Tracheoesophageal fistula

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ABSTRACT

Tracheoesophageal fistula (TEF) is a relatively rare congenital anomaly. Surgical intervention is required to establish esophageal continuity and prevent aspiration and overdistension of the stomach. Since the first successful report of thoracoscopic TEF repair in 2000, the minimally invasive approach has become increasingly popular and widespread. The main advantages of the thoracoscopic technique include avoidance of a thoracotomy, improved cosmesis, and superior visualization of the anatomy and fistula afforded by the laparoscope’s magnification.

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Introduction

Tracheoesophageal fistula (TEF) is a relatively rare congenital anomaly occurring in approximately one in 3000 live births. Esophageal atresia (EA) with distal TEF, Gross type C, in which there is a proximal esophageal pouch and distal tracheoesophageal fistula, accounts for approximately 85% of esophageal atresia anomalies. In addition, other variations include EA with a proximal TEF, accounting for approximately 5%, TEF without EA, approximately 4%, and EA with fistulas to both pouches or an H-type fistula, approximately 1%. TEF may be an isolated defect or may be associated with other congenital anomalies (VACTERL syndrome) of which cardiac and vertebral defects are the most commonly seen.

Improvements in fetal imaging have led to increased prenatal diagnoses of this condition. Prenatal ultrasound findings include a small or absent stomach bubble and polyhydramnios. After birth, patients with EA and distal fistula typically present with excessive salivation and regurgitation with feeds, respiratory distress, and an inability to pass an orogastric tube. Plain films demonstrate a nasogastric tube coiled in the upper esophageal pouch. Air in the stomach and distal bowel confirms the presence of a distal fistula. For H-type fistulas, patients usually choke with feeds or have cyanotic spells. Older infants may present with recurrent pneumonia. In isolated TEF, chest x-rays may show pneumonitis and gastric distention. The diagnosis may be made with a prone, pull-back esophagram.

Surgical intervention is required to establish esophageal continuity as well as prevent aspiration and overdistension of the stomach. The minimally invasive approach to repair TEF is becoming increasingly popular and widespread. The first successful thoracoscopic repair of an esophageal atresia with distal TEF was performed in 2000 by Rothenberg. Subsequently, many series have been published demonstrating the feasibility of this technique.

Pre-operative preparation

Pre-operative work up and preparation is similar for a thoracoscopic and open operation. Evaluation of other congenital anomalies should be performed, including an echocardiogram both to evaluate for structural cardiac abnormalities and to determine the position of the aortic arch. A right-sided aortic arch may be found in approximately 2.5% of cases. Additionally, a physical exam, renal ultrasound, and genetic testing should be performed. A nasogastric tube is placed in the upper pouch to suction secretions and minimize aspiration. Mechanical ventilation should be avoided if possible pre-operatively, and if required, gentle ventilation with low-peak pressures should be used. Although not emergent, surgery should be performed relatively promptly to prevent aspiration and pneumonitis as well as gastric distension from ventilation through the fistula.

Technique

Thoracoscopic approach

There are few contraindications to the thoracoscopic approach. The main contraindication is severe hemodynamic instability. Relative contraindications include significant cardiac defects,
prematurity and small size (< 1500 g), and significant abdominal distension. Other surgical procedures that are required can be done at the same time as a thoracoscopic TEF repair.

General anesthesia is administered with low-peak pressures. Tracheal intubation is sufficient although a left mainstem intubation may be attempted if can be accomplished easily. Otherwise, the endotracheal tube should be positioned just above trachea. A pre-operative bronchoscopy may be performed at the discretion of the surgeon. The patient is placed in a modified prone position with the right side elevated approximately 30°. (Figure 1) If a right-sided arch is identified pre-operatively, the chest may be approached from the left side. This positioning allows the lung to fall away from the posterior mediastinum and provides excellent exposure to the area of the fistula. The surgeon and assistant stand anteriorly at the patient’s front and the monitor is placed at the back. Three ports are usually used. A 4 mm port is placed in the fifth intercostal space just posterior to the tip of the scapula for the camera. Two additional 3 mm ports are placed to make a 90° angle at the level of the anastomosis. The port for the right hand is placed in the midaxillary line one to two interspaces above the camera port. This superior port can initially be a 3 mm port to perform the dissection and then changed to a 5 mm port for the clip applier and introduction of sutures. The port for the left hand is placed one to two interspaces below the camera port along the posterior axillary line. (Figure 2) CO2 insufflation is used with low flow (1–2 L/min) and low pressures (4–8 mm Hg).

The azygos vein is mobilized for a short distance with a Maryland dissector or 3 mm tissue sealer and then divided. (Figure 3) Cautery or a tissue sealing device should be used rather than clips or ties, which could interfere with the fistula dissection. The lower esophageal segment is dissected to identify the fistula with care to avoid the vagus nerve. The fistula is dissected to the area where it enters the back wall of the trachea. A 5 mm clip is then applied. (Figure 4) The fistula can also be suture ligated. The fistula should not be divided at this point to avoid the distal segment from retracting.

Attention is then turned to the thoracic outlet. The anesthesiologist can put pressure on the nasogastric tube to help identify the upper pouch. The pleura overlying this area is opened, and the upper pouch is then mobilized circumferentially until adequate length is obtained. The distal tip is opened with scissors to create a sufficient opening.

The distal esophagus is cut near the clip. A Maryland can be used to dilate the distal opening to ensure an adequate diameter. The anastomosis is created with 4–0 or 5–0 absorbable interrupted sutures. The back row is placed first with intraluminal knots. A transanastomotic nasogastric tube is then placed under direct vision into the lower segment and stomach. Next, the anterior row of sutures is placed with the nasogastric tube confirming patency of the anastomosis and preventing incorporation of the posterior wall. All bites must incorporate mucosa and be of adequate size to avoid ripping out. (Figure 5) A chest tube (CT) is inserted through the inferior trocar site with the tip near the anastomosis. The ports are removed and the incisions are closed.

Open approach

For the open approach, a standard or muscle-sparring right posterolateral thoracotomy is performed. The fourth intercostal space is entered without opening the pleura. This extrapleural approach is advantageous because if an anastomotic leak occurs it will not lead to an empyema. The remainder of the procedure is completed in the same manner as that described for the thoracoscopic technique.

Isolated TEF (H-type)

Most isolated H-type TEFs can be repaired through a low right cervical incision. The sternocleidomastoid muscle is retracted posteriorly and the trachea and esophagus are identified with care.
to avoid the recurrent laryngeal nerve. Stay stitches are placed on each side of the fistula and the fistula is divided. The trachea and esophagus are then closed. Muscle may be placed between them to decrease the risk of recurrence. A bronchoscopic may also be performed at the beginning of the procedure to pass a catheter through the fistula to facilitate identification intraoperatively.

Proximal fistula

A proximal fistula may or may not be associated with a distal fistula. It can be diagnosed with a pre-operative bronchoscopy or during mobilization of the proximal pouch. The fistula can be ligated and divided in the same manner as the distal fistula.

Post-operative care

Ventilatory weaning and extubation can be attempted as soon as possible according to standard criteria. An esophagram should be obtained on approximately post-operative day 5. If no leak is demonstrated, feeds can be started and the CT subsequently removed. Patients should be placed on antireflux medications post-operatively.

Complications

Although the long-term survival and outcomes for infants with TEF are very good, a number of complications can occur post-operatively after repair. Early complications include anastomotic leaks, anastomotic stricture, and recurrent tracheoesophageal fistula. Long-term complications consist of gastroesophageal reflux, tracheomalacia, and poor esophageal motility. Anastomotic leaks can often be treated non-operatively with drainage, antibiotics, and parenteral nutrition. Strictures causing symptoms such as dysphagia can often be treated with dilation, endoscopic balloon or bougie, or endoscopic argon plasma coagulation. Repair should be carried relatively expeditiously once diagnosed. Operative intervention requires complete separation of the esophagus and trachea, division of the fistula, and placement of viable tissue between them. Endoscopic treatments, typically with a combination of diathermy and fibrin glue, have also been reported with variable success.10,11

Discussion

The main advantage of the thoracoscopic approach is the avoidance of a thoracotomy. A posterolateral thoracotomy has been shown to lead to respiratory compromise as well as significant chest wall morbidity.11,12 A thoracotomy involves dividing the musculature, potential damage to thoracic nerves, and spreading of the ribs.5 Another advantage is the smaller incisions and consequent improved cosmesis. In addition, the thoracoscopic repair allows for a magnified view and improved visualization of the anatomy and the fistula. The origin of the fistula can easily be identified, thus minimizing the possibility of an outpouring or diverticula on the trachea. The upper esophageal pouch and planes of dissection can also clearly be seen allowing for easier mobilization into the thoracic outlet if required and potentially reducing the risk of injury to the trachea while separating it from the esophagus.

The operation does pose some technical challenges as the suturing of the anastomosis is difficult in the limited chest space and rigidity of the spine. The compression of the ipsilateral lung with insufflation may also lead to anesthetic problems. However, the majority of patients tolerate the intrathoracic carbon dioxide flow well. Especially before fistula ligation, the endotracheal tube can be adjusted to obtain better ventilation without the need for increasing the intrathoracic pressure. As such, good communication is necessary between the surgeon and anesthesiologist. In addition, the lung itself does not need to be retracted thus venous return is not compromised and barotrauma is minimized. Finally, with the thoracoscopic approach, anastomotic sutures are placed one at a time potentially leading to increased tension on the initial stitches.

A number of studies have shown good outcomes of the thoracoscopic approach. Complication rates have been comparable to historical open thoracotomy series.5,10,14 There have also been reports evaluating the thoracoscopic versus open technique with similar or favorable results for the thoracoscopic approach.5,16

References