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Tracheitis in Pediatric Patients

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Despite the advances that have been achieved in supportive pediatric intensive care, tracheitis remains a significant cause of reversible upper-airway obstruction in pediatric patients. This discussion highlights the epidemiology and clinical presentation of tracheitis in the twenty-first century and reviews diagnostic and therapeutic modalities. The gold standard for therapy remains supportive airway management in conjunction with appropriate antibiotic therapy. Finally, the unique challenges of diagnosis and treatment of tracheitis in the technology dependent child with an existing artificial airway (endotracheal tube or tracheostomy) are addressed.
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Tracheitis remains an important cause of reversible airway obstruction in the pediatric population despite the advances in aggressive supportive pediatric intensive care that have been achieved during the last 2 decades. Tracheitis accounts for 5 to 14 percent of upper-airway obstruction in patients requiring intensive care.[1-3]

Salamone and coworkers[4] have described "exudative tracheitis," a less-severe variant of tracheitis that may occur in older children and may be more likely to respond to local and systemic therapy, possibly without endotracheal intubation. Multiple infectious agents, including viruses, bacterial, or invasive fungal disease, can be responsible. *Staphylococcus aureus*, group A Streptococcus, and *Hemophilus influenza* are the leading bacterial causes of tracheitis in children.[5-7] Porta-Ribera[8] describes antecedent viral illness that may predispose the child to bacterial infection. An immune-compromised host who presents with tracheitis can have atypical pathogens that may not be susceptible to antimicrobial therapy. Tracheitis that develops in the previously healthy child with his or her own native airway is a distinctly different process from tracheitis the occurs in the infant or child with an artificial airway.

Clinical Presentation

The infant or child with tracheitis presents most acutely with signs and/or symptoms of airway obstruction or impending respiratory failure or both. These symptoms may include tachypnea, stridor, a hoarse voice, fever, cough, or increased secretions from the nose and mouth. The infant or child also may be somnolent or combative if s/he is hypercarbic or hypoxemic. The onset of symptoms often is acute.

Many children may have evidence of other concurrent infections, including sinusitis, otitis, pneumonia, or pharyngitis. Some children may have a history of gastroesophageal reflux disease that, with chronic tracheal aspiration, may result in tracheal injury as a predicate to recurrent tracheitis.[9]

Diagnosis

History, physical examination, and clinical suspicion are the hallmarks to the diagnosis of tracheitis. A chest radiograph can differentiate tracheitis from pneumonia, and one study even demonstrated sensitivity in the radiograph in detecting purulent tracheitis.[10] The definitive diagnosis of tracheitis can be made with direct laryngoscopy and trachoscopy, performed preferably in the operative suite by a pediatric otolaryngologist.[11] A normal-appearing epiglottis and larynx with visual evidence of tracheal inflammation, the presence of purulent tracheal secretions, and pseudomembranes is diagnostic.[7,8] Tracheal biopsy is rarely indicated in the evaluation of tracheitis, but may be warranted in the immune-compromised host or the child with ulcerative colitis.[12-14] A Gram stain of tracheal secretions to evaluate for the presence of polymorphonuclear leukocytes and bacteria may be a helpful initial screen. Subsequent aerobic and anaerobic bacterial cultures, as well as indicated viral cultures, should be obtained during the procedure.

Therapeutic Modalities

The single most important therapeutic maneuver in the treatment of tracheitis is the provisions of adequate airway pro-

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tection.[15] The infant or child often may require orotracheal or nasotracheal intubation to ensure a patent airway until the tracheal swelling, inflammation, and copious secretions abate. Diagnosis and treatment is secondary to the definitive treatment of impending airway obstruction in these children.[16] At least half of all children with bacterial tracheitis require intubation, and some studies report an intubation rate of 100 percent.[1,4] Children with tracheitis who require intubation have a critical airway and should be managed in a dedicated pediatric intensive care unit with a team of experienced nurses, respiratory therapists, and practitioners skilled in advanced airway management.

After a secure airway has been established, additional treatment modalities that may be used include broad-spectrum parenteral antibiotics. Rarely, antivirals may be required.[13] On occasion, therapeutic bronchoscopy may need to be repeated to facilitate removal of inspissated secretions.

Steroids and vasoconstrictors (eg, vaponephrine) have been used in the treatment of tracheitis. Both inhaled and parenteral steroids have been reported as being equally effective in the treatment of laryngotracheobronchitis, but none specifically in tracheitis.[17]

With appropriate antimicrobials and aggressive supportive care, children with tracheitis have rapid improvement in their signs and symptoms of airway obstruction, often permitting extubation within 72 to 96 hours.[18,19]

Initial antibiotic choices should include broad-spectrum antibiotics to include coverage for Staphylococcus, Streptococcus, and Hemophilus (eg, vancomycin and cefotaxime). However, in the immune-compromised host, antivirals, antifungals, or immune modulators may be indicated.[19] Fungal tracheitis in the immune-compromisesd individual often portends a grave prognosis.[20]

Special Considerations for Tracheitis with an Artificial Airway

Children with an endotracheal tube, an acute or chronic tracheostomy, or a laryngeal diversion who subsequently develop tracheitis present unique diagnostic and treatment challenges for the practitioner. Technology-dependent children have tracheostomy tubes that bypass the native protection of the nose, mouth, and upper airway. The endotracheal and/or tracheostomy tubes serve as a portal of entry, and the tube itself may result in various degrees of ulceration and tracheal denudation, thus predisposing the trachea to development of infection.[21] In addition, the child may require assisted mechanical ventilation with a humidified circuit, which results in colonization of the trachea with multiple bacteria.[22,23] Despite long-term colonization of potentially pathogenic bacteria, the overall incidence of serious respiratory infections is low.[24]

In this technology-dependent population, differentiating tracheitis from either colonization of the respiratory tract or another upper- or lower-respiratory tract infection is especially important. The same diagnostic tools should be employed in the treatment of tracheitis in the child with an artificial airway, with a few amendments. As always, a careful history and physical examination will yield the most diagnostic information. Determining a clinical deterioration in the respiratory status from the unique baseline is important. Questions that need to be answered are: If applicable, has a change occurred in the mechanical ventilation settings? Have monitored oxygen saturations changed? Does the child require more frequent suctioning by caregivers? Have the secretions changed qualitatively in color, viscosity, or odor? Review of the radiograph for changes from previous films is warranted.

A review of the child's previous tracheal aspirate Gram stains and cultures is essential. If the youngster previously had gram-negative rods and few white cells, but now presents with gram-positive organisms and sheets of white blood cells, the index of suspicion must be significantly higher for a tracheitis, especially if no evidence of pneumonia is present. Obtaining quantitative bacterial cultures from tracheal aspirates in the individual with the artificial airway is not helpful in the determination of true infection.[25]

Tracheoscopy is especially important in establishing the diagnosis of true tracheitis in the patient with an artificial airway. Direct visual examination of the trachea via the artifical airway at the bedside for evidence of inflammation can help to discern between a simple upper respiratory tract infection or tracheitis. Performing a tracheoscopy can ensure that the judicious, appropriate implementation of parenteral antimicrobials in those children with true tracheitis takes place and that antibiotics are not prescribed for individuals who are colonized or who have a concurrent viral infection.[26,27] If antibiotics are warranted, initial therapy should be tailored to cover the microbes isolated on the most recent tracheal aspirate and refined once current sensitivities are known. If the child previously has had multidrug resistant organisms, alternative antibiotics may be required.[28] Adjunctive aerosol therapy has also been reported as beneficial for individuals with artificial airways.[29]

Conclusion

Tracheitis continues to be a rare but significant cause of upper airway obstruction. Aggressive supportive care and airway protection are of paramount importance. In conjunction, airway support with initial broad-spectrum antimicrobial care remains the hallmark of definitive therapy. Infants and children with artificial airways remain a unique challenge to the clinician to discern the difference between other upper and/or lower respiratory tract infections and tracheitis. In all children with suspected tracheitis, direct visualization of the trachea is a valuable adjunct to provide both diagnostic and therapeutic information.

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