Operative Techniques in Thoracic and Cardiovascular Surgery

Mediastinal Tracheostomy With Vessel Transposition and Minimally Invasive Transhiatal Esophagectomy

Christa N. Grant, MD, and M. Blair Marshall, MD

As our surgical outcomes and survival of patients with cancer improves, in particular patients with head and neck cancer would often develop multiple primaries. The limitations of radiation for repeated local therapy leave radical surgery as the only local option for some of these patients. Given the complexity of the issues at hand, these patients should be evaluated by a multidisciplinary team with expertise in otolaryngology, radiation oncology, medical oncology, and thoracic surgery. Mediastinal tracheostomy is rarely used, but it can be a useful tool in the management of these complex patients. When esophagectomy is performed in combination with pharyngolaryngectomy, a minimally invasive transhiatal approach can be used. Transhiatal esophageal mobilization is technically feasible with laparoscopy, and it obviates the need for thoracic incisions and patient repositioning in this already complex morbid procedure. Additionally, for cervical esophageal tumors, neither margins nor completeness of lymphadenectomy are sacrificed. We describe several critical steps of mediastinal tracheostomy and minimally invasive transhiatal esophagectomy for the management of these complex patients.

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KEYWORDS mediastinal tracheostomy, laryngectomy, esophagectomy

Introduction

The surgical care of large and invasive proximal esophageal and upper airway tumors has evolved significantly over the last half century. Although beyond the scope of this article, a comprehensive review of early techniques for reconstruction of the laryngopharynx and cervical esophagus was published by Fabian.[1] It offers a historical perspective and a logical timeline from the first survivable esophageal surgery and the early use of prosthetics through attempts at autografts and mucosal flaps, and finally the introduction of free tissue grafting. At that time, the 5-year survival rate for resection and reconstruction of the cervical esophagus and upper airway was 24%. The most complex lesions involving both trachea and esophagus, once thought inoperable, are now resected with good oncologic outcome followed by any of several well-accepted reconstruction options. These techniques include but are not limited to jejunal free flaps, pedicled local muscle flaps, and free anterolateral thigh flaps.[2]

Mediastinal tracheostomy is indicated in cases of extensive laryngotracheal resection where the residual trachea is too short to accommodate a cervical tracheostomy. This complex operation carries with it high morbidity rates between 20% and 70%, and mortality rate of up to 18%.[3]

We describe mediastinal tracheostomy with vessel transposition and minimally invasive transhiatal esophagectomy. These procedures are useful for the thoracic surgeon in the treatment of both primary tracheal pathologies and secondary tracheal involvement as in the case of locally advanced head and neck cancers.[4-7] The rate of secondary head and neck malignancies after radiation treatment to neck is not trivial. In cases where the second tumor is ineligible for additional neck radiation, this procedure provides a definitive or palliative solution. The technique may also prove useful in the resection and reconstruction of tracheal anatomy for inoperable tumors. Mediastinal tracheostomy can be placed de novo during initial laryngotracheal resection, and it is also easily applied to the patient with a pre-existing tracheostomy in situ.

Careful multidisciplinary operative planning and informed consent are one of the keys to the success of these complex operations. Head and neck surgeons, medical oncologists, radiation oncologists, speech pathologists, and respiratory therapists are among the multidisciplinary team

Division of Thoracic Surgery, Georgetown University Hospital, Washington, DC

Address reprint requests to Christa N. Grant, MD, Division of Thoracic Surgery, Georgetown University Hospital, Gorman 2, 3800 Reservoir Rd NW, Washington, DC 20007. E-mail: christagrantmd@gmail.com

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that would assist the thoracic surgeon. Intraoperatively, the team approach is also of paramount importance in decreasing operative time and minimizing morbidity related to positioning and airway control.

Operative Technique

Part I: Transhiatal Esophagectomy

Patient positioning is of critical importance, particularly when multiple operative fields are active simultaneously. As described in the first part of this article, the patient is positioned supine, with arms tucked to facilitate the neck dissection. The legs are placed in split leg positioners; A 4-6-cm (depending on the size of the surgeon's hand) upper midline incision is made starting 1 cm distal to the xiphoid, and the gel hand port placed. A 5-mm supraumbilical trocar allows camera access, and a liver retractor is placed through a second 5-mm trocar in the anterior axillary line at or above the level of the umbilicus. Two additional working ports are placed in the left upper quadrant. After insufflation, abdominal exploration is undertaken. Although the authors prefer a hand-assisted approach, an entirely laparoscopic approach is a safe alternative. A fifth trocar would be placed in lieu of the hand port. Typically, we use a 30°, 5-mm camera (Fig. 1).

The stomach is pulled inferiorly and to the patient's left, exposing the lesser curvature. A bipolar energy device is used to open the gastrohepatic ligament. Inspection and palpation of the translucent gastrohepatic ligament may reveal an accessory or replaced left hepatic artery (inset). Replaced left hepatic arteries should be spared.[2] Accessory hepatic arteries can be transected. If unclear, temporary clamping of the vessel to assess for ischemia can help in deciphering the anatomy before dividing. When available, careful review of a contrast computed tomography scan would reveal this anatomical variant. The dissection is continued cephalad along the edge of the right crus. The phrenoesophageal ligament is divided across the esophageal hiatus to the left crus.

The operation then proceeds by dissecting along the greater curvature and fundus of the stomach 1-2 cm away from the gastroepiploic vessels. Division of the second layer of the gastrocolic ligament allows entry into the lesser sac, which improves exposure by allowing the surgeon to manually elevate the stomach toward the field. The short gastric vessels are divided by continuing this dissection cephalad along the greater curvature toward the left crus until the spleen falls away from the field. The dissection of the left crus is performed with a hook cautery to complete circumferential exposure of the lower esophagus (Figs. 2 and 3).

The stomach is grasped along the greater curvature and reflected cephalad. Short, avascular attachments to the retroperitoneum and pancreas are divided sharply or with hook cautery, revealing the lesser curvature and the left gastric pedicle from the underside. The pedicle is encircled allowing for continual palpation while the artery and vein are skeletonized with a combination of bipolar cautery and finger fracture dissection and ultimately divided. Bulky pedicles can alternatively be divided using a vascular load of the endovascular stapling device, although sealing devices work quite well for these vessels (Fig. 4).

An extensive kocherization is important for a tension-free, well-vascularized gastric conduit. The dissection of the distal lesser curvature is resumed at the previously opened gastrohepatic ligament and proceeds caudad. The right gastric pedicle is divided in the process, and the dissection proceeds along the duodenum where the Kocher maneuver is performed. Typically, we incise the peritoneum with hook cautery and then use blunt dissection for mobilization of the duodenum. In a similar fashion, the dissection along the greater curvature is taken caudad, being careful to remain at least 1-2 cm off the edge of stomach to preserve the right gastroepiploic pedicle. Palpation of the pulse through a hand port is advantageous here (Fig. 5).

The esophagus is encircled loosely with a 1/4-in. Penrose drain (Medline, Mundelein, IL). With the Penrose elevated, circumferential dissection of the lower esophagus is undertaken using a bipolar energy device. Care is taken to avoid avulsion of direct arterial branches from the aorta by using gentle retraction of the esophagus. An assistant providing countertraction on the crus also significantly improves exposure during this important step. This dissection is continued circumferentially as high as possible, ideally to at least the level of the azygos vein. Here again, the presence of the hand port allows for a more traditional direct palpation of the mediastinal attachments during mobilization of the intrathoracic esophagus. Blunt dissection should be employed liberally in the anterior and lateral dissections to help define planes before dividing tissues, particularly after neoadjuvant radiation. Care is taken to not enter the pleural spaces. In obese or very tall patients, extra long laparoscopic instruments can improve visualization and dissection in this small space (Fig. 6).

The gastric conduit is fashioned using a laparoscopic stapler. The first transection starts at the angular notch of the lesser curvature just proximal to the incisura and aiming 45° toward the greater curvature. The subsequent firings head toward the mid fundus, essentially dividing the stomach in half (Fig. 7).

For cases of cervical esophageal cancer where the necessary gastric margin is small, the esophagus can be transected at the gastroesophageal junction and the stomach extracorporealized. The conduit can then be fashioned such that the lesser curvature is used as an additional (and the most proximal) portion of the gastric conduit providing the additional length, albeit ischemic, to reach the posterior pharynx. These typically will heal (Fig. 8).

Part II: Mediastinal Tracheostomy

A midline upper sternal incision starts at the sternal notch and is carried down past the sternomanubrial junction and onto the sternum to the level of the second rib. Skin flaps are created on each side and the soft tissues in the midline are divided down to the bony sternum and manubrium. Periosteal elevators are used to clear the soft tissue off the anterior surface of the manubrium and heads of clavicles bilaterally. The retromanubrial and retrosternal spaces are bluntly developed and then temporarily packed with sponges to protect the vessels that lay just beneath. The