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Slide tracheoplasty for the treatment of tracheoesophogeal fistulas

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ABSTRACT

Purpose: The purpose of this study is to determine the surgical outcome of slide tracheoplasty for the treatment of tracheoesophageal (TE) fistula in pediatric patients.
Methods: After internal review board approval, the charts of pediatric patients (0–18 years old) who had undergone slide tracheoplasty for tracheoesophageal fistula were retrospectively reviewed. Patient information and surgical outcomes were reviewed.
Results: Nine patients underwent slide tracheoplasty for correction of TE fistula. In five patients the original TE fistula was congenital. Other causes included battery ingestion, tracheostomy tube complications, foreign body erosion, and an iatrogenic injury. The average age at repair was 48 ± 64 months (range: 1–190). Seven patients had undergone previous TEF repair either open or endoscopically. There were no recurrences after repair. Two patients had sternal periosteum interposed between the esophagus and trachea. There were no TEF recurrences. A single patient had dehiscence of the tracheal anastomosis and underwent a second procedure.
Conclusion: Slide tracheoplasty is an effective method to treat complex TE fistulas. The procedure was not associated with any recurrences. This is the first description of a novel, effective, and safe method to treat TE fistulas.

Complex tracheoesophageal (TE) fistulas can be significantly challenging to surgically correct and carry significant morbidity and mortality if left unrepaired. These aberrant connections between the esophagus and trachea are often associated with esophageal atresia, dysmotility, tracheomalacia and various syndromes. Food may enter the airway and soil the lungs. The patients, often medically fragile, are then prone to repeat bouts of pneumonia and respiratory complications. Oral feeding becomes impossible for many. Despite refraining from eating, many continue to have saliva entering the airway, leading to persistent pulmonary injury. Repair of these aberrant connections therefore becomes essential to a healthy lower airway as well as reestablishing oral feeds.

Surgical correction of TE fistulas preserves trachea and esophagus patency while closing the communication between these two structures. A number of procedures have been developed to address this problem. However, many of these procedures have had limited success when dealing with the most complex fistulas. Successful repair was first reported in the 1940's using an extrapleural approach and primary anastomosis to address the fistula and esophageal atresia [1]. Since that time a number of different techniques have been employed [2–4]. These procedures have sought to decrease the morbidity associated with the approach while improving the closure rates. Various alterations in anastomosis have been proposed [1]. Some authors have used cervical esophagostomy and gastrostomy or replacement for treatment in patients with severe disease and atresia [3]. Endoscopic procedures are also employed; small fistulas can be cauterized from both the esophageal and tracheal sides. Fibrin glue can also be placed within the fistula [2].

Previous techniques closed the esophageal and tracheal components separately but continued to leave the two anastomosis lines juxtaposed. Breakdown of one closure made it likely that the opposite side would also fail. Some authors have used various materials, such as vein or pleura, between the two repair sites to help prevent breakdown of the closure [5]. Despite this interposed tissue, the two anastomotic lines continued to be continuity. Even with the success with these procedures, persistent and recurrent fistulas remain surgical challenges. Revision cases carry the additional difficulties of scaring, altered surgical anatomy and compromised blood supply to the tissue. Given these reasons, repair of recurrent fistulas is often difficult and associated with significant morbidity and mortality [3].

Slide tracheoplasty is a technique utilized to address various etiologies of tracheal stenosis [6,7]. It has proven a safe and highly effective treatment for patients with complete tracheal rings [6]. While this procedure has been successfully employed for tracheal abnormalities, the literature is absent of any reports using this

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technique to address complex TE fistulas. We have found success with this technique when reserving it for complex cases or previously repaired fistulas. In this report we present the novel use of slide tracheoplasty for the treatment of TE fistulas and describe the surgical outcomes of this procedure.

1. Materials and methods

1.1. Data collection and analysis

Data collection and patient selection were performed after approval by the Cincinnati Children's Hospital Medical Center Institutional Review Board. Patients were identified who had a diagnosis of TE fistula and who had undergone repair by slide tracheoplasty. Pediatric patients (age 0–18 years old) were identified from 2000 to 2012. Demographic information, surgical data and outcomes were recorded and analyzed using Microsoft Excel (Redmond, WA). Patient gender, age at surgery and medical diagnosis were recorded. Previous surgical procedures were noted as well as intraoperative findings, surgical outcomes and complications.

1.2. Surgical procedure

Our previous publication has described the slide tracheoplasty technique [6]. Modifications have been made to address the TE fistula. Microscopic direct laryngoscopy, bronchoscopy and esophagoscopy are initially performed to verify the location of the fistula. An esophageal bougie is placed. The technique varies depending upon the surgical approach. Patients undergoing a cervical incision will be intubated orally, or in the case of an existing tracheostomy, through the stoma site. Patients requiring a sternal incision and cardiopulmonary bypass will be intubated orally with the stoma sutured shut. In these patients, cardiopulmonary bypass is established prior to the beginning of tracheal work. In both approaches, the anterior wall of the trachea is freed from surrounding tissue as distal as possible. For patients with a cervical approach, mobilization often continues into the mediastinum and to the carina. In all patients, care is taken to preserve lateral tracheal attachments to maintain the blood supply and avoid damage to the recurrent laryngeal nerves. Retraction sutures using 2–0 Prolene (Ethicon, Blue Ash, OH) are placed through the distal tracheal rings to retract the trachea. Flexible bronchoscopy through the endotracheal tube or rigid bronchoscopy can be repeated to confirm the location of the fistula. A needle is placed through the anterior tracheal in the corresponding location of the fistula. The trachea is then divided both superior and inferior to the fistula tract, leaving a small portion of trachea attached to the tract (Fig. 1). The trachealis of the superior and inferior tracheal segments is then separated from the esophagus and mobilized. The trachea that remains attached to the fistula is then freed of it mucosa and the cartilage portion is removed (Fig. 2). The edges of the esophageal side of the fistula are freshened in preparation of closure. The tracheal mucosa is then inverted and folded into the esophageal portion of the fistula. Closure is performed with a series of interrupted vicryl sutures (Ethicon). In cases of large fistulas, the cartilage can be kept in continuity with the mucosa and used in the closure for added support. Periosteum is harvested from the sternum and placed on top of the esophageal closure (Fig. 3).

Approximately 1 cm of the posterior wall of the inferior tracheal segment and the anterior wall of the superior segment are then divided vertically. The corners of the two segments are removed in order to achieve better approximation during closure. A running, polydioxanone (PDS) (Ethicon) is then used to close the anastomosis beginning with the posterior aspect of the trachea. The resulting, oblique anastomosis is longer than a corresponding end-to-end anastomosis, thereby distributing the tension across a longer area. Once all sutures are placed, fibrin glue is then applied across the tracheal closure. If occurring through a cervical incision, the previously placed Prolene retraction sutures can be placed around the hyoid as internal Grillo sutures. When performed through a sternotomy, the retraction sutures can be removed as the hyoid is not exposed. The patient remains intubated overnight in the intensive care unit and is generally extubated on postoperative day one. The endotracheal tube lumen should be large enough to accommodate a flexible bronchoscope containing a suction port, thereby allowing for the removal of secretions or blood. A repeat bronchoscopy can be performed in one to two weeks. Fig. 4 demonstrates preoperative and postoperative photos.

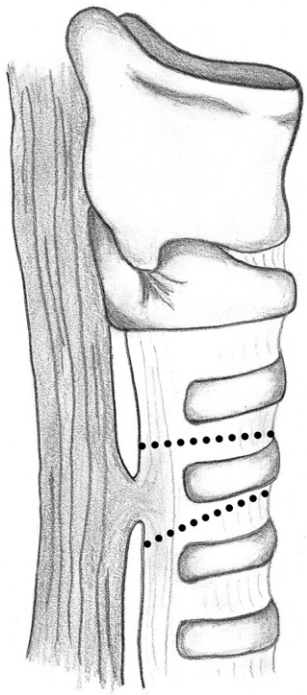

Fig. 1. The trachea is divided superior and inferior to the fistula site. A small portion of the trachea remains attached at the fistula and is used to reinforce the fistula repair.

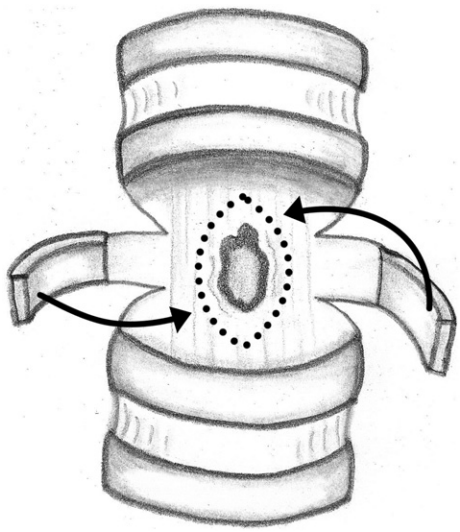

Fig. 2. The tracheal mucosa is removed from the cartilaginous rings and folded into the denuded fistula to reinforce the closure. In some instances the cartilage can also be used to reinforce the closure site.