Hybrid Transthoracic Esophagectomy

18

Bernardo Borraez and Marco G. Patti

18.1 Clinical History

The patient is a 68-year-old man with a 20-year history of heartburn and regurgitation. He was initially treated empirically with H_2 blocking agents and antacids. Ten years after onset, the patient felt that his symptoms were getting worse, so a complete work-up was done, with the following findings:

- Barium swallow: large sliding hiatal hernia
- Endoscopy: 4-cm segment of Barrett's esophagus, with metaplasia but no dysplasia
- Manometry: ineffective esophageal motility
- pH Monitoring: a severe amount of reflux in both the supine and upright positions.

The patient was advised to have a laparoscopic fundoplication and yearly endoscopic follow-up, but he did not want the operation and decide to continue proton pump inhibitors. He did not visit his gastroenterologist for follow-up for 10 years, after which endoscopy showed an 8-cm segment of Barrett's esophagus with metaplasia and low-grade and high-grade dysplasia. Biopsy of a 5-mm nodule was positive for adenocarcinoma. Endoscopic ultrasound could not distinguish between a T1a and a T1b. No pathologic nodes were identified. A chest and abdominal CT scan was normal. The patient underwent an uneventful endoscopic mucosal resection, but pathology showed involvement of the deep margin by cancer. It was decided to proceed with esophagectomy.

B. Borraez • M.G. Patti, MD, FACS (✉)
Department of Surgery, Center for Esophageal Diseases,
University of Chicago Pritzker School of Medicine,
Chicago, IL, USA
e-mail: bborraez@hotmail.com; mpatti@surgery.bsd.uchicago.edu

P.M. Fisichella, M.G. Patti (eds.), *Atlas of Esophageal Surgery*, DOI 10.1007/978-3-319-13015-6_18

18.2 Operation: Hybrid Transthoracic Esophagectomy

This approach combines laparoscopy for preparation of the stomach and pyloroplasty, with a thoracotomy for gastric pull-up, resection of the esophagus, and esophagogastric anastomosis.

Before the beginning of the operation, an epidural catheter, a double-lumen endotracheal tube, and an arterial catheter were inserted.

18.2.1 Laparoscopic Component

Figure 18.1 shows the position of the operating team around the operating table for the laparoscopic portion of the operation. Five trocars are then placed for use in the dissection and gastric preparation for pull-up (Fig. 18.2). During this part of the operation, the camera is inserted through trocar # 1. For the pyloroplasty, the camera is switched to trocar # 3, and trocars #1 and #5b are used for the suturing.

The gastrohepatic ligament is divided, beginning the dissection above the caudate lobe of the liver where the ligament is thinner (Figs. 18.3 and 18.4). An accessory left hepatic artery originating from the left gastric artery is divided between clips (Figs. 18.5 and 18.6).

Dissection is continued proximally, and the right pillar of the crus is separated from the esophagus (Fig. 18.7). The phrenoesophageal membrane is divided using electrocautery (Fig. 18.8). Dissection is then performed in the posterior mediastinum (laterally, anteriorly and posteriorly) for about 5 cm above the diaphragm (Fig. 18.9). This step is important as it allows separation of esophagus from the aorta. Sometimes it can be difficult to find the plane between these two structures, either because of radiation changes or extramural spread of the tumor. In these cases, it is safer to proceed with this part of the dissection during the thoracotomy. Lower mediastinal lymph nodes are retrieved.

The right gastroepiploic artery is identified (Fig. 18.10) and the gastrosplenic ligament is opened using a bipolar instrument (Fig. 18.11). All the short gastric vessels are divided, and the dissection is continued all the way to the left pillar of the crus (Fig. 18.12). A window is created between the left pillar of the crus, the esophagus, and the stomach (Figs. 18.13 and 18.14). A Penrose drain is passed around the esophagus.

The coronary vein and the left gastric artery are divided. The vessels are dissected all the way to their base in order to retrieve as many left gastric nodes as possible (Figs. 18.15, 18.16, 18.17, and 18.18). An Endo GIA™ stapler (Covidien, Minneapolis, MN) with a 45-mm vascular cartridge is inserted through port 2 and is used for the transection of these vessels (Figs. 18.19, 18.20, and 18.21). Adhesions posterior to the esophagus and stomach are taken down using scissors or the hook cautery.

The gastrocolic ligament is opened using the bipolar instrument and the hook cautery (Figs. 18.22, 18.23, 18.24, and 18.25). Upon completion of this step, the blood supply of the stomach is based on the right gastric artery and the right gastroepiploic artery.

To begin the pyloroplasty, the pylorus is opened longitudinally (Figs. 18.26 and 18.27). A rolled-up sponge of absorbable material is inserted through the opening (Figs. 18.28 and 18.29) to separate the anterior from the posterior wall. The opening is then closed transversely with interrupted 2-0 silk sutures (Figs. 18.30 and 18.31). For this step of the procedure, the camera is switched to trocar #3 in order to create a 120° angle for suturing. The surgeon stands on the right side of the table and uses trocars #1 and #5b for suturing.

After a final inspection of the peritoneal cavity (especially the stomach), the trocars are removed, the trocars sites are closed, local anesthesia is injected, and sterile dressings are applied.

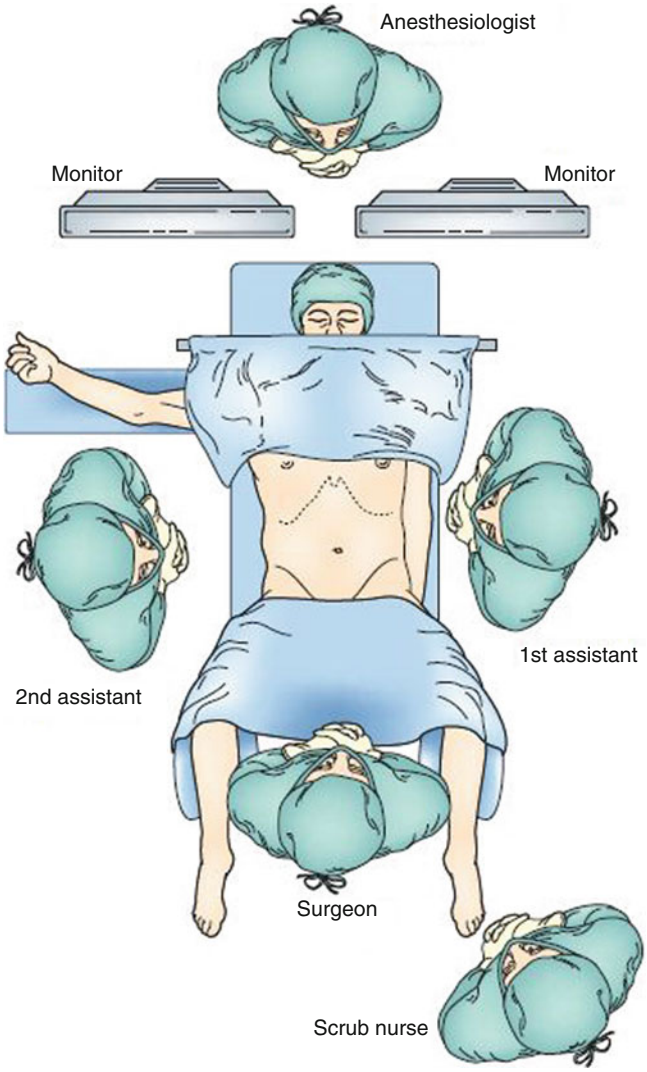


Fig. 18.1 Position of the operating team around the operating table

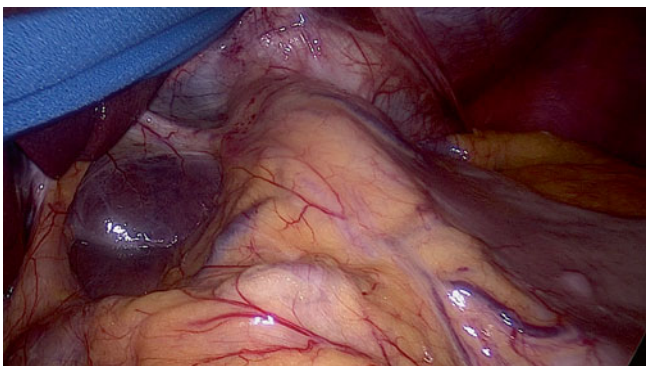


Fig. 18.3 The gastrohepatic ligament

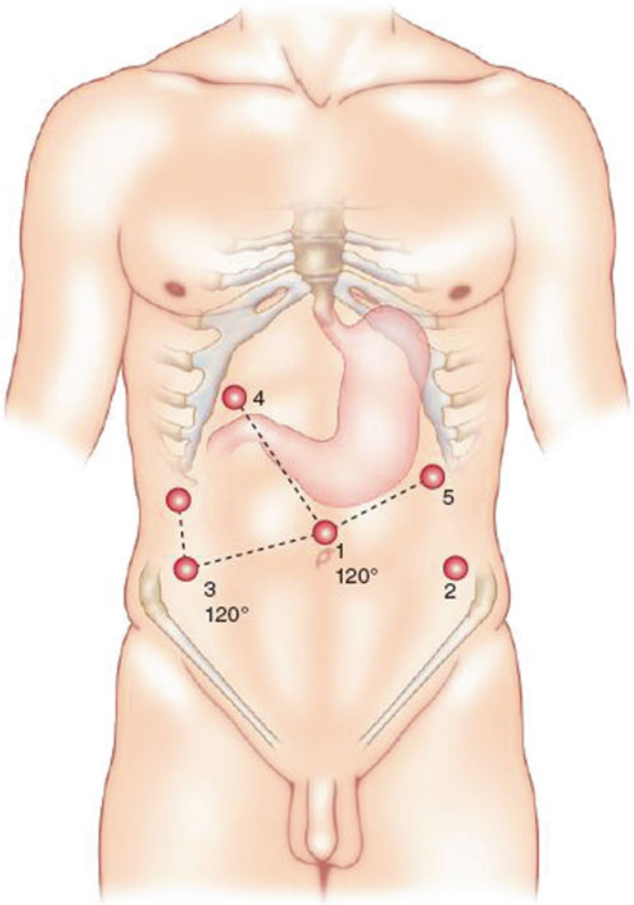


Fig. 18.2 Placement of trocars

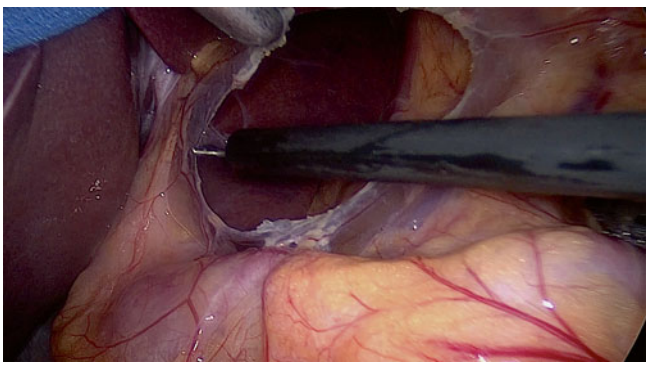


Fig. 18.4 The dissection of the gastrohepatic ligament, begun above the caudate lobe of the liver, where the ligament is thinner

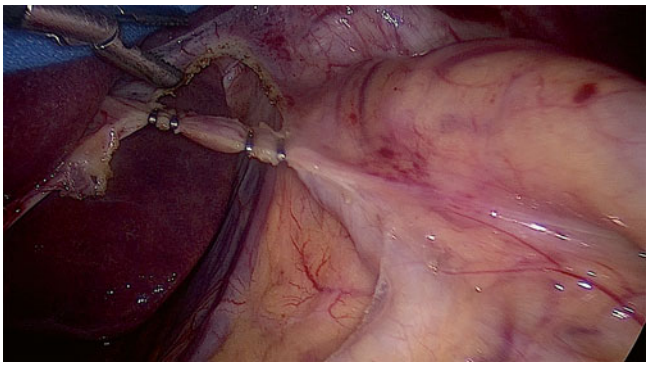


Fig. 18.5 Clips placed on an accessory left hepatic artery originating from the left gastric artery so it can be divided

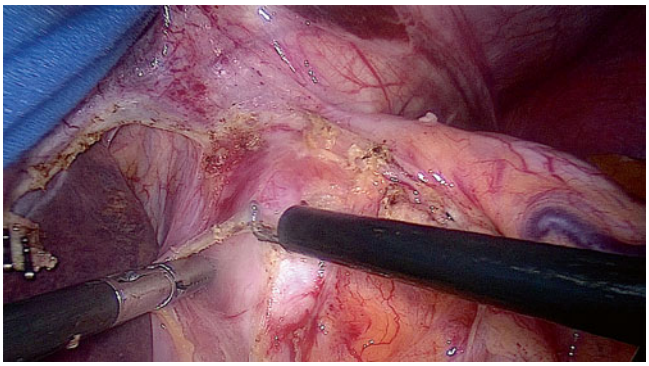


Fig. 18.8 The phrenoesophageal membrane is divided using electrocautery

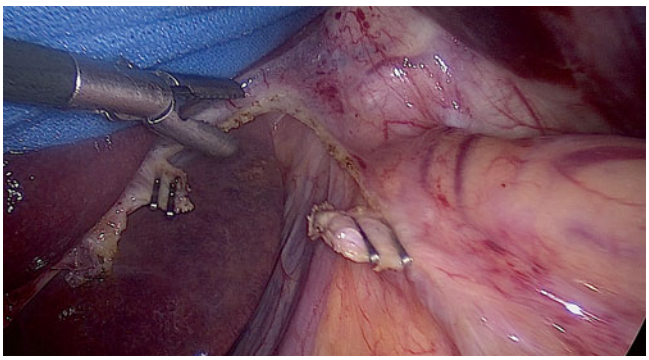


Fig. 18.6 The accessory left hepatic artery divided between clips

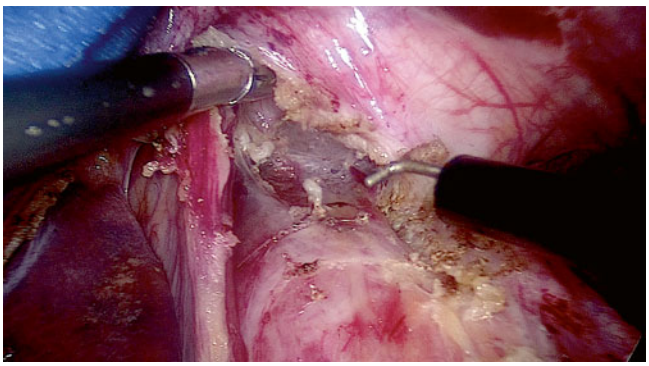


Fig. 18.9 Dissection performed in the posterior mediastinum (laterally, anteriorly, and posteriorly) for about 5 cm above the diaphragm

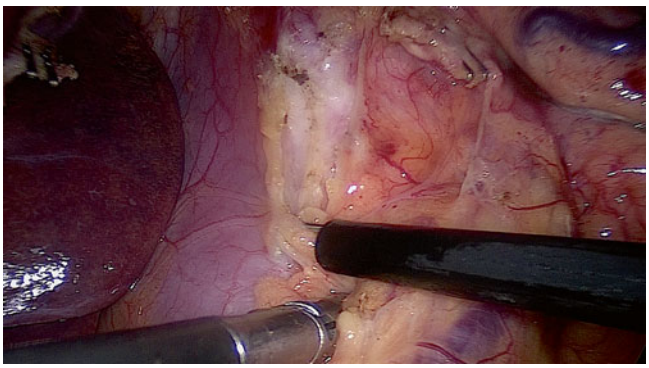


Fig. 18.7 Dissection continued proximally; the right pillar of the crus is separated from the esophagus

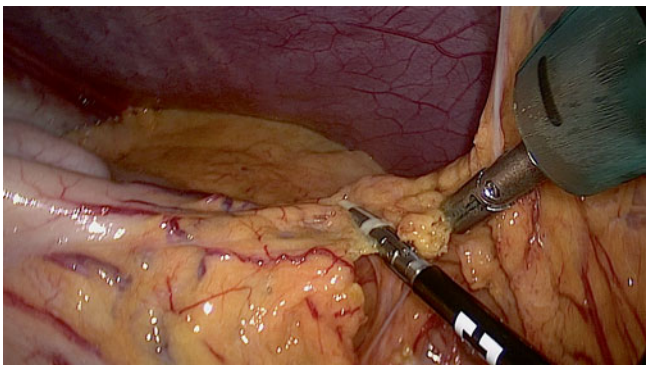


Fig. 18.10 Identification of the right gastroepiploic artery

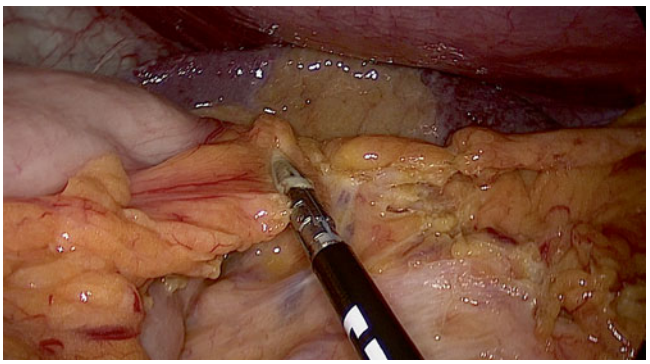


Fig. 18.11 Opening of the gastrosplenic ligament, using a bipolar instrument

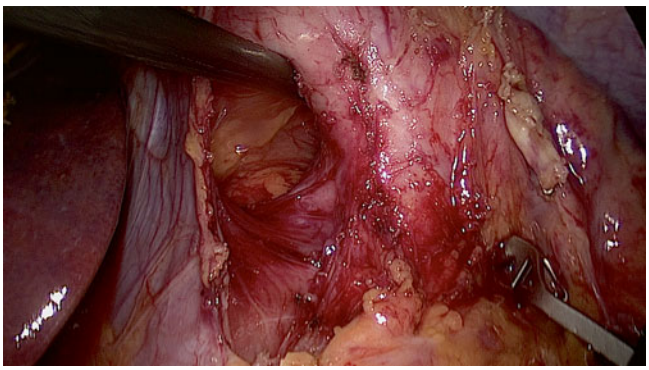


Fig. 18.14 Creation of a window between the left pillar of the crus, the esophagus, and the stomach

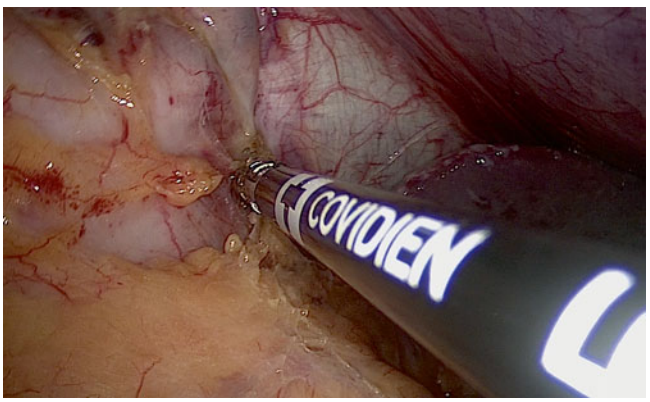


Fig. 18.12 Division of the short gastric vessels; dissection continued all the way to the left pillar of the crus

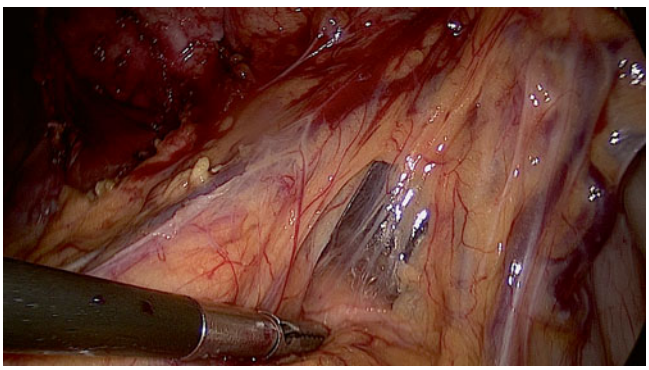


Fig. 18.15 Division of the coronary vein and the left gastric artery, which are dissected all the way to their base

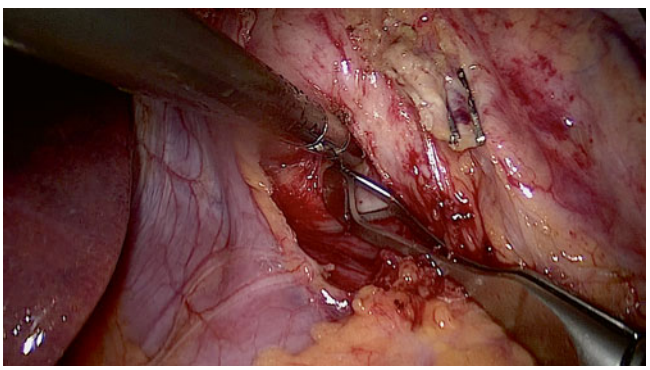


Fig. 18.13 Creation of a window between the left pillar of the crus, the esophagus, and the stomach

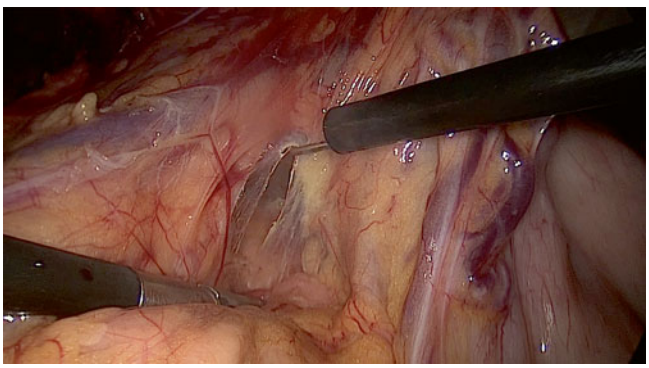


Fig. 18.16 Division of the coronary vein and the left gastric artery, which are dissected all the way to their base

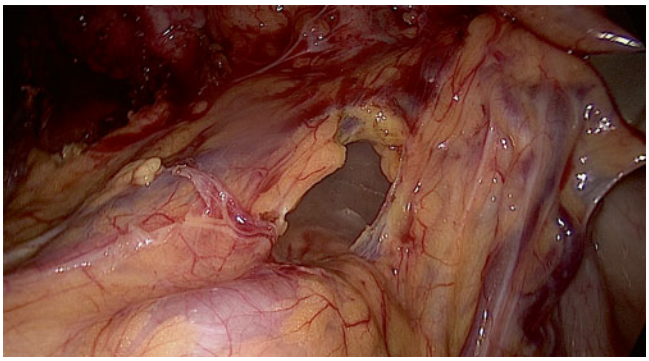


Fig. 18.17 Division of the coronary vein and the left gastric artery, which are dissected all the way to their base

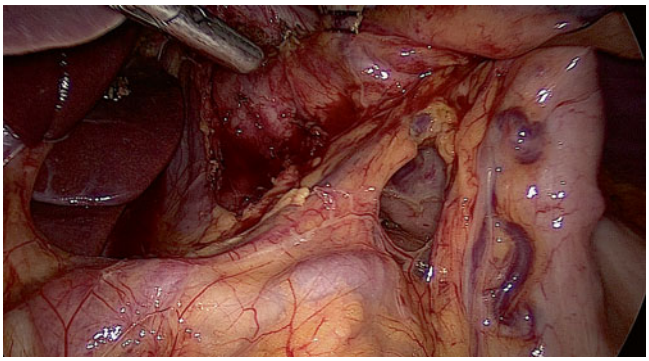


Fig. 18.18 Division of the coronary vein and the left gastric artery, which are dissected all the way to their base

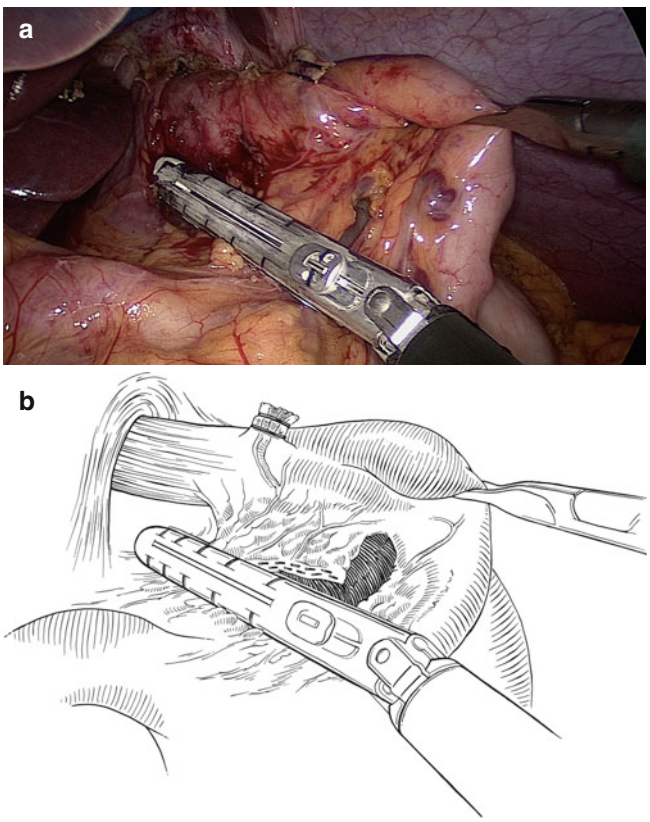


Fig. 18.19 (**a**, **b**) An Endo GIA™ stapler (Covidien, Minneapolis, MN) with a 45-mm vascular cartridge is used for the transection of the coronary vein and left gastric artery

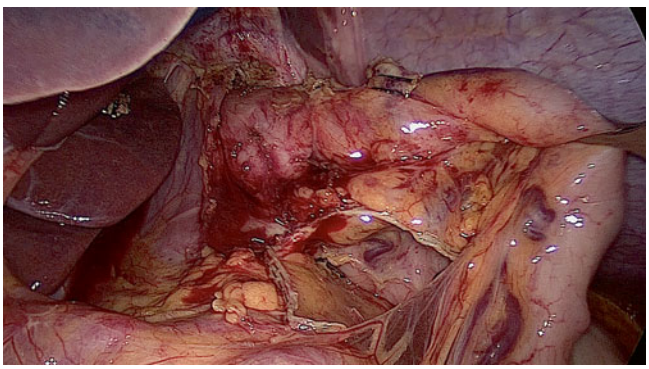


Fig. 18.20 The transected vessels after stapling

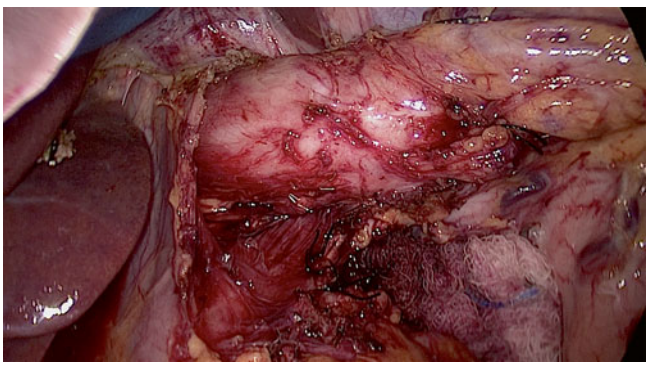


Fig. 18.21 The transected vessels after stapling

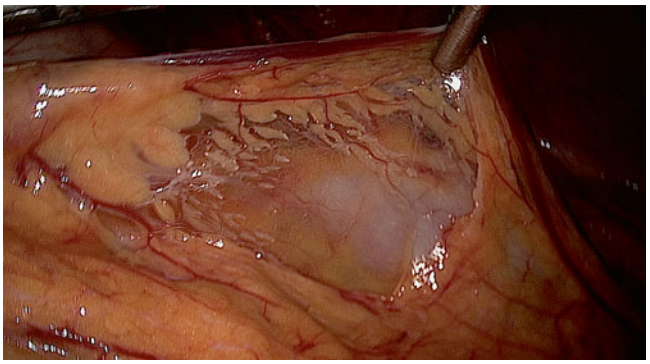


Fig. 18.22 Opening of the gastrocolic ligament

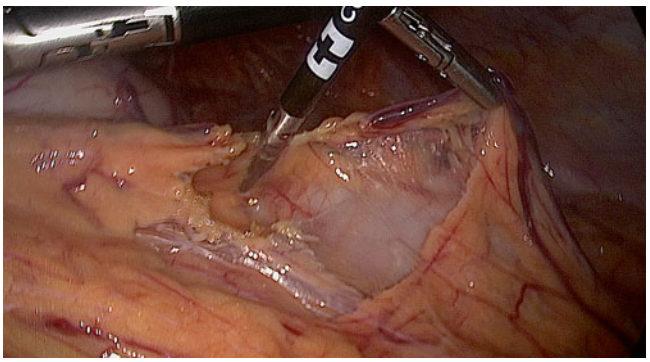


Fig. 18.23 Opening of the gastrocolic ligament

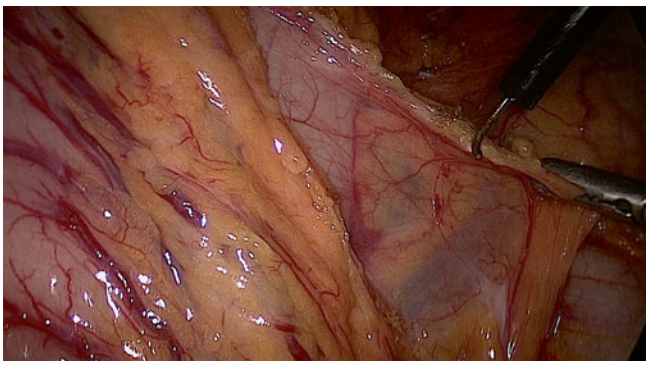


Fig. 18.24 Opening of the gastrocolic ligament

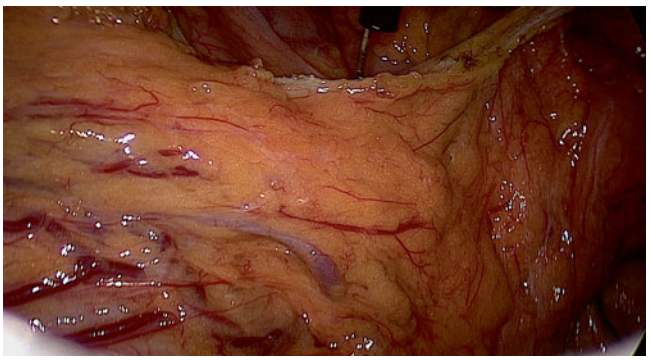


Fig. 18.25 Opening of the gastrocolic ligament

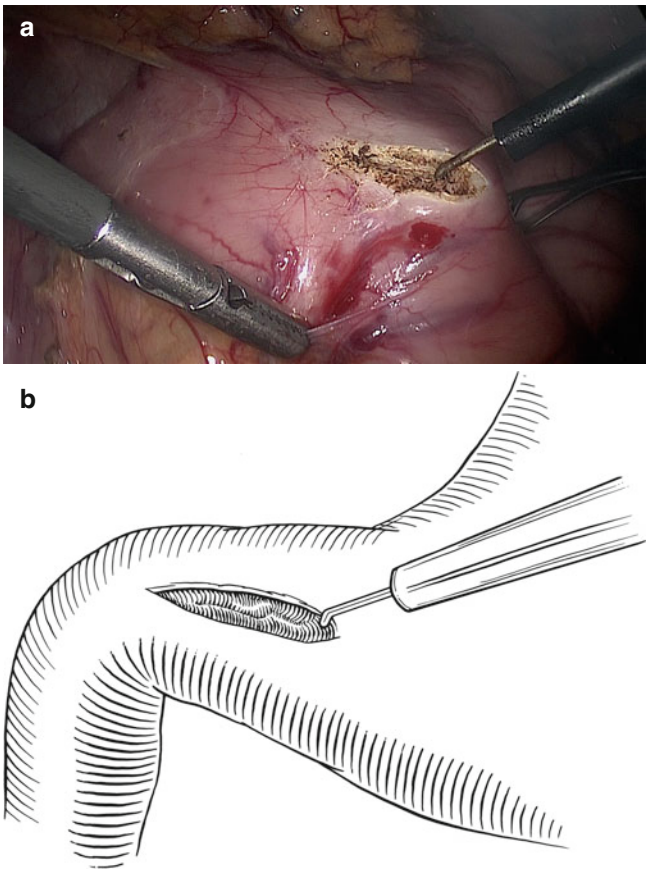


Fig. 18.26 (**a**, **b**) Longitudinal opening of the pylorus

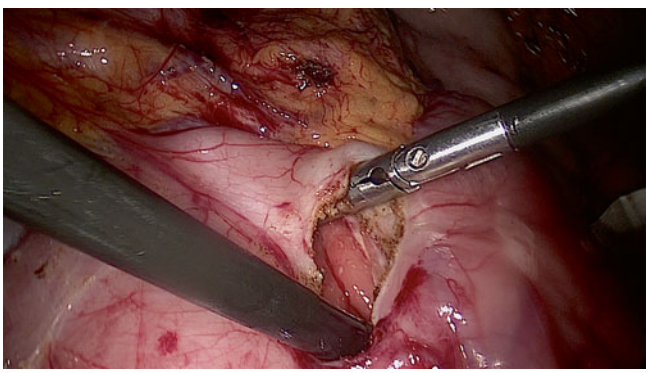
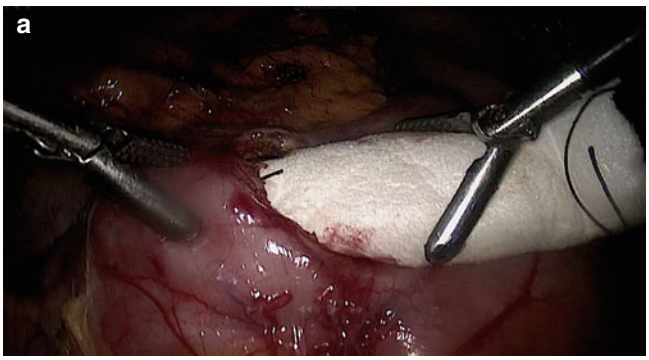


Fig. 18.27 Longitudinal opening of the pylorus



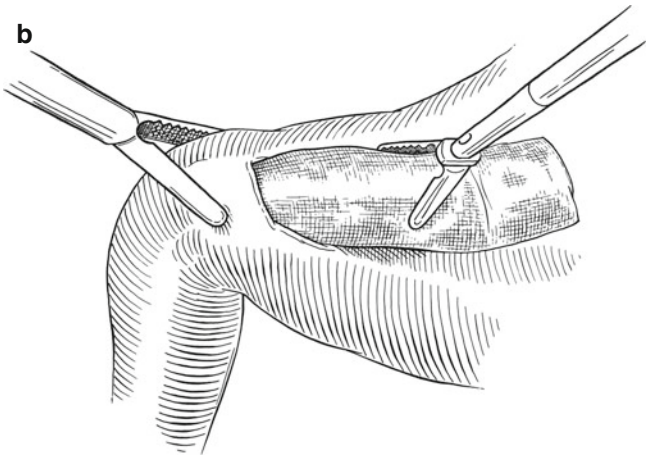


Fig. 18.28 (**a**, **b**) Insertion of a rolled-up sponge of absorbable material through the opening, to separate the anterior from the posterior wall

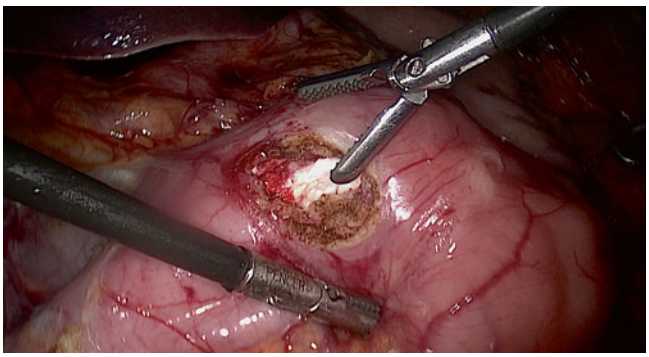


Fig. 18.29 The inserted sponge

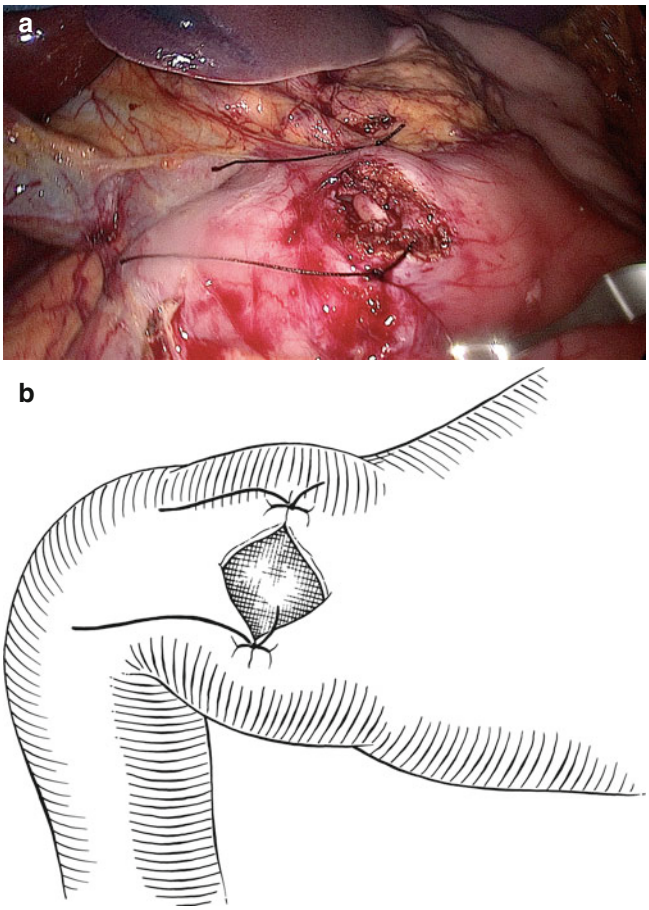


Fig. 18.30 (**a**, **b**) Beginning to close the opening with a suture at each end

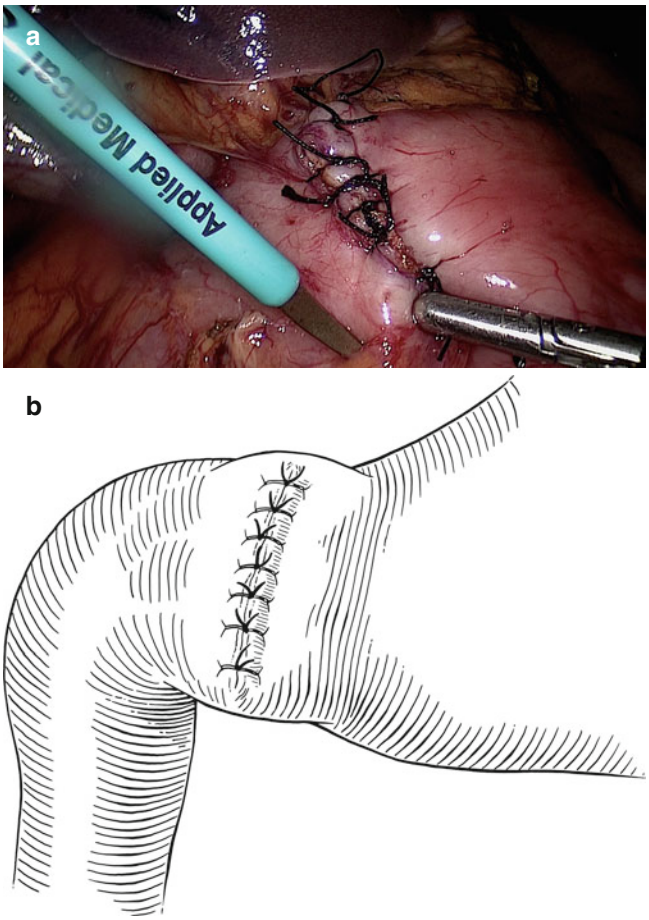


Fig. 18.31 (**a**, **b**) Transverse closing of the opening with interrupted 2-0 silk sutures

18.2.2 Transthoracic Component

After completion of the abdominal portion of the operation, the patient is positioned in a left lateral decubitus. The right chest is entered through a posterolateral thoracotomy in the fifth intercostal space.

The inferior pulmonary ligament is divided in order to allow complete retraction of the right lung. The pleura above and below the azygous vein is opened, and the vein is transected using an Endo GIA™ stapler with a vascular cartridge. The esophagus is then dissected from about 3 cm above the azygous vein all the way to the diaphragm, joining the dissection performed laparoscopically. During the mediastinal dissection, 10–15 lymph nodes are usually retrieved. The stomach is then pulled up, and the upper portion of the stomach is transected with an Endo GIA™ stapler at the level of the angle of His, towards a window opened along the lesser curvature between the second and the third branches of the left gastric artery. Figure 18.32 shows the stomach placed behind the esophagus before its transection.

The next step is transection of the esophagus. To avoid separating the mucosa from the muscle layers, the esophagus is clamped with a Satinsky clamp before the transection (Fig. 18.33). The esophagus is then transected with electrocautery about 3 cm above the azygous vein (Fig. 18.34).

The esophagus is placed over the anterior wall of the stomach (Fig. 18.35), and full-thickness 3-0 silk stay sutures are placed to align the esophagus and the stomach. Stay sutures of 3-0 silk are also placed laterally and anteriorly in the esophagus to avoiding sliding of the mucosa when the stapler is inserted (Fig. 18.36). A gastrotomy is then made in the anterior wall of the stomach, just distal to the esophageal transection line. The superior edge of the gastrotomy is sutured to the posterior wall of the esophagus (Fig. 18.37). A 45-mm Endo GIA™ stapler with a vascular cartridge is then inserted, with one arm inside the stomach and one arm inside the esophagus (Fig. 18.38). By firing the instrument, a 4-cm anastomosis is made between the posterior wall of the esophagus and the anterior wall of the stomach. The staple line is then inspected for bleeding (Fig. 18.39). A nasogastric tube is passed down the esophagus into the stomach. The anterior aspect of the anastomosis is closed with an inner layer of 3-0 braided absorbable suture, followed by an outer layer of interrupted 3-0 silk sutures (Figs. 18.40 and 18.41). Finally, two chest tubes (one straight and one curved) are placed in the right chest cavity, and the chest wall is closed in layers.

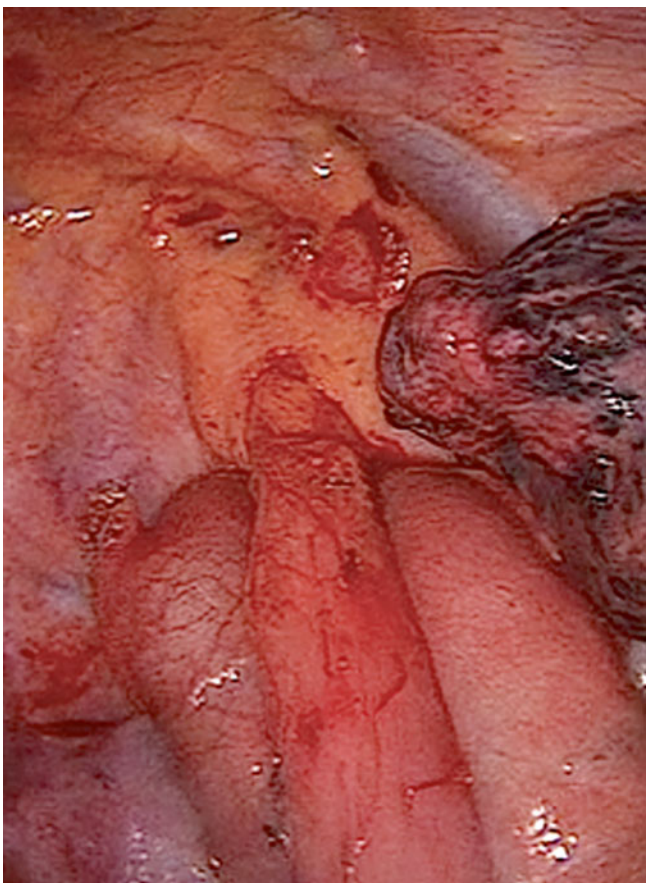


Fig. 18.32 The stomach placed behind the esophagus before its transection

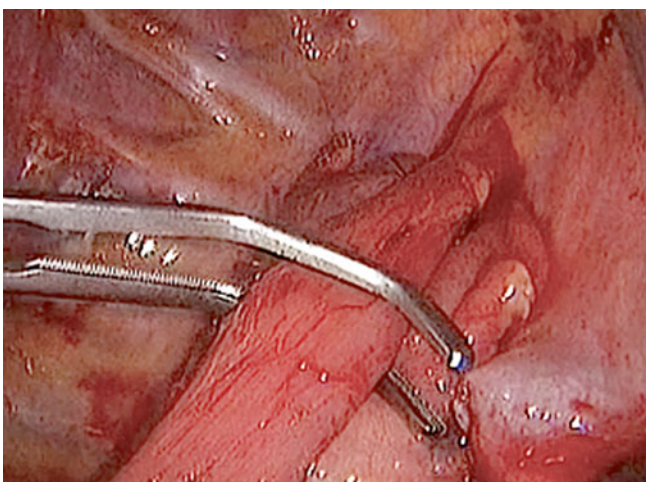


Fig. 18.33 Clamping of the esophagus with a Satinsky clamp to avoid separating the mucosa from the muscle layers during transection

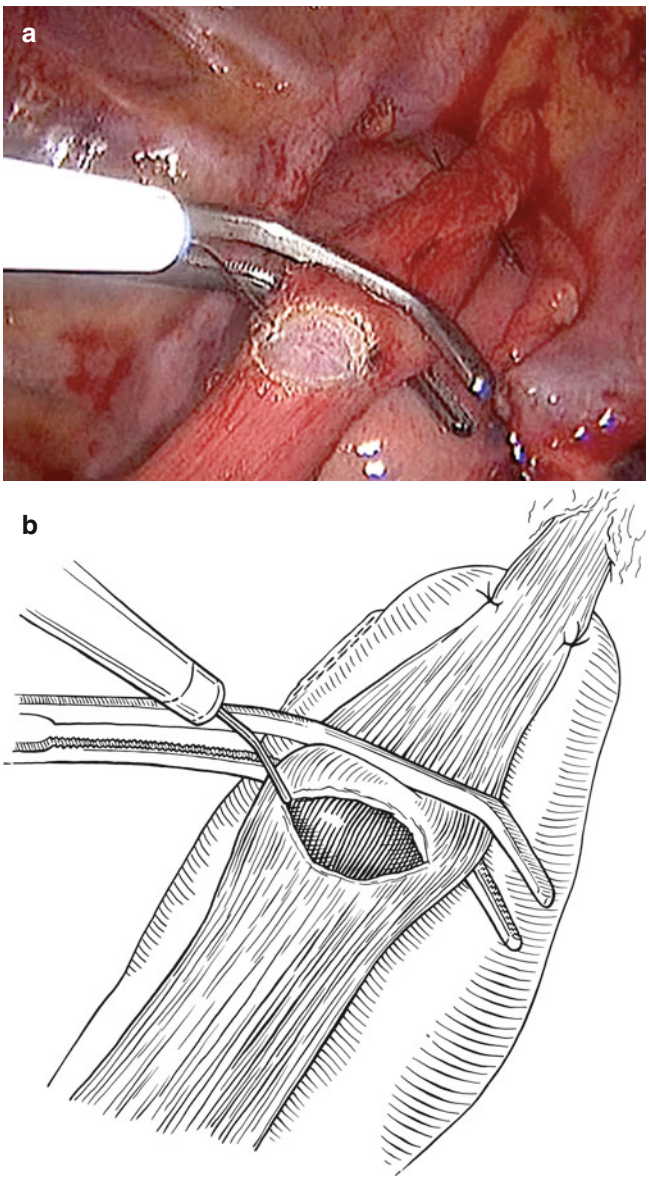


Fig. 18.34 (**a**, **b**) Transection of the esophagus with electrocautery about 3 cm above the azygous vein

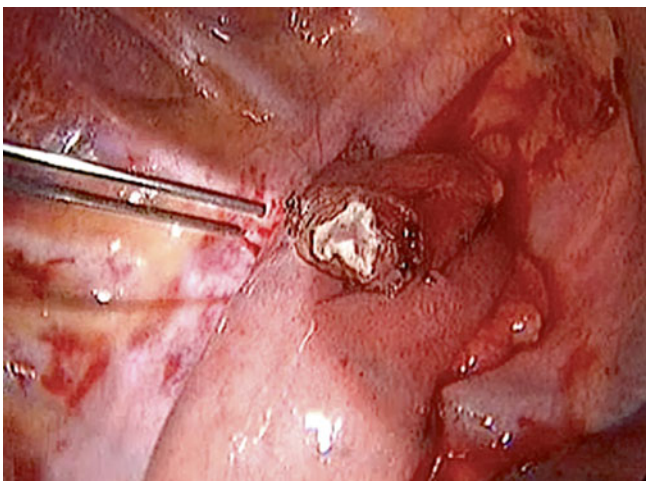


Fig. 18.35 Placement of the esophagus over the anterior wall of the stomach

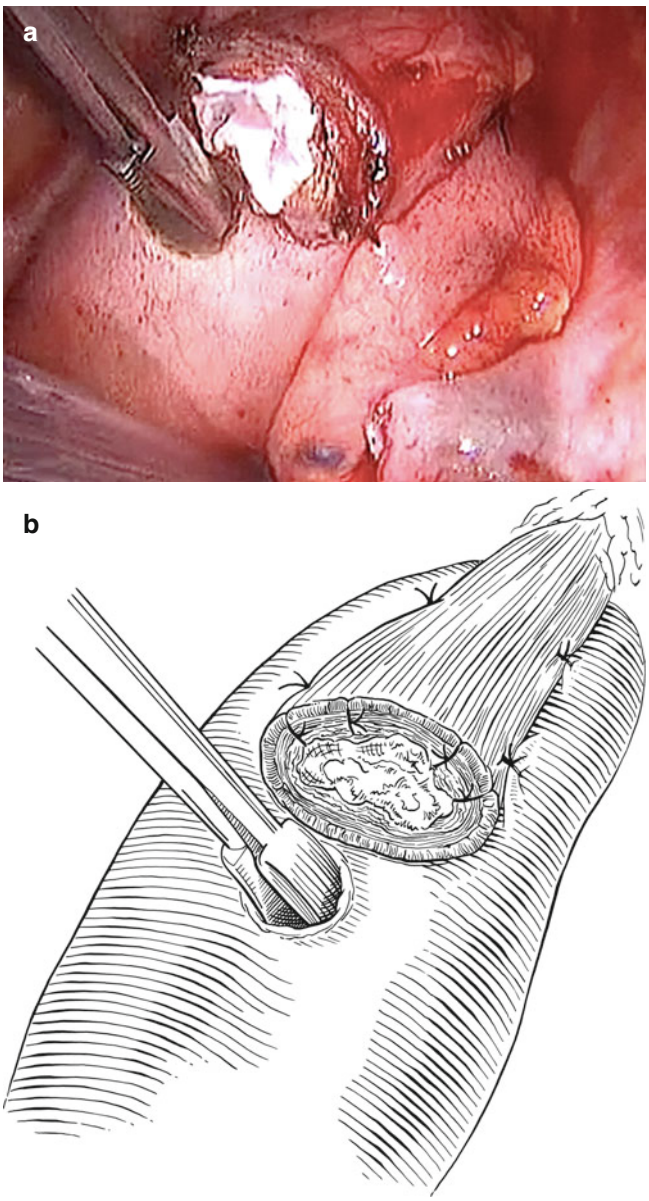


Fig. 18.36 (**a**, **b**) Placement of stay sutures laterally and anteriorly in the esophagus to avoiding sliding of the mucosa when the stapler is inserted

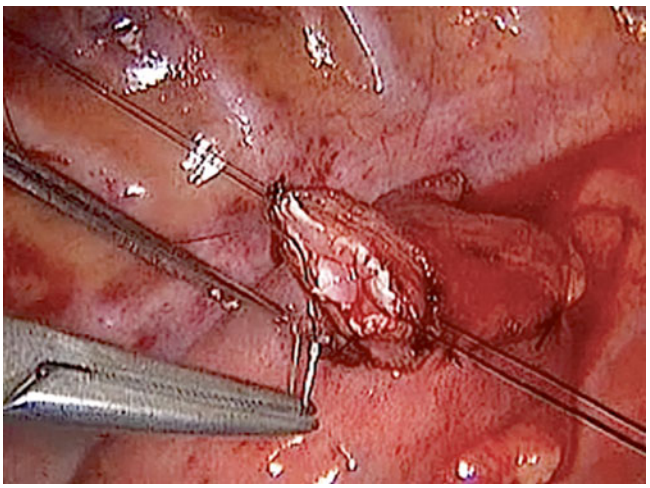


Fig. 18.37 Suturing of the superior edge of the gastrotomy to the posterior wall of the esophagus

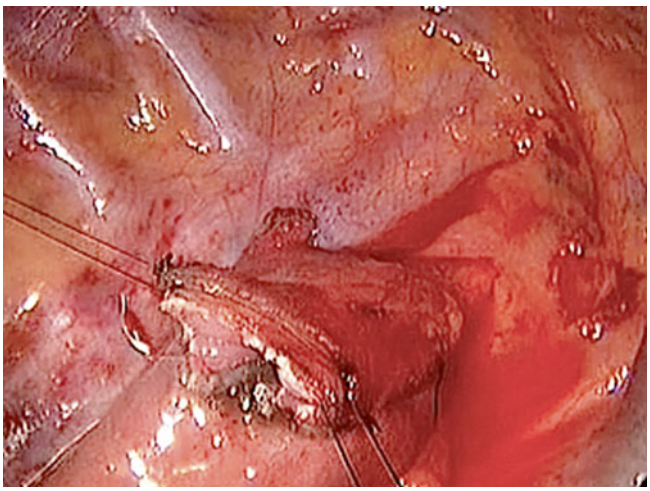


Fig. 18.39 Inspection of the staple line

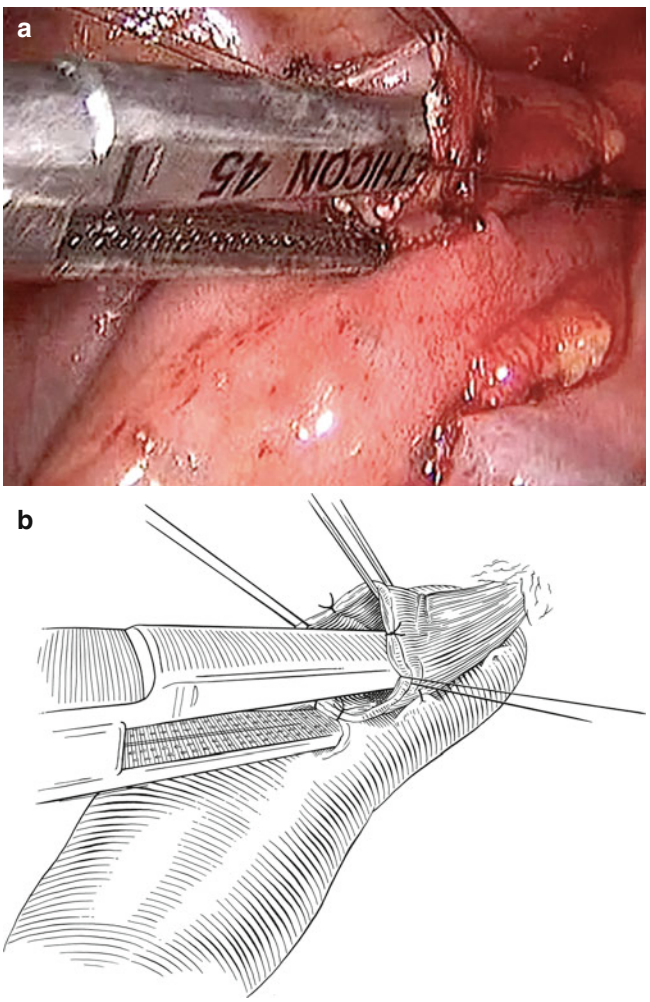


Fig. 18.38 (**a**, **b**) Insertion of the stapler, with one arm inside the stomach and one arm inside the esophagus

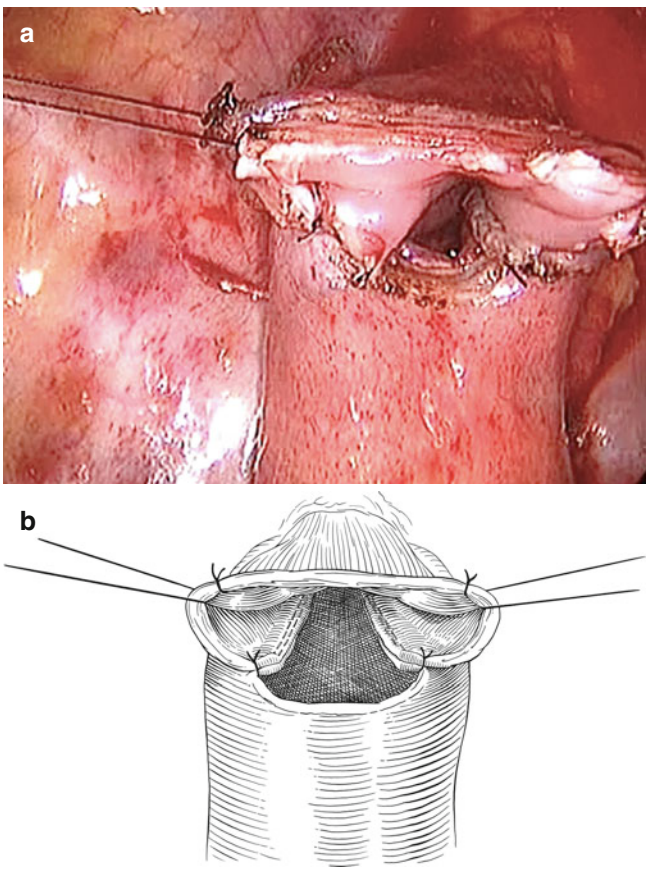


Fig. 18.40 (**a**, **b**) Closing the anterior aspect of the anastomosis

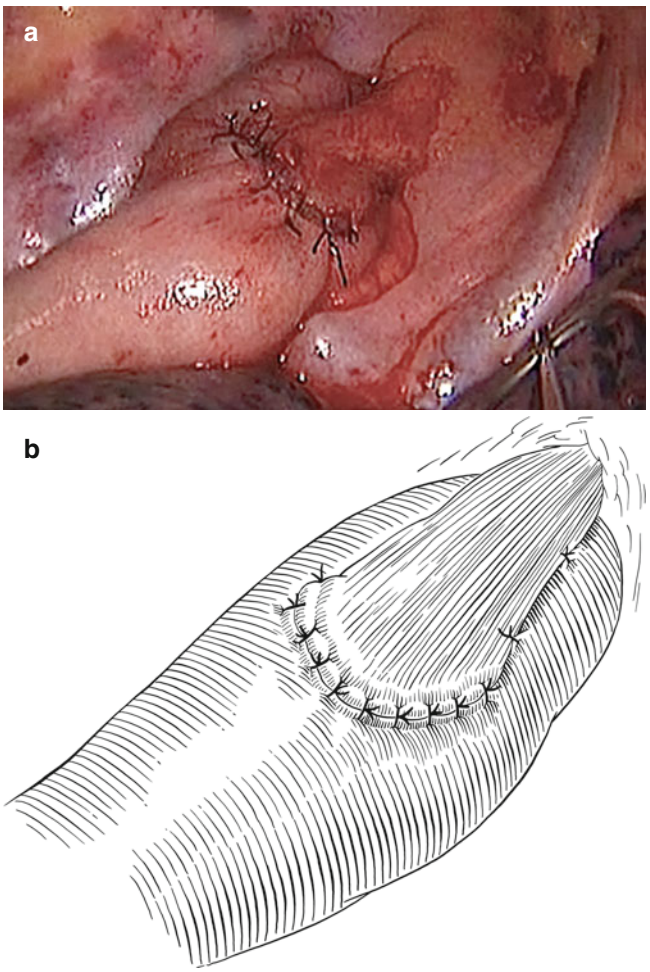


Fig. 18.41 (**a**, **b**) The final appearance of the anastomosis

18.3 Postoperative Course

The patient was extubated in the operating room and spent the first night in the intensive care unit. The epidural catheter was used for pain control for the first 5 days after the operation. The nasogastric tube was removed on postoperative day 3 and a liquid diet was started 1 day later. The patient was discharged on postoperative day 8 on a soft mechanical diet.

Pathology showed a T1b adenocarcinoma with no lymph node involvement (0/26). The margins of resection were free of tumor.

18.4 Hybrid Esophagectomy

The past two decades have seen the development of minimally invasive techniques for esophageal resection, with the goal of decreasing the morbidity and mortality of the open operation. Our preferred approach is a hybrid esophagectomy, which combines laparoscopy for the gastric preparation and a right thoracotomy. The laparoscopic approach follows the same principles as the open approach, but with a significant reduction in surgical trauma and no risk of later developing an incisional hernia. The advantages of a thoracotomy include wide exposure and easier performance of a lymph node dissection and esophagogastric anastomosis. We do perform a side-to-side stapled anastomosis as described by Dr. Collard and by Dr. Orringer (see Selected Reading). In our experience, this anastomosis has reduced both anastomotic leaks and strictures.

Acknowledgement Images taken with SPIES system. Courtesy of Storz.

Selected Reading

Allaix ME, Herbella FA, Patti MG. Hybrid trans-thoracic esophagectomy with side-to-side stapled intra-thoracic esophagogastric anastomosis for esophageal cancer. J Gastrointest Surg. 2013;17:1972–9.

Briez N, Piessen G, Torres F, Lebuffe G, Triboulet JP, Mariette C. Effects of hybrid minimally invasive oesophagectomy on major postoperative pulmonary complications. Br J Surg. 2012;99:1547–53.

Collard JM, Romagnoli R, Goncette L, Otte JB, Kestens PJ. Terminalized semimechanical side-to-side suture technique for cervical esophagogastrostomy. Ann Thorac Surg. 1998;65:814–7.

Gorenstein LA, Bessler M, Sonett JR. Intrathoracic linear stapled esophagogastric anastomosis: an alternative to the end-to-end anastomosis. Ann Thorac Surg. 2011;91:314–6.

Kim RH, Takabe K. Methods of esophagogastric anastomoses following esophagectomy for cancer: a systematic review. J Surg Oncol. 2010;101:527–33.

Lee JM, Cheng JW, Lin MT, Huang PM, Chen JS, Lee YC. Is there any benefit to incorporating a laparoscopic procedure into minimally invasive esophagectomy? The impact on perioperative results in patients with esophageal cancer. World J Surg. 2011;35:790–7.

Luketich JD, Pennathur A, Awais O, Levy RM, Keeley S, Shende M, et al. Outcomes after minimally invasive esophagectomy: review of over 1000 patients. Ann Surg. 2012;256:95–103.

Okabe H, Tanaka E, Tsunoda S, Obama K, Sakai Y. Intrathoracic esophagogastric anastomosis using a linear stapler following minimally invasive esophagectomy in the prone position. J Gastrointest Surg. 2013;17:397–402.

Orringer MB, Marshall B, Iannettoni MD. Eliminating the cervical esophagogastric anastomotic leak with a side-to-side stapled anastomosis. J Thorac Cardiovasc Surg. 2000;19:277–88.

Raz DJ, Tedesco P, Herbella FA, Nipomnick I, Way LW, Patti MG. Side-to-side stapled intra-thoracic esophagogastric anastomosis reduces the incidence of leaks and stenosis. Dis Esophagus. 2008;21:69–72.