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TRACHEITIS IN CHILDREN, TREATMENT OF THIS DISEASE WITH HUMIDIFIED AIR AND CORTICOSTEROIDS

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Annotation. The first reported case of tracheitis was published in 1823 by Pierre Blaud. An increase in incidence was observed during each influenza A virus pandemic— H1N1 during the great Spanish flu (1918), Asian flu caused by H2N2 (1957), Hong Kong flu resulting from H3N2 (1968), and more recently the pandemic H1N1 of 2009. Autopsies performed during the 2009 pandemic showed tracheal denudation, maceration, de-epithelialization and other pathologic changes consistent with tracheitis.

Keywords: tracheit, laryngotracheit, myxoviruses, parainfluenza, superinfection, corticosteroid, Humidified Air.

Introduction

The first reported case of tracheitis was published in 1823 by Pierre Blaud. An increase in incidence was observed during each influenza A virus pandemic— H1N1 during the great Spanish flu (1918), Asian flu caused by H2N2 (1957), Hong Kong flu resulting from H3N2 (1968), and more recently the pandemic H1N1 of 2009. Autopsies performed during the 2009 pandemic showed tracheal denudation, maceration, de-epithelialization and other pathologic changes consistent with tracheitis. Bacterial tracheal infections still maintain a low level of presence in infants and children presenting with symptoms of airway obstruction, requiring ICU admission and potentially endotracheal intubation. Different diagnostic terms have been used for conditions that affect the larynx and trachea. Although it is useful to distinguish between supraglottic and subglottic laryngitis, this distinction is often difficult when the child is first seen. Laryngotracheitis or croup syndrome is a useful preliminary descriptive diagnosis until more definitive information is available. “Croup syndrome” also has been used to emphasize the variety of possible causes and location of laryngotracheal disease. In this chapter, “croup” is used to refer to subglottic laryngitis or laryngotracheitis, presumably viral. “ Epiglottitis ” is an imprecise term often used in place of the better “ supraglottitis ” as the epiglottis may be minimally involved in some cases in which most of the swelling is in the aryepiglottic folds. Preferred terms for tracheal infections are (with the usual terms in parentheses): croup, supraglottitis (epiglottitis), and suppurative tracheitis, laryngotracheitis, laryngotracheobronchitis, or laryngotracheobronchopneumonitis (bacterial tracheitis), depending on the extent of the bacterial superinfection.

Acute laryngotracheitis, considered to be the most common cause for croup, is almost exclusively caused by viral organisms. Both bacteria and viruses may be responsible for infections with collateral components, such as laryngotracheobronchitis, and the more general laryngotracheobronchopneumonitis. In 1958, the first evidence for association between croup and two newly isolated myxoviruses, parainfluenza virus types 1 and 2, resulted in separation of two categories of cases—mild, requiring only outpatient follow up, and severe, requiring hospitalization. Parainfl uenza is a RNA paramyxovirus that actively replicates in respiratory epithelial cells and is comprised of four major serotypes. Parainfluenza type 3, more commonly associated with bronchiolitis or bronchopneumonia, can also produce severe croup in an endemic pattern, while type 4 is rarely seen. Parainfluenza 1 and 2, account for >65 % of all causes of croup. A large series studied 6165 instances of lower respiratory tract infections (LRIs) wherein approximately 75 % of all isolates were identified as parainfl uenza viruses. Of these, parainfluenza type 1 accounted for about 60 %. Conversely, the propensity of the various organisms to produce symptoms of croup reached 60 % for both parainfluenza 1 and 2. For parainfl uenza type 3, the number dropped to about 30 %, whereas all the other microorganisms accounted for about 5–15 %. Thus, parainfluenza viruses were the

most common cause for all age groups; whereas respiratory syncytial virus (RSV) caused croup in infants and the infl uenza viruses and M.pneumoniae were significant causes of croup only in children older than 5 years of age. Summertime croup may be due to enteroviruses, adenovirus, or parainfluenza type 3. Among other important viral pathogens causing tracheal infections, RSV was studied in isolates from sentinel practices in England and Wales from 1975 to 1990, during which an increase in mortality, by as much as 60–80 %, was observed in comparison with parainfluenza and influenza viruses. Prematurity is associated with an increased risk for mortality, with factors such as a decrease in gestational age, increased perinatal oxygen requirements and discharge within 3 months of the RSV season increasing the likelihood for hospitalization. Among the rare viral causes, measles, by virtue of immunosuppression, leads to a bacterial superinfection that results in a condition termed measles- associated bacterial tracheitis (MABT), which carries an increased risk for need of artifi cial airway and intensive care admission. Bacterial tracheitis is much less common when compared to that of viral origin. Previous reports have shown that the most consistent organism is S.aureus , followed by S.pneumoniae and M.catarrhalis. Due to the universal immunization against H. influenzae type b , the incidence has dropped significantly. Similarly, immunization against C.diphtheriae has restricted the incidence of diphtheritic tracheitis to unimmunized children only. Reports of this are largely limited in modern literature, compared to the beginning of the century when tracheostomy was a routine practice to circumvent acute airway obstruction due to formation of pseudomembranes. The pathogens isolated in this series were in agreement with other studies of bacterial tracheitis, comprising Staphylococcus aureus and gram-negative bacteria, and sometimes, mixed flora. In this population, tracheitis was attributed to young age, with smallsized airways in which thick secretions and mucosal inflammation being blamed for impairment of air flow and increased stasis. Head trauma, neuromuscular blockade and mechanical ventilation were independent variables that increased the risk of infection, but the last two risk factors may be physiologically collinear, given that most patients who were administered neuromuscular blockade were intubated, and vice versa. Given the evolution of design features of modern day endotracheal tubes as well as enhanced monitoring of cuff pressures, reports of laryngotracheitis induced by indwelling endotracheal tubes have largely been limited to historic data. Modern endotracheal tubes use materials that intrinsically inhibit or are coated with substances such as micronized silver to reduce bacterial growth by providing less scaffolding for colonization. Infectious agents such as Mycobacterium tuberculosis and fungi have been previously reported to have caused isolated instances of tracheal infection with a picture of long-term respiratory failure requiring a tracheostomy during the course of treatment that may be prolonged. Chronic aspiration as well as gastroesophageal reflux (GERD) may accelerate laryngotracheal injury facilitating the development of tracheitis in those children.

Treatment. The treatment of tracheal infections has evolved over the course of the twentieth century, from initial descriptions of primitive endotracheal intubation to tracheostomy performed for acute airway distress secondary to laryngeal diphtheria. The first recognized form of treatment was the use of mist (humidified aerosol) produced by hot water, historically reported by keeping children close to a running tub with the door closed, leading to accumulation of mist. Discovery of therapeutic benefits from the use of corticosteroids and racemic epinephrine have revolutionized the manner in which croup is treated, and advanced in mechanical ventilation as well as development of rigid telescopes have improved treatment of tracheal infections of bacterial origin as well. These therapeutic strategies are summarized below.

Use of Humidified Air Croup kettles were first introduced in the late nineteenth century to provide aerosolized mist to alleviate the symptoms of viral croup. Later, cool mist was observed to have the same degree of therapeutic benefit as warm mist, and this avoids the risk of burns. There are at least three postulated mechanisms, which include a soothing effect on inflamed mucosa, reduced viscosity of tracheal secretions and activation of laryngeal mechanoreceptors leading to reduction of turbulence. However, humidity may also trigger bronchospasm, thus the duration of therapy should be carefully monitored. Recent studies have, however, shown that the benefits offered by mist treatment may be overemphasized. Three separate studies, that did not include untreated controls, determined that the efficacy of aerosolized mist may not be proportional to the degree of mist saturation, for e.g. the effects of humidity at three different levels (100 %, 40 % and 33 %) remained the same. In yet another study, the effect of nebulized saline was identical to mist. Lastly, a recent Cochrane review of data concluded that the benefit of mist therapy remains unproven.

Use of Corticosteroids. Despite the various recommendations for dosages, routes and drugs for use of corticosteroids, a number of large-scale studies have exemplified their therapeutic efficacy. Their mechanism of action is related to

the reduction of vascular permeability, resulting in a reduction of laryngeal and tracheal mucosal inflammation. The benefits are not readily apparent in children with mild croup as the symptoms begin to resolve in about the same time taken for steroids to show treatment benefit. Following adoption of corticosteroids as a standard first line of therapy in acute viral croup, overall hospitalization and the burden of the disease on healthcare systems worldwide began to fall. Among steroids, dexamethasone is used in a dose of 0.6 mg · Kg −1 body weight given either orally or by the intramuscular route. As dexamethasone is a potent steroid with a prolonged half-life, repeat doses are often unnecessary. Other investigators have shown that orally administered dexamethasone is as efficacious as parenteral formulations. The choice of route should hence be determined based on cost and availability. Yet another study failed to show differences in therapeutic benefit between three different doses (0.15, 0.3 and 0.6 mg · Kg −1) of dexamethasone, so a single dose (0.6 mg · Kg −1; maximum of 8 mg) may be sufficient in the outpatient setting. A double-blind, randomized control trial compared three different treatment strategies that included placebo, nebulized budesonide and oral dexamethasone. In this study, the overall rates of hospitalization were much less in the group treated with dexamethasone (23 %), compared with budesonide (38 %) and far less compared with placebo (77 %). Other studies have also advocated for the use of aerosolized budesonide given the rapidity of its action and effectiveness comparable to that of nebulized epinephrine.

Conclusion, despite the relative commonality of laryngotracheal infections, there are no clearly defined guidelines by national organizations for their treatment. The clinical picture can be often frightening to the parents who bring the child to the emergency room. Fortunately, the vast majority of children show signs of rapid improvement after initiation of treatment using steroids.

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