Pediatric Bacterial Tracheitis—A Variable Entity: Case Series with Literature Review

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Abstract

Objective. To review the presentation and treatment of children diagnosed with bacterial tracheitis at our institution and to review the available literature focusing on key presenting symptoms and clinical outcomes of children diagnosed with bacterial tracheitis.

Study Design. Case series with literature review.

Setting. Tertiary children’s hospital and available literature.

Subjects and Methods. Case series of children with bacterial tracheitis retrospectively reviewed at a tertiary children’s hospital. Those with a tracheostomy or those who developed bacterial tracheitis as a complication of prolonged intubation were excluded.

Results. Thirty-six children were identified (mean ± SD age, 6.7 ± 4.5 years). The most common presenting symptom was cough (85%), followed by stridor (77%) and voice changes/hoarseness (67%). A concurrent viral illness was found for 55%, and the most common bacteria cultured was methicillin-sensitive Staphylococcus aureus. Pediatric intensive care admission occurred for 69%, and 43% required intubation. No patient required tracheostomy. One patient (2.7%) died secondary to airway obstruction and subsequent respiratory arrest. Four patients had recurrence of bacterial tracheitis 4 to 12 months following their initial presentation.

Conclusion. Bacterial tracheitis is an uncommon condition with an atypical presentation and variable clinical course but serious consequences if left unrecognized. Staphylococcus is the most common bacteria identified, and many patients will have a prodromal viral illness. Changes in patient epidemiology and presentation may have occurred over time.

Keywords

bacterial tracheitis, tracheitis, laryngotracheitis

Bacterial tracheitis is an uncommon yet potentially life-threatening infectious cause of upper airway obstruction among pediatric patients. Although similar pathology was reported for adults, it is largely a concern for pediatric patients. Bacterial tracheitis is characterized by thick purulent exudates and tracheal pseudomembranes, which can cause acute airway obstruction and respiratory arrest. Traditionally, children with bacterial tracheitis are described as being critically ill with a high fever, stridor, respiratory distress, and a toxic appearance; however, multiple recent large case series suggested a changing epidemiology of the disease, and some children now present with less severe forms of bacterial tracheitis.

The published literature on the presentation and outcomes for children with bacterial tracheitis is limited, and the majority of available literature is composed of small case series and individual case reports. While recent publications suggested a changing epidemiology of bacterial tracheitis, patients may still present in critical extremis, requiring aggressive management. Identification of these patients provides the largest challenge in treatment. Our study objectives were 2-fold: (1) to review the presentation and outcomes of children diagnosed with bacterial tracheitis at our institution and (2) to review the available literature focusing on key presenting symptoms and clinical outcomes of children diagnosed with bacterial tracheitis.

Methods

After University of Utah Institutional Review Board approval (No. 112039), a retrospective chart review was performed to identify all patients presenting with bacterial tracheitis at a tertiary children’s hospital between 2011 and
Bacterial and Viral Culture Results: Primary Children’s Hospital Data (N = 36).

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>n (%)</th>
<th>Virus</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSSA</td>
<td>18 (50)</td>
<td>Parainfluenza</td>
<td>13 (36)</td>
</tr>
<tr>
<td>Mixed respiratory</td>
<td>6 (16.7)</td>
<td>Rhinovirus</td>
<td>7 (19.4)</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
<td>2 (5.6)</td>
<td>Influenza</td>
<td>5 (13.9)</td>
</tr>
<tr>
<td>MRSA</td>
<td>1 (2.8)</td>
<td>RSV</td>
<td>1 (2.8)</td>
</tr>
<tr>
<td>No growth</td>
<td>7 (19.4)</td>
<td>Negative</td>
<td>3 (8.3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not performed</td>
<td>12 (33)</td>
</tr>
</tbody>
</table>

Abbreviations: MRSA, methicillin-resistant Staphylococcus aureus; MSSA, methicillin-sensitive S aureus; RSV, respiratory syncytial virus.

Results

Thirty-six patients were identified: 20 male and 16 female. The mean ± SD age of presentation was 6.7 ± 4.5 years (median, 5.5; range, 0.6-17.6 years), and the mean prodromal period was 4.2 ± 3.2 days (median, 3; range, 1-14; excluding 2 outliers who presented after 42 and 120 days of symptoms).

Cough was the most common presenting symptom, identified in 30 patients (85%). Other presenting symptoms included stridor (n = 27, 77%), voice changes/hoarseness (n = 24, 67%), fever (n = 24, 67%), dyspnea (n = 23, 64%), and odynophagia/dysphagia (n = 14, 40%). Three patients were brought to the emergency department after suffering a respiratory arrest at home, and 6 patients (17%) were described as “toxic appearing” on presentation.

The mean white blood count was 11.4 ± 5.1 (range, 4.4-23.6; n = 24), and the mean C-reactive protein was 7.3 ± 11.9 (range, 0.4-45.0; n = 17). A chest or lateral neck radiograph was performed for 33 patients. Fifteen patients (42%) had subglottic narrowing, and 13 (39%) had a tracheal filling defect. For 4 patients, lateral neck radiograph yielded normal results; a computed tomography scan was performed for 1 of these patients, which demonstrated a pseudomembrane within the tracheal lumen.

Bacterial tracheitis was diagnosed by bronchoscopy for 27 patients, flexible laryngoscopy for 7, direct laryngoscopy for 1, and autopsy for 1. No patient was diagnosed per imaging findings alone. Edema and inflammation were seen among all patients, with gross purulence reported for 27 and tracheal debris and casts for 14.

Details of viral and bacterial cultures are detailed in Table 1. Twenty patients (55%) had a comorbid viral illness, most commonly parainfluenza (n = 12) and rhinovirus (n = 7). Six patients had ≥1 positive virus on viral panel. Of the 28 positive cultures, 19 (68%) grew methicillin-sensitive Staphylococcus aureus (MSSA); 6 (21%), mixed respiratory flora; 2 (7%), Streptococcus pneumoniae; and 1 (3.5%), methicillin-resistant S aureus.

Thirty-one patients were treated with intravenous steroids and 24 with nebulized racemic epinephrine while in the emergency department. Of the 24 treated with nebulized racemic epinephrine, no patient had a complete response; 14 had partial responses requiring at least 1 additional nebulized treatment, and 10 had no response. Twenty-four patients (69%) were admitted to the pediatric intensive care unit and 9 (25%) to the inpatient floor. Two patients (5.5%) were treated outpatient. Fifteen patients (43%) required intubation, with a mean duration of 3.2 days (range, 1-10 days). The mean length of pediatric intensive care unit admission was 2 days (range, 1-11 days), and the mean total inpatient admission was 4.1 days (range, 0-16 days). One patient died and was diagnosed after postmortem autopsy demonstrated bacterial tracheitis. This patient was treated with steroids and racemic epinephrine for croup at urgent care centers and the emergency department, with a partial response each time. The patient was discharged from the hospital and suffered a respiratory arrest at home. Four patients had recurrence of bacterial tracheitis 4 to 12 months following their initial presentation.

Discussion

Bacterial tracheitis is a rare but potentially life-threatening cause of infectious airway obstruction among pediatric patients. Thick exudative plaques can obstruct the airway, leading to respiratory distress, cardiac arrest, and even death. While early reports of bacterial tracheitis describe a serious and highly fatal disease, a renewed interest in bacterial tracheitis suggests a variable disease with diverse presentations and spectrum of outcomes. Here we review our experience diagnosing and treating patients with bacterial...
series, 5-8 we focus on the clinical presentation of bacterial tracheitis at a single tertiary care institution. While our outcome results are similar to those presented in other large series,5-8 we focus on the clinical presentation of bacterial tracheitis in addition to reporting our outcomes.

Infants and children with bacterial tracheitis will often present acutely with signs and symptoms of upper airway obstruction or impending respiratory failure. Common presenting symptoms identified in this series and in the literature include cough, stridor (inspiratory or biphasic), voice changes or hoarseness, fever, and dysphagia or odynophagia. These symptoms are thought to result from a bacterial superinfection superimposed over a viral upper respiratory infection,4,10 explaining the commonly reported prodromal changes or hoarseness, fever, and dysphagia or odynophagia. Many patients in our series presented with symptoms of a viral prodrome prior to presenting to our institution. Although children with bacterial tracheitis are classically described as “toxic appearing,” only 6 patients (17%) were described as toxic in our series. Furthermore, many patients in our series presented with only findings of an upper respiratory infection. This differentiates the initial presentation in our study from similar large case series reporting outcomes of bacterial tracheitis.5,8 While this may be an effect of a changing epidemiology of disease, it just as well may be a result of increased awareness and improved screening and diagnostic procedures.

In 1991, Gallagher and Myer described a clinical algorithm to aid in the diagnosis of bacterial tracheitis.12 Patients with a high clinical suspicion of disease were taken immediately to the operating room for operative bronchoscopy, clearing of tracheal membranes, and possible intubation. Those with an atypical presentation or low clinical suspicion underwent flexible laryngoscopy. If there was evidence of nonclearing purulent secretions, the patient was taken to the operating room for bronchoscopy. Our institution adopted a similar protocol over the study interval, which likely accounts for our high number of patients with bacterial tracheitis and the variable clinical presentations from mild to severe. However, this did allow us to more readily identify patients earlier in their presentation to prevent unwanted outcomes.

This algorithm was also used by Salamone et al to identify a large number of patients (n = 94) with bacterial tracheitis.5 This is the largest series published to date and was one of the first to suggest a changing epidemiology of the disease (an earlier publication from the same group reported similar findings based on the same series of patients).5,8 In this series, the authors identified a large subset of patients presenting with mild symptoms and no sign of systemic infection (high fever, leukocytosis, etc.). The authors suggested that the term exudative tracheitis was a more accurate description for these cases, implying that a local infection by bacteria or virus causes the formation of the thick exudate without systemic infection. Exudative or bacterial tracheitis may represent a continuum between mild upper respiratory infection and severe bacterial tracheitis.

Management of the airway is critical in the treatment of bacterial tracheitis. Rigid bronchoscopy is the gold standard for determining the presence or absence of tracheal membranes, characteristic of bacterial tracheitis. These membranes can slough into the airway, becoming a life-threatening airway foreign body. Maintaining a stable airway is crucial, and many children may require intubation or tracheostomy placement. In our series, approximately 43% required intubation, and no patient required a tracheostomy. Similar findings were identified in our literature review; however, 2 patients did require a tracheostomy as the initial airway-stabilizing procedure.13,14 Once the airway is stabilized, treatment of all patients, regardless of severity, includes systemic antibiotics and supportive care. Cultures are typically positive for methicillin-sensitive S aureus; however, Haemophilus influenzae, Moraxella catarrhalis, and S pneumoniae are also commonly identified. Complications have been described, including acute respiratory distress syndrome, toxic shock syndrome, septic shock, and disseminated intravascular coagulation,7,15-17 although none of these were witnessed in our series.

Methicillin-sensitive S aureus was the most common bacterial isolate identified in both our retrospective and structured review. Interestingly, there were no other similarities in the bacteriology of the systematic review and the retrospective review. The most commonly identified bacterial isolates in our structured review were H influenzae, S pneumoniae, and M catarrhalis, whereas in our hospital’s case series, no cases of H influenzae or M catarrhalis were identified. Furthermore, the identification of M catarrhalis appeared to decrease substantially over the 3-decade interval of our literature review, suggesting at least a change in the bacteriology of the disease over the interval.

Two patients in our series were treated as outpatients and were thought to have a likely chronic form of bacterial tracheitis.18,19 Both patients presented to the outpatient clinic with a history of intermittent stridor and a hoarse voice at 42 and 120 days. Both these patients were evaluated with flexible laryngoscopy, which demonstrated exudate and crusting in the glottis. These patients were taken to the operating room for bronchoscopy with similar findings extending into the subglottis and to the midtrachea. Culture results for both patients were positive for MSSA. Both were treated with Bactrim (sulfamethoxazole and trimethoprim) on an outpatient basis with significant improvement in their symptoms; however, similar symptoms recurred 5 months later for 1 patient and at 1 and 1.5 years for the other. During each reoccurrence, cultures continued to be positive for MSSA, and the patients were again treated with debridement and a prolonged course of Bactrim. To date, no cases of chronic pediatric bacterial tracheitis or laryngitis have been reported in the literature.18

There was 1 death in our series. The atypical course of the viral croup, with multiple visits to urgent care and the emergency room and only a partial response of treatment, was the likely indicator that further investigation should have been undertaken. In our series, of the 24 patients who received racemic epihnephrine, no patient demonstrated a full response with complete resolution of symptoms. A partial
response, as indicated by either a failure to resolve the stri-
dor or a need for multiple repeat treatments in a short du-
ration, was noted for 14 patients, whereas no response was
noted for 10. Failure to respond to conservative treatment
has been reported as a hallmark of bacterial tracheitis4,20-22
and should serve as a warning that further investigation
needs to be performed.

This study did have limitations. All data from the retro-
spective review were collected from the medical record
and relied on the accuracy of the original documentation by the
medical staff. Additionally, the small sample size of our ret-
rospectively collected data made statistical analysis challeng-
ing. Given the relative infrequency of bacterial tracheitis,
a large prospective trial would be challenging. With the
results of this retrospective review, our institution is work-
ing to create a standard algorithm for treating patients who
present with findings concerning for bacterial tracheitis. We
hope that this will provide not only accurate data for future
analysis but also improved patient care.

Conclusion

Bacterial tracheitis is an acute infectious cause of upper
airway obstruction in the pediatric patient. Results of our
retrospective and literature review suggest that there may be
a spectrum of bacterial tracheitis severity. Bacterial or exu-
dative tracheitis may represent a continuum between a mild
upper respiratory infection and severe bacterial tracheitis.
Future research efforts should be directed at studying this
spectrum and the management of a less severe form of
infectious tracheitis.

Author Contributions

Geoffrey Casazza, study conceptualization, data collection, study
design, analysis, manuscript preparation; M. Elise Graham, data
analysis, manuscript preparation; Douglas Nelson, data collection,
manuscript preparation; David Chaulk, data collection, manuscript
preparation; David Sandweiss, data collection, manuscript prepara-
tion; Jeremy Meier, study design, analysis, manuscript prepara-
tion, mentorship.

Disclosures

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