician or a consulting specialist. Some children may need incision and drainage in the operating room.

Retropharyngeal abscess is a deep space neck infection most commonly seen in infants and children up to age 4 years.[12] Infections are spread to this space by lymphatic drainage of the retropharyngeal lymph nodes. This chain

of lymph nodes is usually obliterated by the time a child reaches school age, so retropharyngeal abscess is not generally encountered in adolescents and adults. Most cases of retropharyngeal abscess are the result of a minor upper respiratory infection or local trauma to the area due to causes such as falling with a sharp object in the mouth.

Some children will complain of sore throat. There may be decreased oral intake, fever, and dysphagia. Varying degrees of stridor, drooling, meningismus, and hyperextension of the neck may be present. The study of choice for evaluating retropharyngeal abscess is a CT scan, although soft tissue lateral neck films may reveal a widened retropharyngeal space.[13]

Antibiotics alone are indicated only for very small localized abscesses and cellulitis. All other cases require formal incision and drainage by an otolaryngologist. Antibiotics should cover *Staphylococcus* and *Streptococcus* species and possibly anaerobes. Methicillin-resistant *Staphylococcus aureus* (MRSA) is an emerging concern for retropharyngeal abscess. Clindamycin, co-trimoxazole, and vancomycin all will cover most MRSA infections. If MRSA is not a concern, other reasonable choices include penicillin G and ampicillin/sulbactam.

EPIGLOTTITIS

Epiglottitis is a relatively rare but serious cause of stridor in a child. Historically, most cases in children were caused by *Haemophilus influenzae*. Since this pathogen has been nearly eradicated with the Hib vaccine, gram-positive organisms (*Streptococcus pyogenes*, *S aureus*, *Streptococcus pneumoniae*) are usually responsible for epiglottitis in immunized children today. In immunocompromised children, the etiology may also include herpes simplex virus, candida, and varicella. Epiglottitis historically peaked at 3 years of age in children, but its presentation has shifted to older children and adults more recently.[12]

>>FAST TRACK<<

Children with bacterial tracheitis usually appear toxic with marked respiratory distress.

The child with epiglottitis classically appears toxic with high fever, drooling, sore throat, muffled voice, and a tripod posture (a "sniffing" position with tongue protruding). There generally is not an associated cough, although stridor may be present. The pitch of the voice may be changed if the vocal cords are also inflamed. There will likely be tenderness with gentle movement of the hyoid. Visualization of a red and swollen epiglottis (in a controlled environment) confirms the diagnosis.[1]

Lateral neck x-rays (to evaluate for a swollen epiglottis) are unnecessary if the diagnosis is apparent. If the diagnosis is unclear and the child is stable with a protected airway, a physician should accompany the child to radiology. An adequate film should be taken during inspiration with an extended neck.

In addition to antibiotics and establishment of a definitive airway, there are some temporizing measures that may be taken prior to intubation. Nebulized racemic epinephrine should be considered to decrease airway edema. Additionally, a trial of heliox may help avoid intubation by increasing laminar air flow. The choice of antibiotics should cover both *H influenzae* and streptococci. A good combination is a second- or third-generation cephalosporin plus vancomycin or nafcillin. Blood cultures should be obtained.

BACTERIAL TRACHEITIS

Rarely, in children younger than 3 years of age, stridor may be provoked by bacterial infection of the trachea, usually with *H influenzae* or *Staphylococcus* species. These infections cause life-threatening constriction of the narrow airway at the level of the cricoid cartilage. Bacterial tracheitis may present with a croup-like cough but does not respond to standard croup treatment.

Children with bacterial tracheitis usually appear toxic with marked respiratory distress. Less frequently, the presentation may be subacute, with several days of croup-like symptoms.[1] The history may reveal a prodromal upper respiratory infection. Inspiratory stridor with varying degrees of expiratory stridor, hoarseness, sore throat, and barking cough is usually present. A high level of suspicion is warranted because the only way to definitively make the diagnosis is with direct laryngotracheobronchoscopy, and a practitioner with expertise in this procedure may not be readily available. A plain film is not necessary, although it may reveal nonspecific subglottic narrowing.

A definitive airway should be established if the child is unstable. A small endotracheal tube will minimize trauma to the inflamed airway. More than half of patients eventually require intubation. Antibiotics

should include vancomycin (to cover MRSA) plus clindamycin or a third-generation cephalosporin.

KEYS TO THE APPROACH

Stridor is common in the emergency department, and most causes are not life-threatening. However, the emergency physician should always consider serious causes of stridor, such as epiglottitis, tracheitis, and foreign body aspiration, before settling on the much more common diagnosis of croup.[3]

If only two additional pieces of data can be obtained, the child's age at onset of the stridor and the chronicity of the stridor are the most helpful. Stridor in a newborn or young infant is more likely due to a congenital problem. An older child (aged 1 to 4 years) is more likely to have an infectious cause of stridor or a foreign body aspiration. Usually, acute causes of stridor are infectious (croup as well as more serious bacterial infections) whereas chronic stridor tends to be anatomic. As always, the emergency physician must be skilled in emergent airway assessment and prepared to intervene, although very few children with stridor will require endotracheal intubation or a surgical airway. □

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