Masters of Cardiothoracic Surgery

Minimally invasive esophagectomy: the Brigham and Women's Hospital experience

Jon O. Wee, Raphael Bueno, Scott J. Swanson

Brigham and Women's Hospital, Division of Thoracic Surgery, Boston, MA, USA

Correspondence to: Jon O. Wee, MD. Brigham and Women's Hospital, 75 Francis St, Boston, MA 02115, USA. Email: jwee@partners.org.

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Clinical vignette

A 68-year-old male presented with a long history of recurrent dysphagia secondary to Schatzki's ring for which he had previously required endoscopy and dilations in the past. He again developed symptoms of dysphagia that had progressed over several months resulting in a 15 pound weight loss and chronic fatigue. He had a barium swallow study that demonstrated a large mass causing partial obstruction in the distal esophagus as well as small hiatal hernia. Endoscopy demonstrated a large mass in the distal esophagus occupying nearly the entire lumen and was friable and with necrosis. The stomach and duodenum appeared normal. Biopsies of the esophageal mass demonstrated poorly differentiated adenocarcinoma, HER-2/neu positive. A computed tomography (CT) scan of the chest, abdomen and pelvis demonstrated a distal esophageal mass measuring 6.5 cm in length by 4.2 cm × 4.4 cm. The proximal esophagus above the mass was distended, but there was no evidence of any mediastinal, hilar or axillary lymphadenopathy. He had an endoscopic ultrasound that demonstrated a hypoechoic lesion that went through the muscularis propria measuring 3.1 cm × 3.8 cm. It was obstructing the lumen of the esophagus and the scope could not be advanced distally. He was staged at least a T3 Nx lesion. A positron emission tomography (PET) CT on 06/23/2016 demonstrated markedly hypermetabolic mass in the distal esophagus with SUVmax of 13.5. He underwent chemoradiotherapy neoadjuvant setting with cisplatin and etoposide and 5,040 cGy of XRT. Repeat PET/CT demonstrated some persistent avidity in the lower esophagus, but no additional activity. We proceeded onto surgical resection.

Surgical technique

Preparation

Patients are given a clear liquid diet 24 hours pre-operatively. We do not give a formal bowel prep as this leads to dehydration post-operatively.

Exposition

Our approach is a minimally invasive Ivor Lewis esophagectomy starting in the supine position laparoscopically, and then transitioning to a left laterally decubitus position for the chest direction. A foot board is utilized to allow for a step reverse trendelenburg position for laparoscopy.

Operation (*Video 1*)

The abdominal dissection is approached with dissection along the greater curvature. As we dissect up towards the cardia if the stomach, a large omental skirt is kept with the specimen for later use as an omental patch. The left gastric artery is dissected to keep all the lymph nodes within the specimen followed by the hiatal dissection to get some distal esophageal mobility. Once mobilized, we used an endoGIA stapler to resect the lesser curvature from the incisura all the way up to the cardia of the stomach to form a 4–5 cm gastric conduit. A feeding jejunostomy tube is placed using a 14 French feeding tube. We then examine the conduit and attached the distal portion of the specimen to the proximal portion of the conduit with some omentum to allow for later passage into the thoracic cavity. A Penrose is also placed around the distal esophagus to assist with the

thoracic dissection.

The thoracic portion of begins with the patient in the left lateral decubitus position. One 5 to 11 mm and one 12 mm laparoscopic port are placed into the intercostal spaces with insufflation. The dissection was begun fairly taken down the pleural flexion and separating it away from the mediastinum. The azygos vein is often divided. Above this level dissection is taken close to the esophageal wall all the way up to the thoracic inlet if needed. We then delivered the specimen and the gastric conduit up into the thoracic cavity being aware of the rotation of the conduit to make sure that the staple line is facing laterally. The sutures are divided and the proximal esophagus is divided sharply with scissors. The posterior inch inferior incision slightly increased and a wound protector placed and the specimens removed and sent to pathology. We then sized the proximal end of the esophagus and use a 25- or a 28-mm EEA anvil. Two purse-string sutures are placed to close the esophagus around the anvil. The conduit is brought further up into the thoracic cavity with division of the proximal staple line. The EEA (United States Surgical Corp) handle is placed within the conduit, and the spike brought out along the greater curvature. This is then approximated to the anvil and fired, forming the anastomosis. Once the NG tube is placed, the open end of the conduit is then closed with additional staple fires of the stapler, removing the proximal end of the conduit. We then bring the omentum anteriorly between the conduit and the airway, wrapping it around not only the anastomosis but also the lateral staple line. Sutures are used to tack to the superior pleural edge as well as to the posterior pleura. An additional stitch is also placed in the gastric conduit to the right crural fibers to prevent conduit herniation.

Completion

A Blake drain is usually placed along the posterior mediastinum along the conduit as well as a tube within the chest cavity. The port sites are closed in standard fashion. Patients are expected in the operating room. Patients are observed for 24 hours in the ICU for transitioning over to our step-down unit. A barium swallow study is performed on postop day 5 before initiating an oral diet, and patients are discharged home with tube feed support. Feeding tubes are generally discontinued at about 6 weeks postop.

Comments

Clinical results

Since 1989 the Brigham and Women's Hospital Division of thoracic surgery began performing esophagectomy through a modification of the McKeown approach. In the late 1960s, McKeown described the technique that starts with an upper left paramedian abdominal incision. Patients then underwent a right thoracotomy followed by a right neck incision to form the anastomosis. Our approach differed in that that we started with a right thoracotomy with total esophageal mobilization with radical lymph node dissection. Then we transitioned to a supine position where patients underwent a midline laparotomy as well as a simultaneous left neck dissection. The stomach was mobilized with all of the perigastric and periceliac lymph nodes. The conduit was formed with the division of the stomach. The esophagus was divided in the left neck, and the specimen was brought out through the laparotomy incision. The conduit was then guided back up through the posterior mediastinum to the left neck where the anastomosis was formed (1). We reported in 2001 in the annals of thoracic surgery illustrating the results of our initial 250 patients. 81% of these patients received neoadjuvant treatment and 78% received both chemotherapy and radiation preoperatively. Thirty day and in-hospital mortality was 3.6%. Recurrent laryngeal injury occurred in 14% of patients; however, within the last 83 patients following a change technique, the rate was down to 7%. About 9% of patients developed a chylothorax, 8% had an esophageal leak, and 5% developed a pneumonia. The length of stay was 13 days, and there was observed a 26% rate of strictures requiring some dilation postop (2).

An R0 resection was seen in 92% of patients and 30% of patients who had neoadjuvant treatment had a complete response. Overall 3 years survival of 44% and median survival was 25 months. These results compared quite favorably to the literature of the time and was our preferred technique for most esophageal cancers. Granted some transhiatal, thoracoabdominal, colon interpositions and other techniques were performed on a patient specific basis but these were in the minority (2).

At approximately, 2002 we began to introduce more minimally invasive techniques and started a hybrid approach to esophagectomy which involved either a thoracoscopy with a laparotomy or a thoracotomy with laparoscopy.

This allowed a transition to a fully minimally invasive esophagectomy which began in 2006. We began to perform a fully port based thoracoscopy with laparoscopy minimally invasive esophagectomy. By 2008 we had performed 34 open esophagectomy, 17 hybrid esophagectomies, and 17 completely minimally invasive esophagectomy for that calendar year. By 2012, the transition continued with decreasing open approaches and increased minimally invasive approaches. We performed 28 open esophagectomies, 21 hybrid approaches and 53 completely minimally invasive approaches in 2012. In total, as of 2012, we had performed 475 open, 153 hybrid and 200 completely minimally invasive approaches.

We also had a mix in our minimally invasive approaches. Initially, most of our esophagectomies were minimally invasive 3-hole esophagectomy utilizing either a thoracoscopy or laparoscopy in the hybrid approach, finishing with a neck anastomosis. Since 2006, we began to perform more minimally invasive Ivor Lewis Esophagectomy starting with a laparoscopy and finishing with a thoracoscopic chest anastomosis as tumor location near the GE junction allowed adequate margins in the chest as well as having a desire to avoid a neck dissection and risk recurrent nerve injury when reasonable.

Our rate of conversion from a hybrid or minimally invasive to an open procedure was approximately 15%, but this decreased as our experience increased. The most common reason for conversion was due to the learning curve and surgeon comfort and not due to an unforeseen complication. Dealing with adhesions and adhesiolysis was the most common reason. The operative length was the longest for these converted cases at 462 minutes whereas the planned open procedure remained the fastest at 334 minutes. However, there was less blood loss in the completely minimally invasive group compared to the open (300 *vs.* 450 cc) and a day shorter length of stay in both the ICU and the hospital for the MIE group. Overall morbidity was not significantly different between the groups though there was significantly less pulmonary embolisms (12.4% *vs.* 4.5%, P=0.001) for the MIE, but also a higher stricture rate requiring dilation (11% *vs.* 4.8 %, P=0.009). Overall mortality remained the same with 0.8% 30 day mortality and 4% 90 day mortality in the open group compared to 0.5% 30 day and 2.5 % 90 day mortality in the MIE group. Overall 73% of cases were performed completely minimally invasively by 2012.

From May 2000 and to June 2012, 123 patients underwent a 3-hole minimally invasive approach and 77 patients underwent a minimally invasive Ivor Lewis approach. Within the 3-hole minimally invasive group, 63% of patients received neoadjuvant chemoradiotherapy followed by surgery. The 30 day mortality for the entire cohort was 0.8% and with a 90 day mortality of 3%. There was no difference in complications in those who had neoadjuvant chemoradiotherapy compared to those who had primary surgical resection. The rates of anastomotic leak, strictures requiring dilation, vocal cord injury, and chylothorax were all not specifically different (3).

In 2013 we began our robotic esophagectomy program utilizing the DaVinci robot for thoracic mobilization and creation of the anastomosis. Our initial experience of 20 patients demonstrated 0% 90 day mortality. 80% of patients had neoadjuvant chemoradiotherapy. Rate of conversion was 0. Morbidity was seen in 55% of patients, mostly from atrial fibrillation at 15%. Length of stay was 8 days, and 85% of patients were discharged to home. Overall operative time was long at 455 minutes, but this may be related to the learning curve (4).

Currently, the vast majority of esophagectomies performed at Brigham and Women's hospital are performed in a minimally invasive fashion. There is a diversity in approaches from a 3-hole modified McKweon minimally invasive approach to a minimally invasive Ivor Lewis , and a robotic assisted minimally invasive esophagectomy. The transition from the open technique to these minimally invasive techniques has resulted in decreased length of stay, decreased morbidity, and improved patient outcomes and satisfaction. This transitioned occurred with practicing established thoracic surgeons who were comfortable with the open approach. The fact that these surgeons were able to adapt new minimally invasive techniques and establish expertise is a testament to the commitment to improve outcomes and advance the care of patients.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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