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A Fractured Tracheostomy Tube Causing Airway Compromise

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Statistical Analysis C
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Patient: Female, 19-year-old
Final Diagnosis: Fractured tracheostomy tube
Symptoms: Airway obstruction
Medication: —
Clinical Procedure: —
Specialty: Otolaryngology

Objective: Unusual clinical course

Background: A wide variety of emergency scenarios associated with tracheostomy tubes have been reported in patients with complex airway disease. Fracture of a tracheostomy tube is a rare complication with a potential for catastrophic outcome. The aim of this case report is to present clinical features and management of airway compromise due to a fractured tracheostomy tube in a patient with subglottic and tracheal stenosis.

Case Report: A 19-year-old woman with a history of chronic lung disease, developmental delay, subglottic stenosis, and tracheal stenosis presented to the Emergency Department after her mother noticed that the tracheostomy tube was broken at the junction of the cannula and neck plate. Upon arrival, the patient was stable and the stoma site had a pinpoint-size opening. A chest X-ray revealed a dislodged tracheostomy tube with the shaft's convexity ventrally oriented in the trachea. The stoma was dilated to allow passage of a 2.5-mm flexible laryngoscope into the trachea. The fractured tracheostomy tube lodged in the trachea distal to the stoma and proximal to the carina. The fractured tracheostomy tube migrated to the suprastomal site at the time of repeat tracheoscopy under general anesthesia. The fractured tracheostomy tube was removed transorally through the tracheal and subglottic stenosis with the use of optical forceps and rigid bronchoscope.

Conclusions: Prompt recognition and management of a fractured tracheostomy tube is critical to prevent morbidity and mortality. Caregivers and healthcare providers must be prudent about proper tracheostomy tube care, potential manufacturing defects, and monitoring the condition of tracheostomy tubes.

Keywords: Airway Obstruction • Foreign Bodies • Tracheal Stenosis • Tracheostomy

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Background

Many children with chronic medical conditions require long-term tracheostomy for management of congenital or acquired upper airway obstruction, respiratory compromise necessitating prolonged ventilation, and increased airway secretions. Comprehensive education of caregivers is critical for optimum outpatient management of children with tracheostomy. Caregivers should be competent in routine tracheostomy care procedures, including suctioning, changing tracheostomy tubes, and emergency tracheostomy care such as recognizing signs and symptoms of distress, and a dislodged or plugged tube [1]. Tracheostomy emergencies are uncommon; however, children with tracheostomy have a higher risk of morbidity and mortality. A fractured tracheostomy tube causing a tracheobronchial foreign body is a rare complication documented in children and adults [2-10]. We present clinical features and management of airway compromise due to a fractured tracheostomy tube in a patient with subglottic and tracheal stenosis.

Case Report

A 19-year-old woman with tracheostomy presented to the Emergency Department after her mother noticed that the tracheostomy tube was broken at the junction of the cannula and neck plate. The patient had a history of premature birth at 23 weeks, chronic lung disease, and developmental delay. The tracheostomy was placed at 4 months of age for subglottic stenosis and ventilator dependence. The patient had subglottic and tracheal stenosis after undergoing laryngotracheoplasty at 14 years of age. The tracheostomy tube has been replaced every 29 to 30 days after the laryngotracheoplasty. The patient had been lost to follow-up for 2 years and had been downsized to a 3.0 pediatric silicone tracheostomy tube at home. The last tracheostomy tube change occurred more than 6 months prior to presenting to the Emergency Department. The patient's mother noticed that the tracheostomy tube was broken at the junction of the cannula and neck plate. The cannula of the tracheostomy tube had been dislodged into the airway when the patient's mother attempted to remove the fractured tracheostomy tube.

Upon arrival at the Emergency Department, the patient was in stable condition. One attempt was made to replace the patient's 3.0 tracheostomy tube at bedside without success by an Emergency Department physician. The Emergency Department physician inspected the stoma site, and the tube was not visible through the stoma site, which was partially patent. The Emergency Department physician did not insert any instrument via the stoma site. A chest X-ray confirmed the fractured piece of the tracheostomy tube to be within the airway, and Pediatric Otolaryngology was consulted (**Figure 1**). On exam,

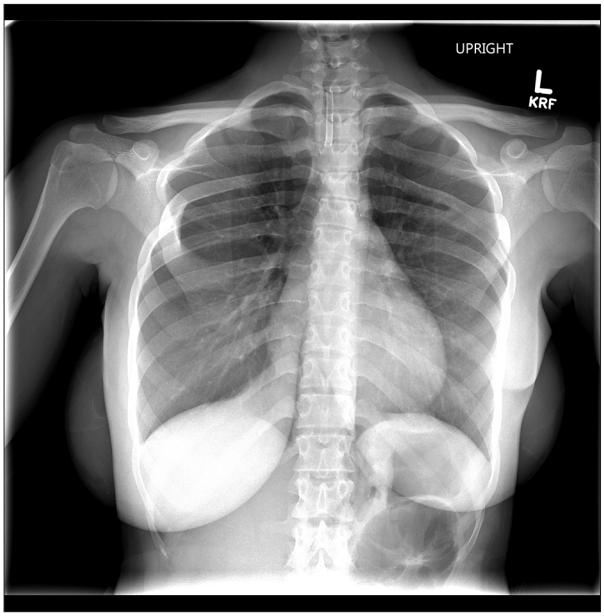

Figure 1. Chest radiograph showing the fractured tracheostomy tube.

the patient was breathing comfortably on room air with normal vital signs. The stoma site had a pinpoint-size opening. The Otolaryngology physician used a sterile cotton-tipped applicator to dilate the stoma at the bedside to allow passage of a 2.5-mm flexible laryngoscope into the airway. The aspirated portion of the fractured tracheostomy tube was located distal to the stoma and proximal to the carina. While awaiting transportation to the operating room, the patient developed severe coughing.

In the operating room, the patient was ventilated using a bag mask and a 3.0 endotracheal tube (ETT) was passed through the stoma over a 2.5-mm flexible laryngoscope to ensure placement into the tracheal lumen without dislodging the fractured tracheostomy tube. The fractured tracheostomy tube was not in the field of view. Under direct vision, the ETT was advanced into the trachea and ventilation was accomplished through the ETT. At this point, the fractured tracheotomy tube was located above the stoma site and ETT.

Laryngoscopy was performed and a ventilating bronchoscope was advanced into the airway. The fractured tracheostomy tube was visualized below the subglottis (**Figure 2**). Optical forceps were advanced through the stenotic region into the trachea and the fractured cannula was removed. The cannula was stiff and had a gross color change (**Figure 3**). The patient was transorally intubated with a 4.0 uncuffed ETT. The 3.0 ETT was removed from the stoma and a 3.5 pediatric silicone tracheostomy tube was placed in the stoma using an obturator. Tracheoscopy performed through the tracheostomy tube revealed that the trachea, carina, and bilateral mainstem

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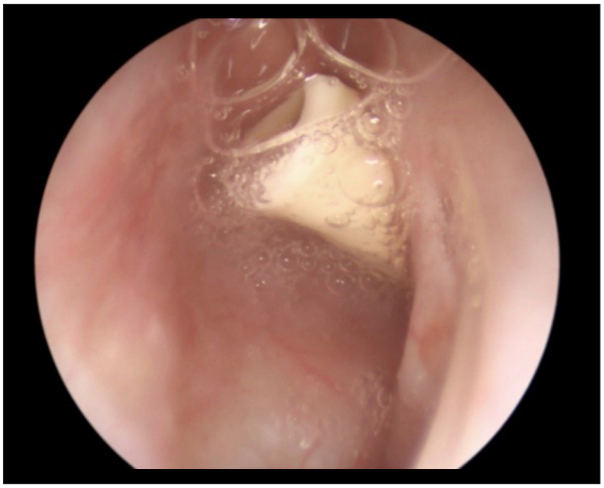

Figure 2. Bronchoscopy picture showing the removal of fractured tracheostomy tube through the stenotic region.

Figure 3. Cannula of the fractured tracheostomy tube after removal.

bronchus were within normal limits. Placement of a silicone T-tube after dilating the stenotic region was another option to establish the airway. We did not insert a silicone T-tube instead of a tracheostomy tube as we aimed to minimize airway manipulation while establishing a secure airway as soon as possible in this patient requiring emergency airway management.

Discussion

Common tracheostomy emergencies in the outpatient setting include accidental tracheostomy tube dislodgement, inability to reinsert the tracheostomy tube, plugging of the tracheostomy tube, and cardiopulmonary arrest [11]. Fracture of a tracheostomy tube is a rare complication with a potential for catastrophic outcome [6]. Since a broken piece of cannula was reported in an adult with metal tracheostomy tube in 1960, the majority of case reports of fractured tracheostomy tube have been published in children with tracheostomy [2-9]. The present case report highlights additional features of clinical presentation and management of fractured tracheostomy tube in an adult with a tracheostomy tube.

The most commonly used tracheostomy tubes in children are made from metal, polyvinyl chloride (PVC), silicone, or polyurethane. Components of tracheostomy tube are universal connector, neck plate, cannula, cuff, and pilot balloon. The majority of fractured tracheostomy tubes reported in children were made from PVC [5-9]. The most common site of fracture is at the junction of the neck flange and cannula. Our patient had a silicone tracheostomy tube and the fracture site was at the junction of the neck plate and cannula. Previous reports postulated that the fragile points of the tracheostomy tubes are the junction between the cannula and the neck plate, as well as the distal end of the tube and the fenestration site [2,6,7]. The association between the material of tracheostomy tube and fracture of the tube components has not been systematically studied.

Proposed risk factors of a fractured tracheostomy tube include patient- and manufacturing-associated elements [5,7]. Routine change of a tracheostomy tube is recommended by manufacturers. Patient non-compliance to routine tracheostomy tube change increases the risk of a fractured tracheostomy tube. Prolonged exposure to tracheobronchial secretions and internal stresses on the surface endanger the integrity of tracheostomy tubes. Tracheotomy tubes made from PVC, silicone, and polyurethane had surface changes causing material wear after 3 to 6 months of use [10]. A manufacturing defect causing faulty fusion at the junction of the cannula and neck plate has been implicated as a cause of fractured tracheostomy tubes [3,9]. Repeated removal and placement of tracheostomy tubes potentially increases the mechanical stress load, leading to a fractured tracheostomy tube. In our patient, prolonged wearing of the tracheostomy tube led to a fractured tracheostomy tube. The original consistency of the cannula material changed from soft to stiff in our patient after wearing the same tracheostomy tube for more than 6 months. We did not have the fractured tracheostomy assessed at the microscopic level; however, in a previous study, surface defects, including cracks, pores, pits, flaking, and color change have been documented [10]. Replacement of PVC, silicone, and polyurethane tubes before the end of 3 months of use has been recommended based on the material degradation at the morphological and chemical level [10]. However, manufacturers recommend changing the tracheostomy tube every 29 days. Nevertheless, the frequency of routine tracheostomy tube change should be determined on an individual basis.

Dislodgement of a fractured tracheostomy tube causes partial or complete tracheobronchial obstruction. Clinical presentation of symptomatic patients includes cough, stridor, respiratory distress, tachypnea, tachycardia, pain, and cyanosis [5-9]. In a rare

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case of a fractured tracheostomy tube, a 7-year-old boy was asymptomatic after aspirating 2 fractured tracheostomy tubes [5]. Our patient was asymptomatic until arriving at the Emergency Department, where she developed an episode of severe cough after a chest X-ray. The pinpoint-size stoma site was manipulated to perform tracheoscopy and to determine the feasibility of removal of the fractured tracheostomy tube. However, blind replacement of a tracheostomy tube and manipulation of the stoma site at bedside should be avoided in a patient with a compromised airway to prevent further airway compromise. Instrumentation of the stoma site has potential risk of further dislocation of the fractured tracheostomy tube. Expedited removal of the fractured tracheostomy tube is critical in preventing a catastrophic outcome and complications. Death was inevitable in a child who was admitted for decannulation when a fractured tracheotomy tube caused sudden airway obstruction [6].

The majority of fractured tracheostomy tubes have been removed with the aid of a bronchoscope placed into the airway transorally or via tracheostomy [5-9]. Removal of a fractured piece of tracheostomy tube is challenging in a patient with compromised airway due to subglottic and tracheal stenosis. In a previous study, the detached portion of the tracheostomy tube was removed after making a stomal incision and retracting tracheal cartilage [6]. We were able to remove the fractured tracheostomy tube transorally with the aid of a ventilating bronchoscope introduced into the airway. The soft and expansible nature of the subglottic and tracheal stenosis allowed passage of the fractured tracheostomy tube through the stenotic region. During the removal of the fractured tracheostomy tube, ventilation was maintained via an endotracheal tube inserted via a tracheostomy. Insertion of an endotracheal tube through stoma site was used in a previous study to improve oxygenation and stabilize the patient [4]. Communication between the surgeon and anesthesiologist is crucial for management of an airway foreign body. Cardiopulmonary partial bypass may be considered for oxygenation and induction in the presence of suprastomal airway obstruction or risk of complete airway obstruction [4].

In the present case, the caregiver's immediate attention allowed for timely management of the fractured tracheostomy tube. However, the caregiver's lack of knowledge about the critical role of routine changing of the tracheostomy tube contributed to occurrence of this incident. Our findings demonstrate that it is important for caregivers to be aware of the possibility of a fractured tracheostomy tube. Our management of airway compromise revealed that a fractured tracheostomy tube can be removed transorally in some patients with soft and expansible subglottic and tracheal stenosis, while maintaining ventilation via an endotracheal tube inserted into the airway through the stoma.

Conclusions

Prompt recognition and management of a fractured tracheostomy tube is critical to prevent morbidity and mortality. Caregivers and healthcare providers must be prudent about proper tracheostomy tube care, potential manufacturing defects, and monitoring the condition of the tracheostomy tube.

Department and Institution Where Work Was Done

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Declaration of Figures' Authenticity

All figures submitted have been created by the authors, who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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