Acute Otolaryngologic Surgical Conditions in Children

MICHAEL J. CUNNINGHAM, MD

Several otolaryngologic conditions present acutely in the pediatric population. They include those of the ear and temporal bone region, the nose and paranasal sinuses, the oropharynx, and the airway. A thorough history and physical examination combined with appropriate laboratory, roentgenographic, and endoscopic studies will enable the physician to diagnose and plan appropriate therapy.

THE EAR AND TEMPORAL BONE

Otitis Media

Otitis media is the second most common disease of childhood following viral upper respiratory tract infection. Acute otitis media is characteristically a bacterial infection for which systemic antibiotic therapy is the initial treatment of choice. Tympanocentesis (needle aspiration of middle ear contents) or myringotomy (tympanic membrane incision) with or without tube placement occasionally proves necessary for diagnostic and drainage purposes. Children in whom such surgical intervention should be considered include immunocompromised patients, otherwise healthy children with severe symptoms refractory to medical therapy, or children presenting with acute otitis media and any of the associated suppurative complications discussed below.

Both acute and chronic otitis media can be complicated by infection spreading beyond the confines of the pneumatized spaces of the temporal bone. Both acute and chronic otitis media can be complicated by infection spreading beyond the confines of the pneumatized spaces of the temporal bone. There are potentially four intratemporal and six intracranial complications (Table 1). Widespread use of systemic antibiotics has both decreased their incidence and altered their clinical presentation. This is best exemplified by the most common of these supplicative complications: mastoiditis.

Mastoiditis

In its classic presentation, acute mastoiditis is readily distinguishable. Such children present with

Dr Cunningham is from the Massachusetts Eye and Ear Infirmary and Harvard Medical School, Boston, Massachusetts. Address reprint requests to Michael J. Cunningham, MD, ENT Pediatric Service, Massachusetts Eye and Ear Infirmary, 243 Charles St, Boston, MA 02114.
fever, otalgia, retroauricular swelling and tenderness, and proptosis of the auricle. Otoscopic examination reveals a suppurrative otitis media. An edematous posterior external ear canal may obscure visualization of the tympanic membrane. The laboratory evaluation of children presenting with suspected mastoiditis should include a complete blood count with differential, blood cultures, audiologic testing if available, and radiographic assessment. Computed tomography (CT) is the radiologic study of choice as it allows the identification of early bone destruction (coalescent mastoiditis) and also can be used as a screen for intracranial complications.2

Acute mastoiditis without evidence of intracranial complication or subperiosteal abscess should be treated initially with intravenous antibiotics. The initial antibiotic choice should provide broad-spectrum coverage for gram-positive Staphylococcus and Streptococcus species as well as gram-negative organisms such as Hemophilus influenzae. Ideally, the antibiotic chosen should cross the blood-brain barrier. Concurrent with the initiation of antibiotic therapy, an attempt should be made to sample middle ear contents for Gram stain, culture, and sensitivity studies. When the child presents with otorrhea, middle ear drainage can be cultured after gentle cleansing of the ear canal with sterile saline. In cases in which the child still has an intact tympanic membrane, otolaryngologic consultation is necessary for the performance of a wide myringotomy. The insertion of a myringotomy tube can assist with drainage as well as allow the administration of topical antibiotics.

Surgical intervention beyond myringotomy with or without tube placement is indicated in uncomplicated cases of acute mastoiditis that fail to respond or progress despite intravenous antibiotic therapy. A tympanomastoidectomy often is performed under such circumstances. Such aggressive surgical intervention also is indicated in children who present with obvious postauricular fluctuation indicative of a subperiosteal abscess or in children with clinically suspected and radiographically confirmed intracranial complications. Manifestations of the latter include a constellation of signs and symptoms such as fever, meningismus, headache, nausea, vomiting, lethargy, and seizure activity. Lumbar puncture to obtain cerebrospinal fluid (CSF) for Gram stain and culture is crucial in such cases.

Hearing Loss
Most hearing loss in children is mild to moderate in severity, transient and conductive in nature, and occurs following acute otitis media or otitis media with effusion. The sudden progressive onset of severe to profound sensorineural hearing loss is comparatively rare. Although the majority of rapidly progressive hearing loss is of an untreated genetic or viral etiology,4 immunologic or anatomic predisposition must be considered and ruled out.

Immune-mediated sensorineural hearing loss should be particularly suspected in children with other manifestations of a systemic immune disorder.5 Work-up should include a white blood count with differential, erythrocyte sedimentation rate, fluorescent treponemal antibody absorption test, and a connective tissue disease screen. Additional assays are available to detect organ-specific antibodies directed against inner ear antigens. When an immunologic pathogenesis is confirmed or strongly suspected, steroids are the mainstay of treatment using an initial dose of 1 to 2 mg/kg/day dexamethasone equivalent. If a positive hearing response is documented, an attempt is made to taper treatment over the subsequent 6 to 8 weeks. When there is no response to steroid therapy, cytotoxic agents and plasmapheresis have been used in specific cases.

Sudden hearing loss, particularly that occurring in the setting of trauma or exertion, should raise clinical suspicion of the presence of a perilymphatic fistula (PLF).6 This is an abnormal communication between the inner and middle ear with resultant leakage of perilymph through the defect. Such PLFs have been associated with progressive, fluctuating, and sudden sensorineural hearing loss. Associated symptoms include episodic vertigo with ataxia and spatial disorientation in younger children. Meningitis, particularly recurrent meningitis, also may be an initial manifestation. There are no physical findings that clearly establish the diagnosis of PLF nor is there any definitive laboratory study. A temporal bone CT scan may document an inner or middle ear anomaly that increases the likelihood of a PLF being present.7 Direct microscopic middle ear examination by means of an exploratory tympanotomy is necessary for diagnosis of a PLF. Various maneuvers have been advo-
Traumatic nasal deformities that interfere with respiration should be corrected. Such injuries, if left untreated, can result in abnormal nasal development and anatomic airway obstruction in later years.

Facial Paralysis

Idiopathic (Bell's) palsy is the most common etiology of nontraumatic unilateral facial paralysis in the pediatric population. This is a diagnosis of exclusion, and radiologic assessment is needed to rule out a neoplastic etiology.9 Exceptions to this rule include facial paralysis arising in the presence of herpes zoster oticus or otitis media, alternative causes that are usually apparent. Lyme disease needs to be considered in children who present with bilateral facial nerve weakness.

Facial paralysis noted at birth can be due to trauma or a developmental anomaly. This distinction is important because the prognosis and treatment differs considerably between these diagnoses.9 Traumatic palsies may require surgical decompression or nerve repair, whereas developmental palsies require no immediate therapy. The most common cause of neonatal facial paralysis is traumatic forceps delivery. Other causes include nerve compression by either the maternal sacral promontory or fetal shoulder. A developmental agenesis or dysgenesis of the facial nerve can be excluded if electrical stimulation of the nerve can be elicited at birth. In traumatic injuries, neuropraxia can be distinguished from complete avulsion by electrophysioilogic studies. If electrical excitability is lost after 72 hours, severe injury or avulsion should be assumed and warrants surgical exploration.

Traumatic facial nerve palsy is reported in approximately 10% to 20% of children with temporal bone fractures. Fracture planes are best visualized on serial axial and coronal CT scans. In one series of 26 children with traumatic facial nerve injuries, 61% of those requiring operative intervention recovered satisfactory facial function. Unsatisfactory results were attributed to a delay of 4 or more weeks in decompression or nerve repair.11 Early steroid administration and frequent observation of facial nerve function with sequential testing is the initial recommended treatment. Again, electrophysiologic studies provide the most specific guidelines for timing surgery.

NOSE AND PARANASAL SINUSES

Nasal Fractures

Isolated nasal fractures in children usually involve the cartilaginous structures alone. Complex bony nasal fractures tend to occur with significant maxillofacial trauma.11 Radiographic assessment, while useful in generalized maxillofacial trauma, is of little help in isolated nasal injuries. Traumatic nasal deformities that interfere with respiration should be corrected. Such injuries, if left untreated, can result in abnormal nasal development and anatomic airway obstruction in later years.13 Conservative surgical management includes repositioning the septal cartilage and nasal bones. Resection of cartilage or bone is avoided unless absolutely necessary. In the absence of functional compromise or gross nasal deformity, observation is the rule.

Epistaxis

Epistaxis in children is a common problem between the ages of 2 and 10 years. Potentially, there are many local and systemic causes, but the vast majority of childhood epistaxes occur secondary to inflammation and excoriation of the nasal mucosa of the anterior septum.

Uncomplicated anterior epistaxis usually ceases spontaneously or responds to conservative measures such as head elevation and firm local pressure, pinching the nose for 5 to 10 minutes. Such pressure may need to be applied successively two or three times. The child should be encouraged to sit with his or her head forward to avoid bleeding into the pharynx with possible risk of aspiration.

When the epistaxis does not respond to these simple measures, a careful nasal examination is needed to identify the site and cause of bleeding. Pledgets soaked in either 1:100,000 epinephrine, 0.25% phenylephrine, or 0.025% oxymetazoline are firmly applied for mucosal shrinkage and hemostasis. Topical 4% lidocaine or 1% tetracaine can be added for local anesthesia. Cocaine as a 4% solution is an alternative agent that achieves both of these effects. Topical anesthesia enhances the child's cooperation and is absolutely necessary if topical cauterization proves necessary. Most cases of uncomplicated anterior septal mucosal bleeding will respond to these measures following the suction removal of old blood and secretions. If a specific focal point of hemorrhage persists, chemi...
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Cal cautery with a silver nitrate stick may be attempted. Diffuse cauteryization of the anterior septal region should not be performed.

Otolaryngology consultation is required in young children when a sufficient nasal examination is not possible or in older children with a very large septal vessel that does not respond to chemical cautery. Arterial ligation of the anterior ethmoid, internal maxillary, or external carotid arteries or angiography with selective embolization of the involved vessels may be necessary in severe refractory cases. Certain screening laboratory tests such as a complete blood count, platelet count, bleeding time, prothrombin time, and partial thromboplastin time can be useful when the history is suggestive of a bleeding diathesis.14

In complicated cases of epistaxis, a thorough pediatric and otolaryngologic evaluation is necessary to determine if a local or systemic neoplastic process is the cause.

Rhinosinusitis

Rhinosinusitis is a common pediatric diagnosis, and the orbital complications of paranasal sinusitis have been recognized for more than 50 years. The most commonly used classification of sino-orbital infections divides such complications into inflammatory edema (preseptal) cellulitis, orbital (postseptal) cellulitis, subperiosteal abscess, orbital abscess, and cavernous sinus thrombosis.15 Table 2 summarizes the clinical manifestations of each of these infections.

Children presenting with inflammation of the periorbital and orbital tissues can be a diagnostic challenge. Treatment depends on the clinical progression of disease. In patients with inflammatory edema and early orbital cellulitis, antimicrobial therapy is the treatment. Predominant etiologic organisms include Streptococcus pneumoniae, Streptococcus pyogenes, H influenzae, and Monoxella catarrhalis.16

Progressive proptosis and chemosis with ophthalmoplegia and visual impairment are the clinical findings that prompt consideration of surgery. Radiographic assessment of the orbit by CT scan is necessary in this age group. Because an abscess within the confines of the bony orbit requires treatment by surgical exploration and drainage, distinguishing between orbital cellulitis and abscess in children is critical. Accuracy of CT imaging appears to be improved by the use of contrast enhancement as well as the use of both coronal and axial projections. Surgical exploration, regardless of CT findings, is recommended in children who initially present with decreased visual acuity or who demonstrate progression of orbital manifestations despite appropriate medical therapy.

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<tr>
<td><strong>Classification of Sino-Orbital Infections</strong></td>
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<tr>
<td><strong>Inflammatory Edema</strong></td>
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<tr>
<td>Inflammatory edema of the eyelid with or without edema of the orbital contents; no limitation of extraocular motility or impairment of visual acuity</td>
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<tr>
<td><strong>Orbital Cellulitis</strong></td>
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<tr>
<td>Diffuse edema of the orbital contents with varying degrees of proptosis, chemosis, limitations of extraocular movement or visual loss</td>
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<tr>
<td><strong>Subperiosteal Abscess</strong></td>
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<tr>
<td>Collection of pus between the periorbital and the bony wall of the orbit with proptosis and displacement of the globe away from the collection; visual loss frequent</td>
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<tr>
<td><strong>Orbital Abscess</strong></td>
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<tr>
<td>Abscess collection within the orbital tissues; severe chemosis and proptosis; complete ophthalmoplegia with moderate-to-severe visual loss</td>
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<tr>
<td><strong>Cavernous Sinus Thrombosis</strong></td>
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<tr>
<td>Proptosis and fixation of the globe; severe visual loss; development of similar signs in the opposite orbit associated with prostration and meningismus</td>
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OROPHARYNX

Hypertrophy of the Adenoid and Palatine Tonsils

Hypertrophy of the adenoid and palatine tonsils is a well-recognized cause of chronic upper airway obstruction in children. Inflammation of these tissues may lead to severe acute upper airway obstruction. Children with decreased oropharyngeal anatomical dimensions and physiologic impairment of oropharyngeal neuromotor function (eg, children with Down syndrome) are particularly prone to such obstruction in the presence of infection-induced lymphoid hypertrophy. Viral infection, particularly Epstein-Barr virus, can acutely cause massive lymphoid hypertrophy in otherwise normal children.18 Such children present with manifestations of both nasal and oral airway obstruction. Surgical intervention is rarely recommended because acutely infected adenotonsillar tissue is friable. In addition, liver inflammation may develop with defective blood coagulation. Acute management should include intravenous rehydration and the institution of intravenous antibiotic therapy because of the possibility of a concomitant group A β-hemolytic streptococcal infection. Dexamethasone is administered intravenously as a 1 mg/kg bolus with 0.5 mg/kg repeated every 6 to 8 hours until signs and symptoms are relieved. A soft rubber nasopharyngeal airway at a length designed to bypass both the obstructive adenoid and tonsillar
Rhinosinusitis is a common pediatric diagnosis, and the complications of paranasal sinusitis have been recognized for more than 50 years.

tissue is recommended in cases of moderate to severe airway obstruction. Endotracheal intubation may be required temporarily in severe cases not responsive to the above measures.

Peritonsillar and Retropharyngeal Abscesses

The peritonsillar and retropharyngeal spaces are two potential sites of acute abscess formation with subsequent upper airway obstruction in children. Despite their anatomical proximity, there is a great difference in the clinical presentation and treatment of peritonsillar and retropharyngeal abscesses.19

Peritonsillar abscess typically occurs as a complication of acute tonsillitis. The severity of the clinical presentation is characteristically out of proportion to that expected from a standard episode of tonsillitis. High fever, severe throat pain, dysphagia, and impaired vocal quality are common. The abscess is almost always unilateral. Physical examination typically will reveal bilateral tonsillitis and an erythematous mass lateral to only one tonsil. A large abscess will push the involved tonsil medially with displacement of the uvula toward the uninvolved side. Trismus caused by inflammation of the adjacent pharyngeal wall musculature may limit the oral examination in some children.

The optimal management of peritonsillar abscess is somewhat age dependent. In the older child without significant trismus, transoral needle drainage will confirm the diagnosis and often provide immediate symptomatic relief. Intravenous volume repletion and parenteral antibiotic therapy is initiated in an ambulatory setting. If the patient is capable of oral intake following needle drainage, antibiotic therapy is continued on an outpatient basis. Penicillin or an equally appropriate anti-group A β-hemolytic streptococcal agent is the antibiotic of choice. In younger children or in patients with severe trismus in whom an adequate oropharyngeal evaluation is not possible, an examination under anesthesia with drainage of the peritonsillar region is required. Such patients are hospitalized for 24 to 48 hours postoperatively. A concurrent tonsillectomy usually is not performed. Tonsillectomy can be done after the acute inflammatory process has resolved.

Retropharyngeal abscess is a disease of young children. In one large series, 70% of the children were younger than 6 years of age.20 Abscess formation results from a suppurative adenitis of the retropharyngeal lymph nodes. Many children have an antecedent history of an upper respiratory tract infection and present acutely with toxicity and high fever. Older children will complain of painful swallowing. Younger children will simply refuse oral intake. Drooling is common, and inspiratory stridor is reported in one fourth of retropharyngeal abscess cases. Physical examination typically reveals cervical fullness and resistance to neck movement. Oropharyngeal examination is difficult and actually may be contraindicated in children with stridor. The pathognomonic bulge or swelling of the posterior pharyngeal wall is rarely visualized. A wide retropharyngeal space demonstrated on a lateral neck radiograph performed during inspiration with the neck fully extended is strongly suggestive of the diagnosis. Fluoroscopy or ultrasonography can be useful in very young children whose pliable soft tissues of the pharyngeal wall may make plain film interpretation difficult.

In the absence of impending airway obstruction, intravenous rehydration and antibiotics are the initial therapy. Potential etiologic organisms include α-hemolytic streptococci and Staphylococcus aureus alone or in combination with gram-negative and anaerobic bacteria. Broad-spectrum coverage with late generation cephalosporins or combination regimens of synthetic penicillins and aminoglycosides is required. The development of airway compromise or failure of clinical response necessitates airway support and surgical drainage. Care must be taken during intubation not to rupture the abscess as this could lead to aspiration. Surgical cultures can guide the selection and duration of postoperative antibiotic therapy.

THE AIRWAY

Foreign Body Aspiration

Acute airway obstruction in children has multiple causes. The most common of the noninfectious etiologies is foreign body aspiration. Early diagnosis and prompt treatment of this potentially lethal problem is essential.21 The greatest incidence of foreign body aspiration is among very young children, and the most commonly aspirated foreign body is the nonradiopaque peanut. Notably, none of the other commonly aspirated objects—vegetables, plastic toys, and popcorn—are radiopaque either.

The diagnosis of radiolucent foreign bodies depends on a high index of clinical suspicion. Radiographic evaluation is essential but not always definitive. Chest radiographs should be obtained during both inspiratory and expiratory phases. Differential inflation of one lung, atelectasis, hyperlucency, or mediastinal shift may be indicative of unilateral bronchial obstruction. Recurrent or persistent pneumonia may be associated with chronic unrecognized foreign body aspiration. Wheezing in a previously healthy child
should always raise the possibility of foreign body aspiration.

Treatment is removal by endoscopy. Because foreign bodies can change location with coughing, a repeat chest radiograph should be obtained if much time has passed between the original radiograph and endoscopic removal. Aspirated foreign bodies can be coughed into the hypopharynx and swallowed. An array of endoscopic instruments of appropriate diameter for the pediatric airway is available for the safe removal of a wide variety of aspirated objects.²²

Infectious Diseases of the Larynx and Trachea

Infectious diseases of the larynx and trachea can rapidly obstruct the child’s airway with secondary respiratory decompensation. The primary aims of management are to establish a diagnosis quickly and to maintain or secure the child’s airway. Medical treatment and airway stabilization measures vary for the three most prevalent laryngotracheal infections: supraglottitis, laryngotracheitis, and bacterial tracheitis.²³

Supraglottitis. Supraglottitis is the more appropriate term for what has been called epiglottitis because it appropriately describes the observed inflammation of all supraglottic structures in addition to the epiglottis. Supraglottitis occurs in children from 1 to 6 years of age with a particular affinity for the 3 to 4 year old. Virtually all of these children present with respiratory distress and require airway management. The characteristic signs and symptoms are best described as four Ds and an S: dysphagia, dysphonia, drooling, distress, and stridor.²⁴ The stridor is inspiratory in nature. There is associated fever, rapid clinical progression, and an absence of cough. The child often sits upright with the jaw thrust forward and the mouth open in a spontaneous attempt to maintain the airway. This classic presentation is enough to initiate immediate definitive treatment. A radiologic evaluation is warranted only when the diagnosis is in doubt. A lateral neck radiograph will be positive in only 50% of children with endoscopically proven supraglottitis. Nonspecific hypopharyngeal dilatation may be the only roentgenographic finding.

The medical treatment of supraglottitis is antibiotic therapy against H influenzae type B, the etiologic organism. Antibiotic choice is based on the fact that 10% to 20% of these bacteria produce β-lactamase. The traditional regimen of ampicillin plus chloramphenicol has been replaced more recently by second- and third-generation cephalosporins. Endotracheal intubation is required for airway management in all young children with symptomatic supraglottitis. Adolescents with endoscopically documented supraglottitis and mild symptoms may be treated without intubation, but must be monitored in an intensive care setting. With any suggestion of progressive airway obstruction, these older patients will require endotra-

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cheal intubation. The most promising change in the overall management of supraglottitis is prevention. The recently available conjugated HiB vaccine can be administered to children as young as 2 months of age. Elevated antibody responses in young children suggest that this vaccine will decrease the incidence of supraglottitis.²⁵

Acute Laryngotracheitis. Acute laryngotracheitis, common croup, is the most frequent cause of airway obstruction in children. The age range of acute laryngotracheitis overlaps that of supraglottitis, although younger children are afflicted more frequently. The mean age of involvement is 18 months. In contrast to supraglottitis, there is a fall/winter predominance of this disease because of its viral etiology. Children with laryngotracheitis characteristically have a prodromal respiratory tract infection after which they develop a hoarse cry and barking cough. The associated stridor is initially inspiratory in nature and becomes biphasic with progressive severity of the disease.

Associated signs and symptoms of respiratory distress likewise vary with disease progression. Children who present with acute stridor in whom there is any question of supraglottitis should be taken to an appropriate setting for direct endoscopic examination. When the more classic clinical presentation of acute laryngotracheitis is present and the degree of respiratory distress is mild to moderate, an outpatient work-up can be conducted. Radiographic evaluation consists of anteroposterior (AP) and lateral neck films. The classic subglottic “steeple sign” is noted in the airway in only 40% to 50% of children. As in supraglottitis, nonspecific hypopharyngeal widening reflecting upper airway obstruction is commonly observed. An accompanying chest radiograph is important to rule out associated lower respiratory tract infection. One AP and lateral view can be used to visualize both the neck and chest in young children.

The management of acute laryngotracheitis usually is an outpatient endeavor. Only those 5% to 10% of children with moderate to severe disease require hospitalization with monitoring of vital signs and oxygen saturation.²⁶ Humidified air is administered,
and oxygen may be necessary, depending on saturation readings. Sedation should be avoided. Properly diagnosed acute laryngotracheitis requires no antibiotic therapy. Nebulized epinephrine can provide temporary benefit in treating acute respiratory decompensation. The use of a single intramuscular or intravenous dose of steroid (0.6 to 1 mg/kg of dexamethasone equivalent) has been shown to decrease both the duration and severity of respiratory symptoms compared with placebo in children with acute laryngotracheitis.

Airway intervention is necessary in children with acute laryngotracheitis who fail to respond to medical management or in whom there is clinical suspicion of an alternative etiology.27 Failure to respond to medical management may reflect diffuse upper and lower airway involvement or associated parenchymal disease. Alternative etiologies include supraglottitis, bacterial tracheitis, or foreign body. In the child who does require endotracheal intubation, the size of the endotracheal tube chosen is crucial. The tube should be at least one and perhaps two sizes smaller than the appropriate size for that child under normal circumstances. Endoscopic airway evaluation is indicated in children who have recurrent episodes of croup requiring hospitalization or those who have atypical croup. Atypical croup is defined as a clinical course lasting longer than 1 week in the standard age group or croup occurring in infants younger than 6 months of age or children older than 5 or 6 years. A noninfectious lesion causing acute airway obstruction would be suspected in such children.

**Bacterial Tracheitis.** Bacterial tracheitis is also known as pseudomembranous croup or membranous laryngotracheitis.28 Children with bacterial tracheitis present both with a barking cough and inspiratory stridor. A gradual progression of mild airway symptoms typically is followed by an acute febrile phase with rapid respiratory decompensation. In contrast to supraglottitis, such children tend to lie flat and do not drool. Anterosuperior and lateral neck radiographs demonstrate a normal supraglottic shadow and subglottic narrowing. The classic roentgenographic finding is clouding of the tracheal air column or, more specifically, an irregular tracheal margin on high resolution soft tissue density films. Approximately 50% of children with bacterial tracheitis will demonstrate pneumonia infiltrates on chest radiographs. This is especially true if the duration of illness is greater than 24 hours.29

In contrast to children with acute laryngotracheitis, with bacterial tracheitis there is an elevated white blood cell count, and tracheal cultures usually are positive for bacterial pathogens. The etiology of bacterial tracheitis is predominantly S aureus, although cases are reported that are caused by S pneumoniae, M catarrhalis, group A streptococci, and H influenzae type B. Medical management includes hydration, humidification, and antibiotics. Early intervention is crucial. Initial antibiotic therapy includes nafcillin plus cefuroxime or cefotaxime. Clindamycin plus chloramphenicol is an alternative regimen in penicillin-allergic children. Endoscopic airway assessment is diagnostic and potentially therapeutic. The removal of obstructive membranous exudate may prevent the need for subsequent endotracheal intubation or tracheostomy. The need for airway support appears to be related to both age and the presence of associated pulmonary involvement. Tracheostomy may be necessary when there is repeated obstruction of an endotracheal tube by thick secretions or in cases of prolonged intubation when there is concern for the development of subglottic stenosis.

**REFERENCES**