

Pediatric Airway Nightmares

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KEYWORDS

- Pediatric airway • Airway obstruction • Croup
- Bacterial tracheitis

Pediatric disorders that involve actual or potential airway compromise are among the most challenging cases that emergency department providers face. This article discusses the diagnosis and management of common and uncommon conditions in infants and children who may present with airway obstruction.

UPPER AIRWAY OBSTRUCTIONS

Croup, or laryngotracheobronchitis, is the most common infectious cause of acute upper airway obstruction in children. Emergency physicians and pediatricians manage thousands of patients with this condition every year, commonly without radiographic evaluation. The general croup population benefits greatly from one oral dose of dexamethasone,¹ which seems as efficacious as an intramuscular dose,^{2,3} and occasionally children need nebulized racemic epinephrine for persistent stridor or significantly increased work of breathing. Although croup is usually a benign and rapidly reversible condition, emergency providers must be aware of young children who present with stridor, increased work of breathing, and fever and who do not respond to croup management. The differential diagnosis for these children includes bacterial tracheitis, epiglottitis, retropharyngeal abscess, and structural lesions worsened by laryngotracheobronchitis. Airway burns may also cause rapidly progressive airway obstruction.

TRACHEITIS

Cases of bacterial tracheitis are most likely a complication of a preceding viral upper airway infection involving the trachea. Children often present with croup symptoms, such as cough, stridor, prolonged inspiratory phase breathing, retractions, and fever. Several key factors, however, differentiate young children with croup from those with bacterial tracheitis. Children with croup develop a croupy or bark-like cough soon followed by respiratory distress and stridor due to subglottic edema.

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It is common for young children to be distressed at home and calm and free of stridor on presentation in an emergency department, possibly due to amelioration of the subglottic edema from a combination of the upright position and breathing cool night air on the ride to the hospital. In contrast, children with bacterial tracheitis universally present to emergency departments with stridor and fever. Common features are copious purulent sputum, high fever, and toxic appearance. Toxic-appearing children with croup-like symptoms who respond poorly to croup management should be evaluated for tracheitis.

Bacterial tracheitis is a secondary infection caused by *Staphylococcus aureus* or *Haemophilus influenzae* type b (usually in unvaccinated patients) in a trachea inflamed by an antecedent viral infection.⁴ Bacterial tracheitis has features of croup and epiglottitis: stridor and croup-like coughing as in the former and high fever and toxic appearance as in the latter. Doses of dexamethasone and aerosolized racemic epinephrine, which have substantial efficacy in the symptomatic relief of stridor and respiratory distress in croup, have little to no effect in patients with tracheitis.^{5,6} With the widespread use of dexamethasone for croup infections and *H influenzae* immunization, bacterial tracheitis has now eclipsed croup and epiglottitis as a cause of severe upper airway obstruction and respiratory failure requiring intubation.⁵

The management of tracheitis is airway control with intubation and intravenous (IV) antibiotic administration. Ear, nose, and throat (ENT) consultation is warranted because nearly all patients with bacterial tracheitis require tracheal intubation and, as in epiglottitis, intubation should be done in an operating suite under anesthesia. If a portable lateral neck radiograph is done in a patient with tracheitis, the epiglottis appears normal in size, and laryngoscopy and intubation confirm this finding. Copious purulent debris is found in the trachea during intubation. Every attempt at clearing the endotracheal tube of purulent material should be done via suction catheter to prevent complete obstruction. After patient stabilization and cultures of tracheal aspirate and blood are done, a broad-spectrum parenteral antibiotic, such as ceftriaxone, should immediately be started.⁷ Antibiotic therapy and hospitalization may be required for up to 14 days.⁴

EPIGLOTTITIS

Over the past 20 years, there has been a dramatic decline in pediatric cases of epiglottitis. The *H influenzae* vaccine has practically eliminated invasive *H influenzae* infection, well known to have caused meningitis and epiglottitis in children under 4 years of age.^{8,9} In a retrospective chart review, a large children's hospital noted a 10-fold decrease in the admission rates for pediatric epiglottitis over the past 27 years.¹⁰ In a recent retrospective study, however, 10% of children presenting with epiglottitis were found to have invasive *H influenzae* type b infection, despite having been vaccinated.⁷ These findings highlight the importance of considering acute epiglottitis in the differential diagnosis of all children presenting with upper airway obstruction. This is particularly relevant because fewer doctors today are familiar with the symptoms and signs of the disease.

Epiglottitis presents abruptly with high fever, toxicity, and significant upper airway obstruction with stridor, unlike tracheitis, which usually is preceded by a viral croup infection but can manifest as a primary infection.¹¹ Children with epiglottitis present in distress with muffled voices and without spontaneous coughing. They may present leaning forward (ie, tripod position) with mouth breathing and tongue and mandible protrusion. When acute bacterial epiglottitis is suspected, immediate airway management, preferably under anesthesia in an operating suite, is indicated.

RETROPHARYNGEAL ABSCESS

Retropharyngeal abscess is an uncommon disease. In a pediatric study of 64 patients under 16 years of age, 75% of retropharyngeal abscesses were found in children less than 5 years of age and 16% of this condition in infants less than 1 year of age.¹³ In a mixed-group study of 19 patients, 1 to 69 years of age, with retropharyngeal abscess, 37% of retropharyngeal abscesses cases were less than 5 years of age and 47% of these cases were over 17 years of age.¹³ Unlike epiglottitis, with its rapid onset, retropharyngeal abscess is commonly preceded by nasopharyngitis with development of high fever, dysphagia, severe throat pain, noisy breathing, and stiff neck. Infants under 1 year of age may present with fever, drooling, and stridor or, instead, with isolated fever and lethargy. In a study of 25 infants under 9 months of age with deep neck abscesses, 92% had a neck mass, 60% had fever, and 36% had dysphagia or poor feeding. In 13 of 17 who were scanned, the computerized tomography scan of the neck revealed some degree of airway compromise.¹²

With the exception of the abrupt onset and tripod position seen in epiglottitis, epiglottitis and retropharyngeal abscess may have strikingly similar clinical presentations. Children with retropharyngeal abscess may use mouth breathing, tongue protrusion, and mandible thrust to maintain a patent airway. They often present with fever and a toxic appearance. In the same study of 64 pediatric patients under 16 years of age with retropharyngeal abscess, however, only 5% had respiratory distress or frank stridor whereas 45% had limitation to neck extension.¹⁴ In another study of 169 patients under 19 years of age with deep neck abscesses, only 6% had stridor and 7% had respiratory distress. The most common clinical finding in this study was neck mass in 91%.¹⁵ The low incidence of respiratory distress and stridor in children with retropharyngeal abscesses, in contrast to the high incidence of these findings in epiglottitis and tracheitis, helps differentiate these airway disorders. An adequate portable lateral neck radiograph revealing the distended retropharyngeal space can be diagnostic of retropharyngeal abscesses (Fig. 1). Although the management of tracheitis and epiglottitis includes early airway control via intubation in addition to IV antibiotic administration, retropharyngeal abscesses can often be managed with IV antibiotics and close observation. The need for immediate intubation is rare. ENT consultation is warranted in all cases of retropharyngeal abscess confirmed by CT.

CONGENITAL STRUCTURAL DEFECTS

Infants with stridor beginning at birth or within 2 weeks of birth may have congenital airway abnormalities, such as laryngomalacia, tracheomalacia, and subglottic hemangioma. Infants with a history of chronic stridor suggestive of one of these disorders who present with worsened upper airway obstruction after a viral prodrome may have superimposed laryngotracheobronchitis exacerbating pre-existing airway abnormalities. These infants generally have only partial response to croup management, and a high index of suspicion for underlying structural abnormality is recommended in these clinical scenarios. ENT consultation and airway endoscopy should be considered in all suspected cases.

AIRWAY FOREIGN BODIES

Children with foreign bodies in the nasal cavity may present with rhinorrhea, malodorous breath, or an explicit history of placing an object in the nose, although they generally do not present with extreme respiratory distress. Children with foreign bodies, such as plastic candy wrappers, lodged in the oropharynx generally present

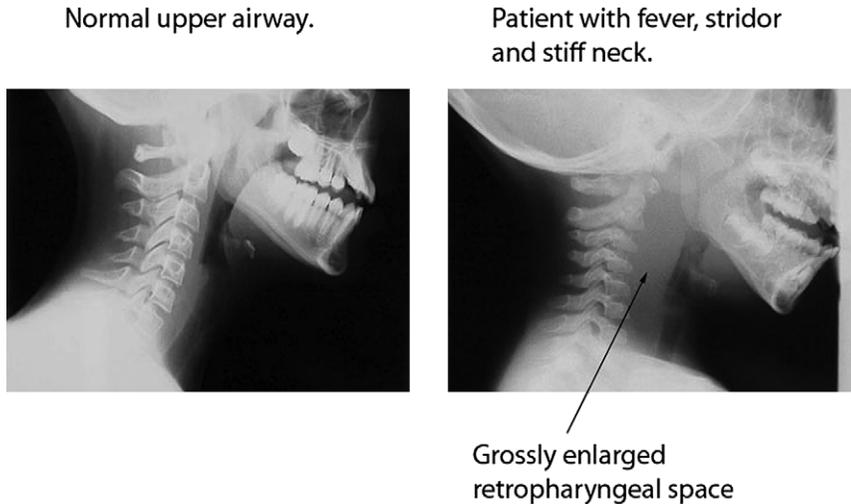


Fig. 1. Retropharyngeal abscess in a 3-year-old (*right*) compared with a normal upper airway (*left*).

with mouth breathing, refusal to feed, irritability, and mild drooling. These children do not usually present in respiratory distress unless the object is large and partially obstructing the glottic opening. Children who present in distress with a sudden onset of stridor, prolonged inspiratory phase, head bobbing, and excessive drooling are more likely to have foreign bodies partially obstructing the supraglottic area and proximal esophagus.

Management of nonaspirated foreign bodies in children depends on the location of the foreign bodies and the degree of resulting obstruction. Children who can cough and verbalize should be given supplemental oxygen and placed in a position of comfort. Nasal foreign bodies can generally be removed in an emergency department with a variety of instruments, such as a balloon-tipped catheter. Oropharyngeal foreign bodies in patients without extreme respiratory distress can be removed with Magill forceps. Beware of children who present with severe partial upper airway obstruction due to foreign body. If these children can cough and verbalize, give supplemental oxygen and place them in a position of comfort. Consider delaying IV line placement and other interventions that might cause agitation and worsen airway resistance. Do not try to remove foreign bodies causing severe partial upper airway obstruction because these attempts may result in complete glottic obstruction. A better course of action is immediate consultation with an otolaryngologist and operating room personnel to ensure rapid transfer to an operating suite for intubation. In children with airway obstruction that prevents cough or verbalization, basic life-support maneuvers should be initiated immediately to dislodge the foreign body.

Aspirated lower airway foreign bodies in children may be subtle, and delays of up to 4 months¹⁶ and as long as 5 years¹⁷ in diagnosing foreign bodies are reported. In one study, 99% of patients reporting foreign body aspiration or choking were found to have confirmed foreign body,¹⁷ although in another study of 202 confirmed cases of airway foreign bodies, there was no history of foreign body aspiration in 15% of cases.¹⁸ In a study of 128 patients with suspected foreign body aspirations, 28 presented later than 1 month after the event or onset of symptoms. All those who presented late had a chronic cough and 48% had a history suggestive of foreign body

aspiration; 63% of the children presented with complications that included pneumonia ($n = 13$), bronchiectasis ($n = 3$), and bronchoesophageal fistula ($n = 1$). The diagnostic delays were variously attributed to physician misdiagnosis ($n = 9$), failure by parents to seek early medical advice ($n = 4$), patients leaving against medical advice ($n = 1$), and unknown cause in the remaining 14 children.¹⁹ The most common age for foreign body aspiration is 1 to 2 years of age with up to two-thirds of cases occurring in this age group¹⁶ and 68% of foreign body aspirations occur within the first 8 years of life.¹⁷ Approximately 80% of aspirated foreign bodies are lodged in the lower airways,¹⁷ leaving laryngotracheal foreign bodies less common but immediately life threatening.¹⁶

In 548 cases of foreign body aspiration over a 10-year period, in children 2 months to 16 years of age, the percentage of children presenting with cough was 83%, choking 4%, and wheezing 10%. Four percent of children presented asymptotically and 16% of cases had no physical examination findings to suggest foreign body.¹⁷ In this same study, chest radiograph was frequently abnormal with atelectasis in 35%, hyperinflation in 27%, and radiopaque foreign bodies in 13%, although chest radiograph was normal in 14% of cases. A peanut was the most common aspirated foreign body in children^{16,17} whereas balloons are the most common foreign body aspirations to result in death.¹⁶

Management of aspirated foreign bodies in children depends on a child's age and location of the aspirated foreign body. Because the narrowest portion of the pediatric airway is at the cricoid ring, any foreign body at this level may cause severe airway resistance. Children with foreign bodies at the cricoid region generally present in extreme respiratory distress with severe retractions and stridor. Immediate intubation using rapid sequence intubation medications or immediate transfer to an operating suite is generally indicated. Children with aspirated foreign bodies in the lower airways present as diagnostic challenges. Findings suggestive of lower airway foreign bodies include air trapping leading to asymmetric hyperinflation (38%–63%), pulmonary consolidation (8%–25%), or barotrauma (7%).¹⁶ Initial radiographic studies should include standard anteroposterior and lateral chest radiographs. Only approximately 6% to 15% of aspirated foreign bodies are radiopaque, however, and approximately 15% of radiopaque foreign bodies cases are initially seen on radiograph.¹⁶ In suspected cases of aspirated foreign bodies, where standard radiographic studies are normal (**Fig. 2**), lateral decubitus films in young children and inspiratory and expiratory films in cooperative older children may provide more information. A lung placed on its side on a lateral decubitus film without a foreign body will compress normally due to gravity (**Fig. 3**). A lung placed on its side with a foreign body generally will not compress and will resist the forces of gravity due to the ball-valve obstruction (**Fig. 4**). Likewise, inspiratory and expiratory films may reveal hyperinflation on expiratory film if the foreign body in the lower airways causes a ball-valve obstruction and prevents full deflation of the obstructed lung on expiration. Bronchoscopy, however, remains the diagnostic tool of choice for suspected foreign body aspiration.

AIRWAY BURNS

There are many documented cases of delayed airway deterioration in young children who initially present with body scald burns.^{20,21} Although compromise of the airway by direct thermal injury to the upper respiratory tract is most commonly associated with smoke or steam inhalation,²² aspiration of microwave-heated liquids is the most common cause in infants and young children.^{20,23} Heated liquid ingestions and aspiration have caused thermal epiglottitis and edematous arytenoidal tissue.^{20,24}



Fig. 2. Normal-appearing anteroposterior chest radiograph in a 12-month-old infant with a left mainstem foreign body.

Because thermal epiglottitis injuries in children may be clinically (and radiographically) similar to acute infectious epiglottitis,^{24,25} children with these injuries are at risk for significant upper airway obstruction, which may continue to progress for several hours. Children in whom thermal epiglottitis is suspected should be approached with the same caution and preparedness for emergency airway management as those with acute infectious epiglottitis.²⁴ Even superheated, microwaved hot potato ingestions have caused edematous arytenoidal tissue and acute airway deterioration requiring intubation. Patients with airway burns often progress rapidly to acute upper airway occlusion.

Judicious airway management is crucial in these children. Because the initial pharyngeal examination does not always identify patients at risk, fiberoptic visualization of the larynx provides an excellent diagnostic and prognostic tool. Because edema may continue to progress over several hours, it is essential to secure the airway

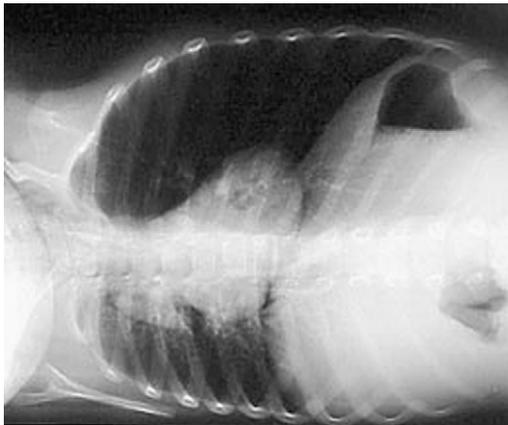


Fig. 3. Same patient as in **Fig. 2**; normal right lateral decubitus chest radiograph. Note how the right lung compresses normally due to the effects of gravity.

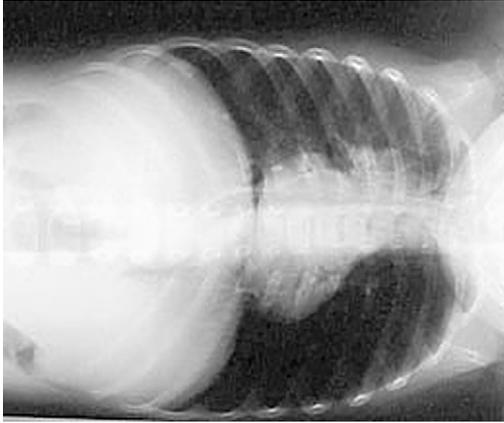


Fig. 4. Same patient as in **Fig. 2**; abnormal left lateral decubitus chest radiograph. Note how the left lung does not compress despite the effects of gravity. A large, dog-claw, foreign body was found in the left mainstem bronchus and removed by bronchoscopy.

via endotracheal intubation at the onset of any signs of laryngeal edema, including stridor, hoarseness, or change in character of a child's voice or cry.²⁰

SUMMARY

Upper airway obstruction in infants and children, whether or not caused by infection, foreign body or airway burn, may present with extreme respiratory distress. Simple croup should be responsive to dexamethasone and nebulized racemic epinephrine. The incidence of epiglottitis has dramatically decreased in the pediatric population in the past decade, and bacterial tracheitis seems to have eclipsed croup and epiglottitis as the most common infectious cause of severe upper airway obstruction requiring intubation. Retropharyngeal abscess commonly presents with neck pain, stiffness, or mass and uncommonly causes respiratory distress and stridor. Airway foreign bodies in the laryngotracheal region may be immediately life threatening whereas lower airway foreign bodies may be subtle and the delay to diagnosis may be prolonged. Airway burns in infants and children may be occult on routine inspection of the oropharynx, and fiberoptic visualization of the larynx provides an excellent diagnostic and prognostic tool. Airway burns may progress rapidly to acute upper airway occlusion and intubation at the first signs of laryngeal edema is essential to prevent complete airway obstruction and respiratory failure.

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