Total Portal Robotic Linear Stapled Anastomosis during Robot Assisted Ivor Lewis Esophagectomy

Running head: Robotic Anastomosis during Esophagectomy

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ABSTRACT

There are several options for intrathoracic esophagogastric anastomosis during Ivor Lewis esophagectomy. These include end-to-end stapled anastomosis, hand-sewn anastomosis, and stapled anastomosis. We present the case of an 84-year-old male with benign esophageal stricture who underwent robot-assisted laparoscopic and thorascoscopic Ivor Lewis esophagectomy with the first documented case of a total portal robotic linear stapled anastomosis that allowed for intrathoracic esophagogastric anastomosis creation entirely using the robotic platform. This technique alleviates the need for a skilled bedside assistant and further demonstrates the convenience, maneuverability, and dexterity of the robotic platform.
First described in 1946, Ivor Lewis esophagectomy originally involved a two-stage procedure wherein the stomach would first be mobilized via a laparotomy followed 10-15 days later with an open right thoracotomy, esophageal resection, and intrathoracic esophagogastric anastomosis\(^1\). Laparoscopy and video-assisted thoracoscopy subsequently decreased peri-operative morbidity. At our institution, we have adopted a robotic platform (Intuitive Surgical Inc., Sunnyvale, CA, USA) which offers greater maneuverability and dexterity when compared to traditional laparoscopy/thoracoscopy. In this report, we detail the first reported total portal robotic linear stapled anastomosis technique for intrathoracic anastomosis that improves the efficiency and convenience of robot-assisted Ivor Lewis esophagectomy.

We present the case of an 84-year-old male with a past medical history of coronary artery disease, chronic kidney disease, type 2 diabetes mellitus, and known hiatal hernia. His surgical history was significant for 4-vessel coronary artery bypass graft. He reported a 6-month history of progressively worsening dysphagia and 20lbs weight loss. His gastroenterologist identified a 4cm long esophageal stricture 30cm from the incisors and performed dilations of the stricture up to 8mm. Biopsies taken during a previous esophagastroduodenoscopy demonstrated a benign stricture. Esophagram demonstrated severe stenosis at the site of the stricture (Fig 1A). His stricture was refractory to endoscopic dilation and he was scheduled for robot assisted Ivor Lewis Esophagectomy. He underwent jejunostomy tube placement for pre-operative nutritional optimization.

The steps of the operation as well as port placement are highlighted in the Video 1. The abdominal portion of the case began with dissection of the diaphragmatic hiatus. An omental patch
was mobilized from the greater omentum to later reinforce the esophagogastric anastomosis. Care was taken to preserve the omental branch of the left gastroepiploic artery to supply the omental patch and the right gastroepiploic artery to supply the gastric tube. A Penrose drain was passed around the esophagus to aid with retraction. The left gastric artery was ligated and the robotic stapler was used to create a 3 cm gastric tube beginning at the incisura angularis, working towards the fundus of the stomach. Indocyanine green and Firefly™ fluorescence imaging was used to assess perfusion of the gastric conduit. The abdominal component of the operation concluded with Botox injection (100 units) in the pylorus for improved gastric emptying.

The patient was repositioned in the left lateral decubitus position for the thoracic portion of the case. The right lung was retracted medially, and the pleura was dissected from the distal esophagus to the level of the azygous vein which was divided with the white load robotic stapler. Using the Penrose drain for retraction, the esophagus was dissected circumferentially with a vessel sealer beginning from the hiatus and continuing proximally until the esophagus proximal to the stricture was mobilized. This was confirmed with intra-operative esophagastroduodenoscopy. The esophagus was divided with the robotic blue load stapler. The remainder of the proximal stomach, gastric conduit, and omental patch were brought into the chest. Indocyanine green was used to identify the most proximal well-perfused portion of the gastric tube. This was divided with the robotic stapler. The resection of the distal esophagus and remnant stomach was now complete.

A 3-0 absorbable stitch brought together the esophagus and gastric tube and reduced tension on the anastomosis. Bipolar forceps were used to create a gastrotomy on the greater curvature of the stomach and an esophagotomy in the middle of the esophageal staple line. A common channel was created between the esophagus and gastric tube using a robotic blue load stapler (Fig 2A). Indocyanine green demonstrated adequate perfusion of the stapled anastomosis.
The esophageal staple line was removed and sent to pathology. The common channel was closed with full-thickness simple interrupted, 3-0 absorbable sutures (Fig 2B). Indocyanine green demonstrated adequate perfusion of the anastomosis (Fig 3B). The suture line was imbricated with partial thickness 3-0 silk sutures in a Lembert fashion (Fig 2C). Finally, the omental patch was secured over the closure with simple interrupted 3-0 silk sutures (Fig 2D). The specimen was removed prior to the conclusion of the case by enlarging the 12mm port site. A 28 Fr chest tube and nasogastric tube were placed prior to the conclusion of the case. Post-operatively, the patient did well. On post-operative day 1, his chest tube was placed to water seal and trickle feeds were started through his jejunostomy tube and progressively advanced. His chest tube was removed on post-operative day 6 and he was discharged home on post-operative day 7 on jejunostomy tube feeding. Esophagram at post-operative week 2 demonstrated no leak or residual stenosis (Fig 1B). Final pathology was benign esophageal mucosa with ulcer and granulation tissue. About 3 months after surgery, patient developed stricture at the anastomosis that was successfully treated with serial endoscopic dilation.

**COMMENT**

Robot-assisted Ivor Lewis esophagectomy demonstrates several advantages compared to other esophagectomy approaches. Compared to traditional thoracoscopic/laparoscopic esophageal dissection, the robotic platform allows for greater maneuverability due to the wristed nature of the instruments. ICG capability is standard on the robotic platform which allows for intra-operative assessment of tissue perfusion, whereas the gross appearance of the tissue which may be more transient. In a meta-analysis by Mederos et al. comparing robot-assisted esophagectomy vs. open
or video-assisted esophagectomy, robot-assisted esophagectomy demonstrated decreased blood loss and pulmonary and overall complications. Intrathoracic anastomosis was also shown to have lower rate of anastomotic leak and severe complications compared to cervical anastomosis in a randomized clinical trial by Workum et al.

Various options exist for intrathoracic esophagogastric anastomosis during Ivor Lewis esophagectomy. In a randomized control trial comparing combined stapled/handsewn, totally handsewn, and circular end to end stapled anastomoses, Wang et al. demonstrated that the combined stapled/handsewn technique was associated with a significantly lower incidence of anastomotic stricture. The total portal linearly robotic stapled anastomosis with handsewn closure described above allows for the robotic platform to be utilized to its full extent without the surgeon having to return to bedside until the conclusion of the operation. This technique also avoids a large thoracotomy, reducing post-operative pain and the risk of significant respiratory complications. Further investigation is needed to quantify the potential benefit of the total portal linearly stapled anastomosis.
REFERENCES


FIGURE LEGEND

Figure 1. Barium esophagram (A) Pre-operative esophagram demonstrates severe stenosis of the mid-esophagus consistent with esophageal stricture. (B) Post-operative esophagram demonstrates patent anastomosis without contrast extravasation.

Figure 2. Image of total robotic anastomosis. (A) A common enterotomy between the proximal esophagus and the gastric tube is created using the robotic blue load stapler. (B) The enterotomy is closed with full thickness, 3-0 absorbable suture in a simple interrupted fashion. (C) Suture line is imbricated with 3-0 silk suture. (D) Omental patch is secured with 3-0 silk suture.

Figure 3. ICG angiography. (A) After the stapled anastomosis is made, ICG angiography shows well perfused mucosa of the esophagus and the gastric conduit. (B) After the closure of the enterotomy, ICG angiography shows a well perfused suture line.