13. Thoracoscopic Repair of Esophageal Atresia and Tracheoesophageal Fistula

Ibrahim Abd el-shafy and José M. Prince

Introduction

Esophageal atresia, with or without TEF, occurs in approximately 1/3500 live births. There is a slight male preponderance of 1.26:1. First pregnancy, advanced maternal age, hormonal exposure in pregnancy, and an affected parent and/or siblings are all risk factors. Chromosomal abnormalities, twinning, and associated anomalies are more common than expected. In retrospective studies, only one third of affected infants are identified successfully by prenatal ultrasound. Classically, the diagnosis has been made by the inability to pass a nasogastric tube (NGT) at birth in the setting of excessive drooling, coughing, choking, and regurgitation during feeding. Confirmation of a blind-ending pouch can be made by radiographs showing a coiled NGT at the thoracic inlet. If uncertainty persists in the diagnosis, esophageal atresia can be further characterized by the injection of air or a small amount of dilute contrast into the tube. A child with an esophageal atresia with TEF, type C, will have distal air in the stomach and intestines on X-ray in conjunction with abdominal distention on physical exam. By comparison a patient with a pure esophageal atresia will have a gasless, flat abdomen. Operative intervention for children with pure esophageal atresia typically does not require emergent repair compared to children with esophageal atresia and TEF who do require expeditious operative repair to prevent the development of chemical pneumonitis. Thoracoscopic repair of esophageal atresia and TEF is a safe and effective approach with results equivalent to open repair in some studies. The first reported successful thoracoscopic repair was completed in 2000.

D.S. Walsh et al. (eds.), *The SAGES Manual of Pediatric Minimally Invasive Surgery*, DOI 10.1007/978-3-319-43642-5_13

Preoperative Workup

Children with esophageal atresia and TEF have associated anomalies half of the time, the most common of which are cardiac malformations. It is often seen as part of a nonrandom association of anomalies known as VACTERL (**v**ertebral anomalies, **a**nal atresia, **c**ardiac defects, **t**racheo-esophageal fistula and/or **e**sophageal atresia, **r**enal and **r**adial anomalies, and **l**imb defects). In evaluating a child preoperatively, the echocardiogram is essential to determine the presence of cardiac defects and the location of the aortic arch. The location of the aortic arch might influence the side of the thoracoscopy. The presence of severe cardiac defects could be considered a relative contraindication for a thoracoscopic repair. Some surgeons consider small size between 1500 and 2000 g and severe abdominal distention as relative contraindications. The combination of hemodynamic instability as indicated by significant vasopressor support and severe prematurity with a birth weight less than 1500 g is a contraindication for thoracoscopic repair. Other anomalies such as an imperforate anus or cloacal anomalies are not contraindications to thoracoscopic repair. Preoperative evaluation should also include a chest X-ray and an abdominal radiograph. Absence of air in the abdomen typically represents isolated esophageal atresia without distal TEF.

Operation

There are five main variants of esophageal atresia. This chapter will touch upon operative repair of the most common variant: proximal atresia with a distal TEF type C. Long gap esophageal atresia and pure esophageal atresia will be discussed in a separate chapter reviewing esophageal replacement. Emergent operation for TEF is seldom required, and a period of 1–2 days between initial diagnosis and operation permits for a thorough assessment and preparation of the child. Prior consultation with a pediatric anesthesiologist is critical to establishing a coordinated operative plan.

The patient is initially placed in a supine position for a diagnostic laryngoscopy with rigid/flexible bronchoscopy to evaluate for an H-type fistula. Bronchoscopy also allows for balloon occlusion of the fistula using a small Fogarty catheter or similar. Endotracheal intubation is then performed with the endotracheal tube in the trachea without attempts to perform isolated lung ventilation. Low peak airway pressures and spontaneous ventilation should be utilized until the fistula has been ligated.

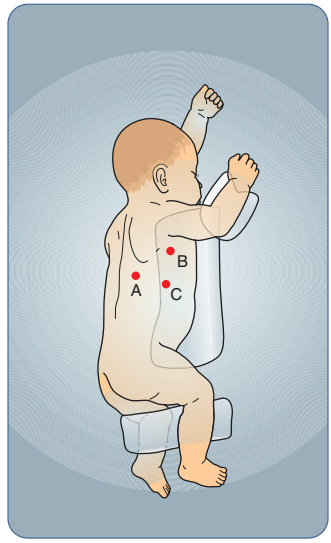

Fig. 13.1. Patient is in the modified prone position with ports as shown. (*A*, *B*) Working ports. (*C*) Camera port.

Consideration should be given for serratus anterior block for regional anesthesia given the potential benefits of decreasing operative pain and narcotic requirement. The patient is then placed in the modified prone position (Fig. 13.1). After positioning, three port sites are selected. Typically, the first port is a 5-mm port near the anterior axillary line approximately by the fifth intercostal space. Often this is the camera port for the 4-mm 30° laparoscope. Two 4-mm ports are placed at the second interspace mid-axillary line and the seventh interspace below or at the posterior axillary line, through which 3-mm instruments will be used. A fourth port is rarely helpful in retracting the lung. Some surgeons prefer to use the most posterior and inferior port for the camera to improve the ergonomic position of the operative surgeon. Initial insufflation should start at 4 mmHg, but if the lung does not collapse to allow adequate visualization, the pressure may be increased to 7–8 mmHg.

The next step is to identify the tracheoesophageal fistula, which can usually be found entering the membranous portion of the trachea superior to the carina (this area is usually delineated by the azygos vein) (Fig. 13.2). Mobilization of the azygos vein with division may be accomplished by the following: hook electrocautery, bipolar sealing device, or 5-mm clips. The vein may be preserved if desired, with a

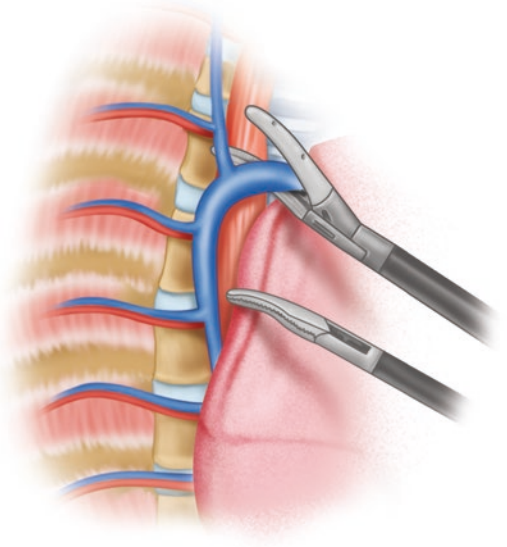

Fig. 13.2. Azygos vein.

suggestion that it might improve the vascularity of the area and decrease the esophageal anastomotic leak rate. The lower esophageal segment is identified and followed to its insertion point on the trachea. The fistula can be either suture ligated or ligated using endoclips. The vagus nerve should be identified to prevent injury. Identification of the upper segment is facilitated by asking the anesthesiologist to place gentle pressure on the naso-esophageal tube. The overlying pleura is then opened. Though not typically required, placement of a stay suture on the lowest aspect of the upper esophageal segment into the NGT may aid in retraction during dissection. Blunt/sharp dissection along the plane between the esophagus and trachea extending into the thoracic inlet completes the mobilization of the upper pouch. An opening and resection of the most distal upper pouch is made to create a wide anastomosis to prevent future stricture formation. The resulting opening may be dilated with the Maryland dissector to improve visualization of the mucosa. The NGT may be advanced to decompress the stomach after the anastomosis is established. The anastomosis is completed using 4-0 or 5-0 absorbable sutures on a small tapered needle in an interrupted manner. (A slipknot approach may be taken with initial approximation. With the second suture, the tension can be increased to gradually bring the ends together

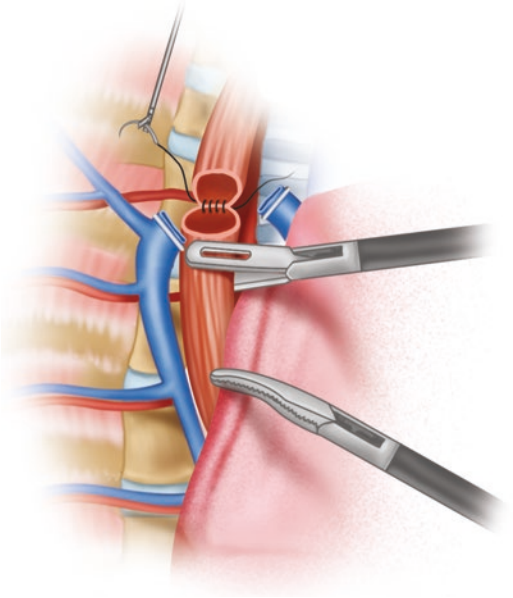

Fig. 13.3. Anastomosis posterior esophageal.

under shared tension.) Alternatively, a traction suture through the chest wall may be used to suspend the two ends of the esophagus to facilitate suturing. The back wall is completed first typically with four interrupted sutures and knots placed intraluminally (Fig. 13.3). Care should be taken to guarantee full-thickness bites that include the mucosa. The nasogastric tube can be used as a guide to suture the anterior wall and prevent inadvertent inclusion of the back wall in the anterior repair. The anterior wall is completed with an additional four interrupted sutures. Under magnification there may appear to be small tears. These tears are usually not clinically relevant but if there is concern, fibrin glue or a pleural patch may be used to bolster the anastomosis. The final step is placement of a chest tube via the lower of the three port sites to facilitate drainage postoperatively.

Postoperative Care

Postoperative care should not differ from open tracheoesophageal fistula repair. It is preferable if the child may be immediately extubated in the operating room. When possible, weaning off ventilator support

and removal of the ET tube should be achieved within the first day. Infants with an anastomosis under significant tension, with underlying cardiac disease or with severe prematurity, may require prolonged ventilatory support. Prophylactic antibiotics are given for the first 48 h. On day 5–7 following the operation, we obtain a water-soluble esophagram. In the absence of a leak, oral feeds are initiated and the chest tube is removed the next day. If there is a concern for an anastomotic leak, feeds are held and antibiotic treatment initiated, with a repeat esophagram in 1–2 weeks.

A significant number of neonates have esophageal dysmotility postoperatively, but with time it is less clinically apparent. The latest published series demonstrated a 3.8 % stricture rate requiring endoscopy and dilation. Over half of these neonates develop significant gastroesophageal reflux disease which responds well to H2 blockers.

Pearls

- Consider bronchoscopy for placement of Fogarty catheter to occlude fistula.
- After dividing the fistula, dilating the opening with a Maryland dissector improves visualization of the mucosa and will aid in obtaining full-thickness esophageal tissue when performing the anastomosis.
- If there appears to be significant tension while approximating the two esophageal ends, one may use the slipknot technique and distribute tension to prevent suture tear through.
- Consider transthoracic suture for traction to suspend the two ends of the esophagus to facilitate suturing.

Pitfalls

- Patient selection for thoracoscopic TEF repair should account for low birth weight, or hemodynamic instability, and surgeon experience.
- Failure to communicate and having an inexperienced anesthesiology team reduces the likelihood of success for completing a thoracoscopic TEF repair.
- Do not remove the first suture if you are unable to bring the two esophageal ends together because this may create a tear. Having a gap that can be closed is easier than having a rent.

Summary

- Overall, thoracoscopic repair of TEF offers a safe alternative to open thoracotomy with the potential benefits of reduced risk of scoliosis, less muscle weakness, decreased postoperative pain, and improved cosmetic appearance.
- While requiring more advanced laparoscopic technical skills, this procedure is increasingly used for TEF.

Suggested Reading

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