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Emergency evaluation of acute upper airway obstruction in children

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Contributor Disclosures
All topics are updated as new evidence becomes available and our peer review process is complete.
Literature review current through: **Mar 2020. |** This topic last updated: **Jun 20, 2019.**

INTRODUCTION

This topic will review an emergency diagnostic and therapeutic approach to acute upper airway obstruction in children. The emergent evaluation of children with acute respiratory distress and airway management techniques for the difficult pediatric airway are discussed separately.

- (See "Acute respiratory distress in children: Emergency evaluation and initial stabilization".)
- (See "The difficult pediatric airway".)
- (See "Devices for difficult endotracheal intubation in children".)
- (See "Emergency rescue devices for difficult pediatric airway management".)

CAUSES

Any condition that causes upper airway obstruction can be life-threatening (table 1). Patients with an upper airway foreign body (FB), smoke inhalation, laryngotracheal injury, and epiglottitis (infectious, thermal, or chemical) are at particular risk for sudden decompensation and also frequently require emergency airway intervention.

The discussion will emphasize causes that can result in acute, severe, and rapidly progressive symptoms. The causes of hoarseness, and the assessment of stridor are discussed elsewhere. (See "Hoarseness in children: Evaluation" and "Assessment of stridor in children".)

Infection — Most infectious processes that affect the upper airway cause a gradual onset of symptoms such as cough, change in voice, and difficulty swallowing. Infection directly involving structures of the upper airway, such as the epiglottis, larynx, or subglottic trachea, can cause sudden, life-threatening symptoms.

The most common infections that may impinge on the airway include:

Croup — Croup, also known as laryngitis, laryngotracheitis, and laryngotracheobronchitis, is the most common infectious cause of upper airway obstruction in children 6 to 36 months of age. Spasmodic croup causes symptoms that are the same as those of laryngotracheitis, but without signs of infection. There may be an allergic component to spasmodic croup.

Croup cause inflammation of the subglottic trachea that results in cough, hoarseness, stridor, and respiratory distress. The severity of the distress depends upon the degree of obstruction. The diagnosis usually can be made based upon a characteristic "barking" cough with hoarseness. If performed, radiographs have characteristic findings of subglottic haziness (image 1), a narrowing of the superior trachea ("steeple sign" (image 2)), and a normal epiglottitis. The evaluation and management of croup is discussed separately. (See "Croup: Clinical features, evaluation, and diagnosis", section on 'Clinical presentation' and "Management of croup".)

Bacterial tracheitis — Bacterial tracheitis may be a complication of viral laryngotracheitis or a primary bacterial infection. Children are generally older than those with croup, have more severe symptoms, and are highly febrile. Radiographs may show an intraluminal tracheal membrane or tracheal wall irregularity (scalloping) (image 3). (See "Bacterial tracheitis in children: Clinical features and diagnosis".)

Most children with bacterial tracheitis warrant emergency endoscopy and endotracheal intubation. (See "Bacterial tracheitis in children: Treatment and prevention", section on 'Ongoing assessment of the airway'.)

Retropharyngeal abscess — Retropharyngeal abscess most commonly affects young children two to four years of age. Prominent presenting complaints are usually fever, neck pain, neck stiffness, and sore throat rather than acute, severe airway obstruction. A lateral radiograph can help differentiate retropharyngeal abscess from other infectious causes of upper airway obstruction (image 4). However, computed tomography (CT) of the neck with intravenous contrast is required to definitively make the diagnosis. (See "Retropharyngeal infections in children", section on 'Evaluation and diagnosis'.)

Rarely, a retropharyngeal abscess may extrinsically compress structures in the upper airway. These patients require definitive airway management before diagnostic imaging.

Peritonsillar abscess — Peritonsillar abscess (PTA) is a collection of pus located between the capsule of the palatine tonsil and the pharyngeal muscles. It generally occurs in later childhood and adolescence.

The typical clinical presentation of PTA is a severe sore throat (usually unilateral), fever, and a "hot potato" or muffled voice. Pooling of saliva or drooling may be present. Trismus, related to irritation and reflex spasm of the internal pterygoid

muscle, occurs in nearly two-thirds of patients; the sudden onset of severe respiratory distress or significant airway obstruction is rare.

The diagnosis of PTA can usually be made clinically without laboratory data or imaging of any kind in the patient with medial displacement of the tonsil and deviation of the uvula (picture 1). (See "Peritonsillar cellulitis and abscess", section on 'Evaluation' and "Peritonsillar cellulitis and abscess", section on 'Management'.)

Infectious mononucleosis — Infectious mononucleosis (IM) is the best known acute clinical manifestation of Epstein-Barr virus infection. IM often begins with malaise, headache, and low-grade fever before development of the more specific signs of tonsillitis and/or pharyngitis, cervical lymph node enlargement and tenderness, and moderate to high fever. Affected patients usually have peripheral blood lymphocytosis, composed in large measure of atypical lymphocytes.

The lymphadenopathy characteristically is symmetric and involves the posterior cervical chain more than the anterior chain. Tonsillar exudate is a frequent component of the pharyngitis; the exudate can have a white, gray-green, or necrotic appearance. Obstruction of the upper airway due to massive tonsillar enlargement and mucosal edema is an uncommon but potentially fatal complication of infectious mononucleosis [1]. (See "Clinical manifestations and treatment of Epstein-Barr virus infection".)

Epiglottitis — Although much less common in the post-conjugate vaccine era, epiglottitis (supraglottitis) is a life-threatening bacterial infection characterized by rapidly progressive inflammation of and around the epiglottis. Common symptoms of upper airway compromise include acute respiratory distress with the child preferring an upright posture with the head in a sniffing position (picture 2), dysphagia, muffled voice, and difficulty handling oral secretions. In children, risk factors include incomplete or lack of immunization to *Haemophilus influenzae*, type b or immune deficiency. (See "Epiglottitis (supraglottitis): Clinical features and diagnosis".)

A rapid overview provides key clinical findings and immediate management for patients with epiglottitis (table 2). An algorithm provides the diagnostic approach to epiglottitis (algorithm 1) and specific steps in acute airway management (algorithm 2). (See "Epiglottitis (supraglottitis): Management".)

Foreign body — Small children often choke on food or small objects and usually clear the obstruction spontaneously with coughing and choking. In a retrospective report, the majority of prehospital calls for airway obstruction in children less than 5 years of age were caused by a foreign object [2]. Symptoms resolved in more than half of children prior to the arrival of paramedics. An intervention was required in 2 percent of cases.

Clinical manifestations vary by the location of the FB:

- **Airway FB** – Most aspirated objects lodge in the bronchi and are not immediately life-threatening. Although rare, FBs in the larynx or trachea can cause significant complete or partial airway obstruction that requires immediate treatment. These patients may have a history of choking and present with signs of severe airway obstruction (marked suprasternal retractions, stridor, and anxious appearance) typically without fever. (See "Airway foreign bodies in children", section on 'Signs and symptoms'.)
If a child presents with **complete** airway obstruction (ie, is unable to speak or cough), dislodgement using back blows and chest compressions in infants, and the Heimlich maneuver in older children, should be attempted (algorithm 3). By contrast, these interventions should be **avoided** in children who are able to speak or cough since they may convert a partial to a complete obstruction. For the same reason "blind" sweeping of the mouth and oropharynx should **not** be performed. (See "Airway foreign bodies in children", section on 'Management'.)
For patients with suspected FB aspiration who are symptomatic but stable, the first step in the evaluation is to perform plain radiography of the chest (algorithm 4). Ideally, both inspiratory and expiratory radiographs (eg. lateral decubitus films) should be obtained, if this is possible, because this may increase the sensitivity for detecting a radiolucent FB. Subsequent steps depend on the degree of clinical suspicion for FBs, and may include CT or bronchoscopy. Normal radiographic studies do not exclude the presence of an aspirated FB. (See "Airway foreign bodies in children", section on 'Evaluation' and "Airway foreign bodies in children", section on 'Management'.)
- **Esophageal FB** – FBs lodged in the esophagus in the area of the cricoid cartilage or the tracheal bifurcation can compress the airway causing partial airway obstruction (figure 1). It is also possible that an esophageal FB will become dislodged into the upper airway. Eliciting a history of choking in a child with characteristic findings of dysphagia, drooling, and respiratory distress are the keystones in diagnosing an esophageal FB and to the prevention of its complications. Imaging can be used to confirm the findings and to localize the site of the FB (image 5). The diagnostic steps and treatment depend on the patient's symptoms, the shape and location of the FB, whether it is radio-opaque, or whether it has magnetic properties (algorithm 5 and algorithm 6). (See "Foreign bodies of the esophagus and gastrointestinal tract in children".)

Trauma

Blunt or penetrating airway injury — Serious airway trauma is rare in children and requires rapid assessment and management of the airway similar to the approach in adults (algorithm 7). (See "Emergency airway management in the adult with direct airway trauma", section on 'Airway assessment' and "Emergency airway management in the adult with direct airway trauma", section on 'Management'.)

Blunt or penetrating injury to various anatomic structures may result in upper airway obstruction:

- Traumatic injury to the face or neck may cause soft tissue swelling or hemorrhage, leading to airway compromise.
- Blunt or penetrating trauma directly to the larynx or subglottic trachea may result in dyspnea, altered phonation, bruising and swelling of the neck, and/or subcutaneous emphysema [3]. Other signs of significant airway trauma include hemoptysis, dysphagia, and cough.
- Injury to the epiglottis (eg, aggressive blind finger sweeps for an FB) can cause swelling and upper airway obstruction with a clinical presentation indistinguishable from infectious epiglottitis [4].

Injuries sustained from direct trauma to the airway are often dynamic and conditions can deteriorate quickly. Because of the higher likelihood that bronchoscopic intubation or emergency tracheostomy may be necessary, emergency consultation with an otolaryngologist and anesthesiologist should occur [3]. It is best to secure the airway early whenever signs of active or impending obstruction are identified or there is doubt about the extent of the injuries or their likely course.

Upper airway burns (thermal and chemical) — A history of exposure to high heat in a closed space, facial burns, or singed facial hairs should alert the practitioner to the possibility of thermal injuries to the upper airway. Although there may be no initial airway compromise, edema can rapidly progress. Thus, timely endotracheal intubation before the development of edema is advisable. (See "Moderate and severe thermal burns in children: Emergency management", section on 'Initial management decisions'.)

Thermal injury to the epiglottitis, usually from hot beverages, has been reported [4]. Thermal injury below the vocal cords is unlikely due to the cooling efficiency of the upper airways [5]. Burns following ingestion of caustic liquids or solids have also been associated with chemical burns of the epiglottis. (See "Caustic esophageal injury in children", section on 'Airway injury'.)

The airway management of thermal or caustic epiglottitis is the same as for infectious epiglottitis and requires prompt airway management (table 2 and algorithm 1). (See "Epiglottitis (supraglottitis): Management", section on 'Approach to airway management'.)

Anaphylaxis — Anaphylactic reactions may be severe and life-threatening when edema involves the retropharynx and/or larynx. Onset of symptoms is usually sudden, and there may be associated signs such as urticaria and facial swelling. Emergency treatment requires timely administration of intramuscular epinephrine and can be life-saving (table 3).

Patients whose symptoms do not improve or worsen despite treatment with epinephrine require definitive airway management (algorithm 8).

Hereditary angioedema — Laryngeal edema with or without swelling of the lips, tongue, uvula, and soft palate occurs in approximately one-half of all patients with

hereditary angioedema at some point during their lifetime. Many patients present in childhood or adolescence. Tooth extraction and oral surgery are common triggers for laryngeal attacks which present with progressive airway obstruction that is often associated with lip and oral swelling. (See "Hereditary angioedema: Epidemiology, clinical manifestations, exacerbating factors, and prognosis".)

Hereditary angioedema should be suspected in patients with progressive upper airway edema that is not responsive to intramuscular epinephrine. Assessment and protection of the upper airway is the first and most important management issue in the patient with an acute attack involving any part of the airway, because none of the available therapies (table 4), including first-line agents, can be considered universally effective in all cases. In addition, these agents take time to work and the patient's airway must be protected in the interim. (See "Hereditary angioedema: Acute treatment of angioedema attacks", section on 'Laryngeal attacks'.)

Laryngospasm — Laryngospasm is an acute manifestation of vocal cord dysfunction that is usually precipitated by irritation of the vocal cords (eg, aspiration during sedation). The vocal cords become tightly opposed and cause complete upper airway obstruction. Hypocalcemic tetany is also a rare cause of laryngospasm. (See "Clinical manifestations of hypocalcemia", section on 'Tetany'.)

Management of laryngospasm should start with application of continuous positive pressure (CPAP) using a bag valve mask. Rapid sequence intubation should be performed if the laryngospasm does not rapidly resolve with CPAP.
(See "Anesthesia for the child with a recent upper respiratory infection", section on 'Treatment'.)

Decreased oropharyngeal muscle tone — The tongue can fall back into the pharynx and obstruct the airway in children with decreased oropharyngeal muscle tone as can occur with depressed levels of consciousness or neuromuscular disease (eg, cerebral palsy, congenital myopathies, or cranial neuropathy). Simply repositioning the airway may relieve the obstruction. Persistent obstruction may be treated with a nasopharyngeal airway in the conscious or semiconscious patient. (See "Basic airway management in children".)

Airway secretions or bleeding — Oropharyngeal or nasopharyngeal bleeding and secretions can cause significant upper airway obstruction in children. Superficial suctioning of the naso- and oropharynx and, as needed, control of bleeding resolves the obstruction. However, the physician should be careful to not perform orotracheal suction children with underlying conditions (eg, epiglottitis or an upper airway FB) where excessive oro- or nasopharyngeal stimulation may cause abrupt and complete airway obstruction.

Examples of conditions where suctioning is indicated include:

- Infants younger than six months of age who are obligate nasal breathers and who are at particular risk for significant airway obstruction caused by nasal

secretions secondary to a viral process (eg, viral upper respiratory infection [URI]).

- Patients with a chronic upper airway obstruction exacerbated by excessive airway secretions due to a viral URI. (See 'Acute on chronic conditions' below.)
- Children exposed to organophosphates or other cholinergic agents. In these patients, suctioning should be augmented by atropine administration. The recognition and management of organophosphate poisoning is discussed separately. (See "Organophosphate and carbamate poisoning", section on 'Clinical features' and "Organophosphate and carbamate poisoning", section on 'Cholinergic toxicity'.)
- Children with posterior arterial epistaxis (rare) or oropharyngeal trauma with bleeding; management consists of suctioning and rapid hemorrhage control. Posterior epistaxis requires advanced techniques to tamponade bleeding in the posterior nasopharynx. (See "Management of epistaxis in children", section on 'Advanced techniques'.)

Vocal cord dysfunction — Vocal cord dysfunction (VCD) may be caused by injury to the recurrent laryngeal nerve (eg, after thoracotomy), brainstem abnormality or injury, or paradoxical vocal fold movement. The anatomy and physiology of vocal cord function are discussed extensively elsewhere. (See "Hoarseness in children: Evaluation".)

The symptoms of VCD are usually chronic. The acute onset or worsening of stridor in patients with VCD can be alarming and may be a clue to a more serious and possibly progressive problem. This is particularly true when the VCD is due to a lesion in the brainstem. As an example, VCD can occur in children with Chiari II malformations and may warrant neurosurgical intervention.

Involuntary vocal cord adduction during inspiration has been described in children and adolescents and is called paradoxical vocal fold movement. Significant findings of upper airway obstruction may occur. However, endotracheal intubation, cricothyrotomy, or tracheostomy is not an appropriate treatment for this condition. (See "Inducible laryngeal obstruction (paradoxical vocal fold motion)", section on 'Acute management'.)

Acute on chronic conditions — Children who have chronic narrowing of the upper airway, either congenital (table 5) or acquired, can develop critical obstruction with an acute illness (eg, croup) or injury that affects the upper airway. As an example, a child with mild stridor as the result of a laryngeal web may develop severe obstruction with a URI. Similarly, mild upper airway obstruction as the result of extrinsic compression of the trachea from a neoplasm can become acutely life-threatening if bleeding into the tumor causes it to suddenly expand.

Most children with chronic causes of upper airway obstruction (eg, tracheomalacia) become symptomatic gradually, usually in early infancy. Some conditions, such as lymphatic malformations, may become evident at an older age, in association with infection or, occasionally, trauma [6]. Severe, recurrent croup may be an indicator of an underlying airway abnormality that warrants diagnostic investigation.

Congenital anomalies affecting the airway are discussed in detail elsewhere. (See "Congenital anomalies of the jaw, mouth, oral cavity, and pharynx" and "Congenital anomalies of the larynx" and "Congenital anomalies of the intrathoracic airways and tracheoesophageal fistula".)

EMERGENCY AIRWAY ASSESSMENT AND MANAGEMENT

Rapid assessment of the airway and breathing — The initial evaluation of children with acute upper airway obstruction begins with a rapid assessment of airway patency and respiratory status to identify those who need emergency airway management [7]. Throughout this evaluation, every reasonable effort must be made to keep the child calm and comfortable because anxiety and crying can substantially increase airway obstruction and the work of breathing in young children [7].

The clinician should focus upon signs of airway obstruction and respiratory failure:

- **Upper airway obstruction** – The degree of obstruction can be estimated based upon physical findings:
  - **Mild** – Mild obstruction presents with the following findings:
    - Ability to speak (voice may be hoarse) or hoarse cry
    - Good air entry
    - Inspiratory stridor (may only be heard with crying, agitation, excitement, or tachypnea) or occasional snoring (stertor)
    - Minimal or no suprasternal retractions and no flaring or grunting
  - **Moderate to severe** – Moderate obstruction is characterized by:
    - Tachypnea
    - Audible inspiratory stridor (and possibly expiratory stridor) with every breath
    - Prolonged inspiratory time with signs of significant effort (suprasternal retractions, nasal flaring, or grunting)
    - Decreased air entry

    Hypoxemia (pulse oximetry <91 percent or poor color), the presence of "sniffing" (picture 2) or "tripod" (picture 3) positions taken to maintain an open airway, and/or decreased mental status suggest that the obstruction is severe and that emergency airway management is needed.
  - **Complete** – With severe or complete upper airway obstruction, there is markedly reduced or no effective air movement; the child is struggling to

breathe with signs of severe respiratory distress (nasal flaring, grunting, and/or marked suprasternal or supraclavicular retractions), and may be silently gagging or coughing in an attempt to clear the airway. If the obstruction is not relieved, the child's condition can rapidly deteriorate, with loss of consciousness. (See 'Severe or complete obstruction' below.)

- **Respiratory failure** – Children with respiratory failure caused by upper airway obstruction have developed inadequate oxygenation, inadequate ventilation, or both. The following clinical features indicate respiratory failure [7]:
  - Poor color (ashen or centrally cyanotic)
  - Obtunded mental status
  - Decreased chest wall movement, with or without signs of respiratory distress
  - Bradypnea or marked tachypnea

As respiratory failure progresses, the child's respiratory rate often decreases and the pattern of respirations becomes irregular. Without intervention, respiratory arrest quickly develops.

It is often impractical to initially measure pulse oximetry in an anxious child with respiratory distress. Poor color and decreased mental status are indications of hypoxemia in this situation.

Emergency airway management

Severe or complete obstruction — With severe or complete upper airway obstruction, there is markedly reduced or no effective air movement; the child is struggling to breathe with signs of severe respiratory distress (nasal flaring, grunting, and/or marked suprasternal or supraclavicular retractions), and may be silently gagging or coughing in an attempt to clear the airway. If the obstruction is not relieved, the child's condition can rapidly deteriorate, with loss of consciousness.

These patients require emergency airway management by the most experienced physician available. Whenever possible, an anesthesiologist and otolaryngologist should be emergently called to assist with securing the airway.

Suspected foreign body — The management of a child with severe or complete obstruction due to a suspected foreign body (FB) is provided in the algorithm (algorithm 3).

An obstructing upper airway FB may be suspected based upon the history of a witnessed ingestion, history of a sudden onset of symptoms in a previously well child without signs of an allergic reaction, or visualization of the FB in the oropharynx or on plain radiographs although many FBs are not radiopaque.

Basic life-saving maneuvers for FB airway obstruction should be initiated based upon cadaver studies and extensive experience and as recommended by the American Heart Association [7,8].

The approach varies by degree of responsiveness:

- Responsive patients:
  - Infants younger than 1 year of age – Five back slaps are delivered with the infant held in a head down position, followed by five chest thrusts. Abdominal thrusts are **not** recommended for infants less than 1 year of age because they may cause damage to the liver, which is relatively large and unprotected in this age group.
  - Children ≥1 year of age – Five abdominal thrusts (Heimlich maneuver) should be performed.

  After each round of back slaps and chest thrusts or abdominal thrusts, check to see if the airway obstruction is relieved.
- Unresponsive patients: Initiate cardiopulmonary resuscitation (CPR) beginning with compressions (algorithm 9 and algorithm 10). (See "Pediatric basic life support for health care providers", section on 'Basic life support algorithms'.)

  Prior to each attempt at ventilation, open the airway and look for and remove any obstructing airway. Do **not** perform a blind finger sweep.

  If the obstruction is relieved and the child resumes adequate breathing, the physician should ensure that the FB is completely removed and observe the patient for signs of postobstructive pulmonary edema (eg, hypoxemia by pulse oximetry, tachypnea, rales, and/or pulmonary edema on chest radiograph).

If the obstruction is relieved but the child does not resume adequate breathing, initiate bag-mask ventilation and prepare for endotracheal intubation by rapid sequence intubation (table 6). (See "Rapid sequence intubation (RSI) outside the operating room in children: Approach", section on 'Approach' and "Emergency endotracheal intubation in children".)

If the obstruction is **not** relieved within 1 minute, then direct laryngoscopy should be performed to determine if the FB can be visualized and removed by Magill forceps or suction. If successful, proceed with airway management according to whether the child recovers with adequate breathing or not as described above.

If the airway obstruction remains, further care is determined by the location of the FB:

- **Obstructing FB above the vocal cords** – When an FB causing complete airway obstruction above the vocal cords cannot be removed, the patient should undergo cricothyrotomy; either needle cricothyrotomy (table 7 and figure 2 and figure 3) for patients younger than 12 years of age (see "Needle cricothyroidotomy with percutaneous transtracheal ventilation", section on 'Needle cricothyroidotomy') or surgical cricothyrotomy in patients 12 years of age or older. (See "Emergency cricothyrotomy (cricothyroidotomy)", section on 'Methods'.)

  Once the cricothyrotomy is in place, percutaneous transtracheal ventilation is used to bypass the obstruction and oxygenate the patient. (See "Needle

cricothyroidotomy with percutaneous transtracheal ventilation", section on 'Performing transtracheal ventilation'.)

Patients should then be immediately transferred to the operating room (OR) for establishment of a definitive airway and FB removal.

- **Obstructing FB below the vocal cords** – An FB that is lodged below the vocal cords may completely obstruct the subglottic trachea. This obstruction cannot be removed with direct laryngoscopy. In this situation, the trachea should be intubated and the endotracheal tube advanced into the right mainstem bronchus. This maneuver is an attempt to relieve the tracheal obstruction by pushing it into the right mainstem bronchus. At this point, the endotracheal tube should be withdrawn to a position above the carina and ventilation with the right side down performed to maximize ventilation of the left lung.

  The child will now have a bronchial FB but may receive adequate ventilation and oxygenation while preparations are being made to remove it in the OR. Anecdotal experience supports the effectiveness of this approach in the setting of complete subglottic airway obstruction from a FB. Case reports of patients requiring one lung ventilation for surgical procedures and studies in dogs have also demonstrated effective oxygenation and ventilation [9,10].

No foreign body suspected — The acute airway management for patients with severe or complete upper airway obstruction but no FB is provided in the algorithm (algorithm 8).

Patients with severe upper airway obstruction in patients without signs of a FB should undergo bag-mask ventilation. If bag-mask ventilation achieves adequate oxygenation (pulse oximetry in the high 80s or better and steadily improving), then the patient should emergently undergo controlled intubation in the OR.

If bag-mask ventilation does **not** rapidly establish adequate oxygenation, then the most experienced physician present should make one attempt at endotracheal intubation using rapid sequence intubation (algorithm 11 and table 6). If endotracheal intubation is accomplished, then further care directed at the underlying cause should be provided and the patient admitted to a pediatric intensive care unit.

If endotracheal intubation is unsuccessful and the obstruction is due to tongue swelling, then placement of a supraglottic device (eg, laryngeal mask airway [LMA]) (figure 4) may be attempted. The size of the LMA is chosen based upon weight (table 8). If oxygenation is maintained by the supraglottic airway, then the patient should undergo controlled intubation in the OR. If oxygenation is not maintained, then proceed with cricothyrotomy as described below for patients with distortion of airway anatomy.

If the airway obstruction is caused by distortion of the airway anatomy (eg, laryngeo-tracheal trauma or epiglottic swelling due to burns, trauma, or infection) then a supraglottic airway is contraindicated and the patient should undergo cricothyrotomy; either needle cricothyrotomy (table 7 and figure 2 and figure 3) for

patients younger than 12 years of age (see "Needle cricothyroidotomy with percutaneous transtracheal ventilation", section on 'Needle cricothyroidotomy') or surgical cricothyrotomy in patients 12 years of age or older. (See "Emergency cricothyrotomy (cricothyroidotomy)", section on 'Methods'.)

Once the cricothyrotomy is in place, percutaneous transtracheal ventilation is used to bypass the obstruction and oxygenate the patient. (See "Needle cricothyroidotomy with percutaneous transtracheal ventilation", section on 'Performing transtracheal ventilation'.)

Patients should then be immediately transferred to the OR for establishment of a definitive airway.

Conditions with progressive upper airway obstruction — Patients with the following conditions may initially have mild to moderate symptoms of upper airway obstruction but warrant rapid sequence intubation to avoid the risk of sudden decompensation and increased difficulty with securing the airway due to rapidly progressive upper airway swelling:

- Upper airway burns caused by smoke inhalation or caustic ingestion
- Upper airway angioedema that does not rapidly respond to administration of intramuscular epinephrine
- Significant trauma to the airway (algorithm 7)
- Epiglottitis (infectious, thermal, or chemical) (algorithm 2) (see "Epiglottitis (supraglottitis): Clinical features and diagnosis", section on 'Clinical features')

Whenever difficulty with endotracheal intubation is anticipated, the physician should emergently call for an anesthesiologist, pediatric intensivist, and/or otolaryngologist to assist with airway management.

Furthermore, all stable patients with suspected FBs of the upper airway warrant emergency consultation with an otolaryngologist to perform airway visualization and removal of the FB in the OR.

EVALUATION

History — Historical findings that are particularly helpful in determining initial management priorities include the following:

- **Acute onset of symptoms** – The sudden onset of choking, gagging, or stridor in the absence of trauma or fever suggests a foreign body (FB) or an allergic reaction. In general, symptoms that have been rapidly progressive indicate severe disease.

  By comparison, the gradual development of hoarseness then worsening to stridor suggests less severe involvement, as in viral croup.

- **Trauma** – Stridor in the setting of acute trauma (eg, clothesline injury, hanging, motor vehicle collision, thermal burns, or caustic ingestion) points to a high likelihood of a critical airway injury that requires immediate action. Smoke inhalation can result in chemical or thermal injury to the airway. Ingestion of a caustic liquid can cause chemical epiglottitis. (See 'Emergency airway assessment and management' above.)
- **Fever** – A history of fever suggests an infectious etiology. Rapid onset of symptoms in a febrile child is more likely in a bacterial process such as epiglottitis, bacterial tracheitis, retropharyngeal abscess, or peritonsillar abscess (PTA).
- **Change in voice** – Most children with acute upper airway pathology will have a change in voice. A muffled voice can be seen in supraglottic processes such as infection (epiglottitis or PTA) or injury. Hoarseness or stridor occurs with laryngeal or subglottic inflammation, as with croup.
- **Exposures** – An allergic reaction may be the cause of upper airway obstruction when symptoms are related to exposure to a known allergen (eg, bee sting) or new food or medication.
- **Underlying medical conditions** – More severe symptoms are frequently observed in children with congenital anomalies and/or previous airway surgery who develop inflammation of the upper airway from any cause. Similarly, children with underlying poor tone or neuromuscular disease (Down syndrome, cerebral palsy, muscular dystrophy, or quadriplegia) are at increased risk of more severe symptoms.

Physical examination — For the child with severe respiratory distress, the initial physical examination may consist solely of a rapid respiratory assessment. (See 'Emergency airway assessment and management' above.)

Vital signs, including weight, should be obtained as the child's respiratory status permits. A careful examination of the pharynx and lungs can be performed as soon as the child's condition is stabilized.

Signs of airway obstruction — The following findings suggest upper airway obstruction:

- Tachypnea
- Inspiratory stridor, wheezing, or stertor
- Suprasternal or supraclavicular retractions
- Prolonged inspiratory phase
- Drooling
- Dysphagia
- Positions of comfort to help maintain airway patency in patients with severe obstruction:
  - "Sniffing" position (picture 2) (neck is mildly flexed and head is mildly extended)
  - Tripod position (picture 3) (leaning forward while bracing on the arms with neck hyperextended and chin thrust forward)

In addition, children may have general signs of respiratory distress including tachypnea, nasal flaring, and grunting.

Based upon physical findings, the physician should rapidly identify patients who warrant emergency airway intervention. (See 'Rapid assessment of the airway and breathing' above.)

Associated findings — The following findings may suggest a particular diagnosis:

- High fever, toxic appearance, and significant respiratory distress suggest bacterial tracheitis or, rarely, epiglottitis. (See "Bacterial tracheitis in children: Clinical features and diagnosis", section on 'No artificial airway' and "Epiglottitis (supraglottitis): Clinical features and diagnosis", section on 'Children'.)
- Abrupt onset of choking, gagging, or difficulty swallowing without other associated findings (eg, fever, allergen exposure, or trauma) suggest the presence of upper airway FB; inspection of the posterior pharynx frequently does not permit visualization of the object.
- Acute upper airway symptoms with stridor in association with any of the following: swollen lips, tongue, or uvula; generalized urticaria or flushing, or pruritus especially in the setting of allergen exposure (known food allergy or exposure to a new food or medication) supports the diagnosis of anaphylaxis. (See "Anaphylaxis: Acute diagnosis", section on 'Criterion 1'.)
- Altered phonation, bruising and swelling of the neck, and/or subcutaneous emphysema suggest laryngeo-tracheal injury caused by blunt or penetrating trauma.
- The child with burns or singed hair who has hoarseness, drooling, or respiratory distress may have a burn injury to the upper airway. (See "Moderate and severe thermal burns in children: Emergency management", section on 'General examination'.)
- An infant or toddler who is irritable, not moving the neck, and who will not swallow may have a retropharyngeal abscess. (See "Retropharyngeal infections in children", section on 'Clinical manifestations'.)
- PTA can present in the older child as a muffled (eg, hot potato) voice and trismus. Palatal cellulitis and a bulging mass are apparent on examination of the pharynx. (See "Peritonsillar cellulitis and abscess", section on 'Typical presentation'.)

Ancillary studies — Securing a definitive airway takes priority over the diagnostic evaluation in a child with acute upper airway obstruction. Many causes are readily apparent based upon clinical findings supplemented by direct visualization of the airway, as needed. Imaging and laboratory studies supplement this clinical impression in selected patients. (See 'Determining the cause of upper airway obstruction' below.)

Imaging — Plain radiographs may be useful in identifying the location and nature of the airway obstruction but should **never** interfere with the stabilization of a child with a critical obstruction:

- Soft tissue radiographs of the neck can be helpful in diagnosing epiglottitis (image 6), retropharyngeal abscess (image 4), and croup (image 7) [11].
- In patients with signs of acute airway obstruction, AP and lateral neck and chest films may demonstrate the presence of an FB (image 5), but most FBs are radiolucent. Other imaging studies (eg, barium swallow or computed tomography are more definitive but cannot be safely performed in unstable patients. (See "Airway foreign bodies in children", section on 'Plain radiographs'.)

Laboratory studies — Laboratory studies generally are **not** necessary for establishing the cause of upper airway obstruction.

In the child with a bacteriologic etiology such as epiglottitis, PTA, infectious mononucleosis, or a retropharyngeal abscess, a throat culture, blood culture, and/or serologies for Epstein-Barr virus may provide important information for antimicrobial treatment once the airway is secured. (See "Evaluation of sore throat in children", section on 'Ancillary studies' and "Epiglottitis (supraglottitis): Clinical features and diagnosis", section on 'Laboratory features'.)

Direct visualization — Direct visualization of the posterior oropharynx in the anxious child with significant partial airway obstruction may risk causing abrupt complete obstruction. Thus, it should only be performed in an emergency department, intensive care unit, or operating room with necessary specialized airway equipment and, whenever available, pediatric airway specialists (ie, anesthesiologist and otolaryngologist) immediately available.

Direct visualization during laryngoscopy for severe airway obstruction can identify structural abnormalities of the epiglottis (eg, epiglottitis, epiglottic burns, or angioedema) and supraglottic FBs.

Nasopharyngeal endoscopy is also useful for airway decisions in patients with partial obstruction and is the diagnostic method of choice for vocal cord dysfunction during an acute episode.

The approach to direct visualization of the airway in children with epiglottitis is discussed in detail separately. (See "Epiglottitis (supraglottitis): Clinical features and diagnosis", section on 'Examining children'.)

Determining the cause of upper airway obstruction — Airway management precedes the diagnostic evaluation in children with upper airway obstruction and severe respiratory distress (algorithm 8 and algorithm 3) [12]. (See 'Emergency airway management' above.)

Clinical findings, supplemented as needed with direct visualization of the airway, usually identify the underlying etiology (algorithm 12) [13].
(See 'Evaluation' above.)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Airway foreign bodies in children".)

SUMMARY

- Any condition that causes upper airway obstruction can be life-threatening (table 1). Patients with an upper airway foreign body (FB), smoke inhalation, laryngotracheal injury, and epiglottitis (infectious, thermal, or chemical) are at particular risk for sudden decompensation and also frequently require emergency airway intervention. (See 'Causes' above.)
- The initial evaluation of children with acute upper airway obstruction begins with a rapid assessment of airway patency and respiratory to identify those who need emergency airway management (see 'Rapid assessment of the airway and breathing' above):
  - **Mild** – Mild obstruction presents with the following findings:
    - Ability to speak (voice may be hoarse) or hoarse cry
    - Good air entry
    - Inspiratory stridor (may only be heard with crying, agitation, excitement, or tachypnea) or occasional snoring (stertor)
    - Minimal or no suprasternal retractions and no flaring or grunting
  - **Moderate to severe** – Moderate obstruction is characterized by:
    - Tachypnea
    - Audible inspiratory (and possibly expiratory) stridor with every breath
    - Prolonged inspiratory time with signs of significant effort (suprasternal retractions, nasal flaring, or grunting)
    - Decreased air entry

    Hypoxemia (pulse oximetry <91 percent or poor color), the presence of "sniffing" (picture 2) or "tripod" (picture 3) positions taken to maintain an open airway, and/or decreased mental status suggest that the obstruction is severe and that emergency airway management is needed.
  - **Complete** – The child is struggling to breathe with signs of severe respiratory distress (nasal flaring, grunting, and/or marked suprasternal or supraclavicular retractions), and may be silently gagging or coughing in an attempt to clear the airway. If the obstruction is not relieved, the child's condition can rapidly deteriorate, with loss of consciousness. Such patients require immediate interventions to secure the airway.
  - **Respiratory failure** – Children with respiratory failure caused by upper airway obstruction display one or more of the following findings:

- Poor color (ashen or centrally cyanotic)
- Obtunded mental status
- Decreased chest wall excursion, with or without signs of respiratory distress
- Bradypnea or marked tachypnea

- Whenever managing a child with severe or complete upper airway obstruction or respiratory failure arising from obstruction, the physician should emergently call for an anesthesiologist, pediatric intensivist, and/or otolaryngologist to assist with definitive management. (See 'Suspected foreign body' above and 'No foreign body suspected' above.)
- The management of a child with severe or complete upper airway obstruction depends on whether obstruction is due to a suspected FB (algorithm 3) or due to other conditions (algorithm 8) as shown in the algorithms.
- Airway management precedes the diagnostic evaluation in children with upper airway obstruction and severe respiratory distress. Clinical findings, supplemented, as needed, with direct visualization of the airway, provides the underlying etiology in most patients (algorithm 12). Imaging or ancillary studies may be helpful in selected patients. (See 'Evaluation' above.)

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