7
Anatomy and Clinical Outcomes in Surgery for Esophageal Reflux

RIFAT LATIFI, JAMES C. ROSSER JR., and HAROLD BREM

Anatomy of Laparoscopic Antireflux Surgery

Performance of laparoscopic antireflux surgery requires mastery of pertinent anatomy as seen through the laparoscope. Important landmarks include the left lobe of the liver, the left triangular ligament, the gastrophrenic ligament the phrenoesophageal ligament, the caudate lobe of liver, the anterior vagus with its hepatic branch, the right posterior vagus nerve, the distal esophagus, the left and right crura of the diaphragm, the stomach, spleen, and short gastric vessels. In addition to the preceding structures detailed familiarity with the lesser omentum, aortic hiatus, vessels and lymphatics of the hiatal region as well as the diaphragm, transverse colon, and pancreas are essential. Understanding the normal and pathological anatomy and its variants as seen in laparoscopic dissection will minimze or help avoid misadventures such as bleeding, liver injuries, gastric perforation, splenic injuries, pneumomediastinum, dysphagia and vagal injuries. Examples of important anatomical structures[1,2] are found in Figures 7.1 to 7.4.

Clinical Studies

Although long-term clinical outcomes of laparoscopic fundoplication (LFP) will not be known for several decades, the short-term success of this operation has been established.[3] Outcomes of laparoscopic Nissen fundoplication (LNF) and open Nissen fundoplication were similar in 81 patients (47 open, 34 LNF) graded by functional parameters.[4] There was no mortality in either group and no difference in morbidity, but lower esophageal sphincter pressures (LES) in LNF were markedly higher. In another study 132 patients underwent laparoscopic fundoplication with overall morbidity of 7.5%, and good-to-excellent results were achieved in 94% of patients.[5]

Three hundred patients underwent LFP (252 Nissen fundoplication [NFP] and 48 Toupet technique) for gastroesophageal reflux (GER) associ-

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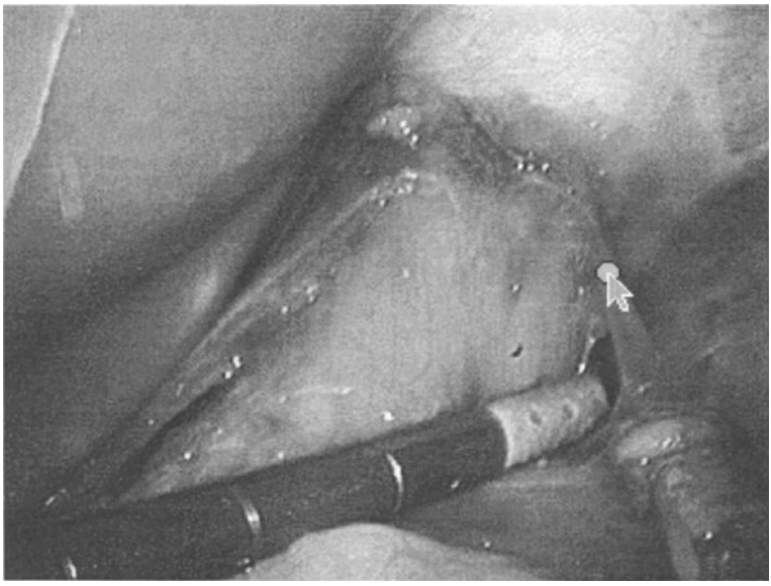

FIGURE 7.1. Photograph demonstrating the left anterior vagus nerve. Arrow points to nerve. It is of critical importance to avoid dissection near the vagus nerves.

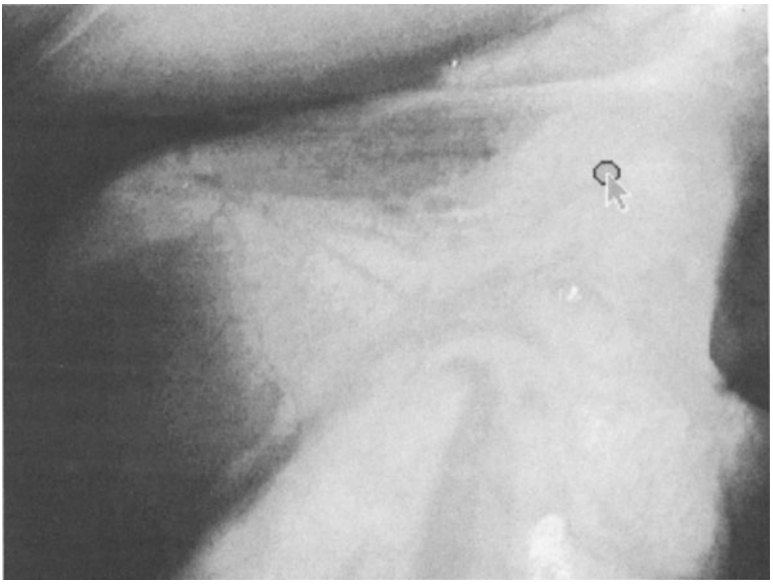

FIGURE 7.2. Photograph demonstrating the phrenoesophageal ligament.

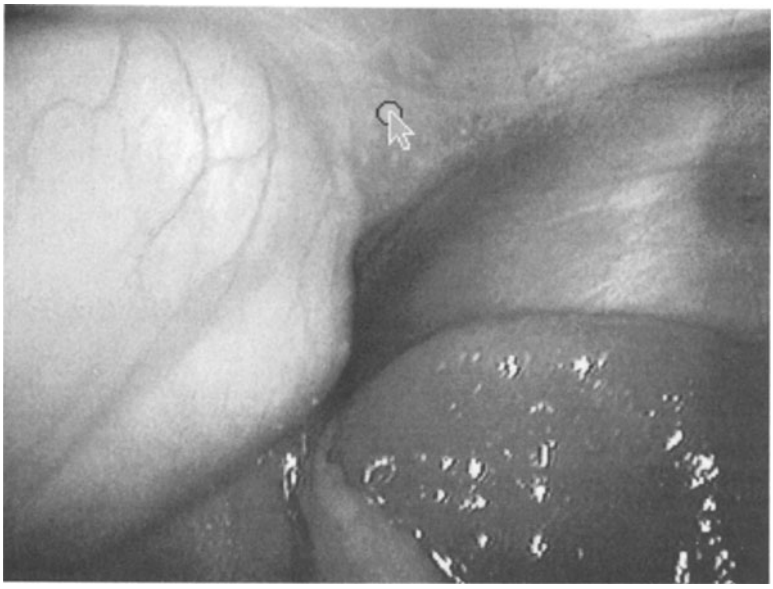

FIGURE 7.3. Photograph demonstrating the gastrophrenic ligament.

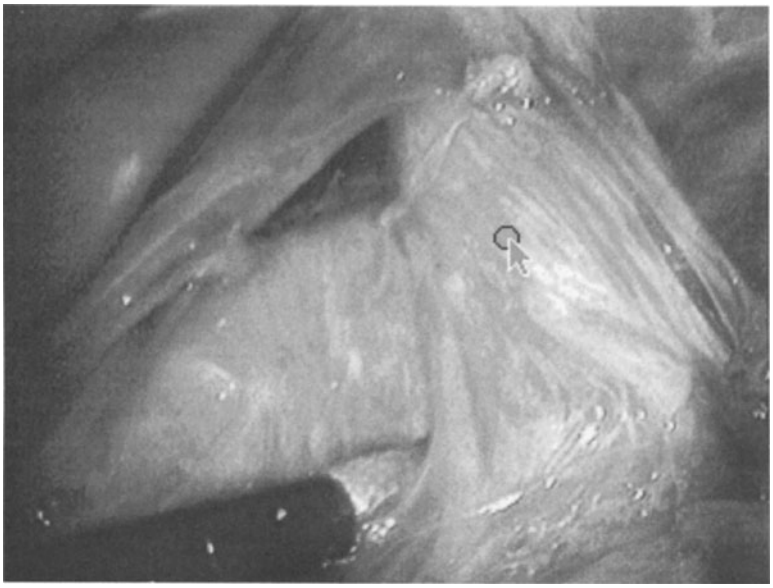

FIGURE 7.4. Photograph demonstrating the distal esophagus.

ated with atypical reflux symptoms, erosive esophagitis, or Barrett's esophagus, as well as an abnormal 24-hour pH probe. Ninety-three percent of patients at 1 year following the operation were free of heartburn. Furthermore, atypical reflux symptoms (e.g., asthma, hoarseness, chest pain, cough) were eliminated or improved in 87% of patients.[6] Three of the four patents in this series who had a recurrence of regurgitation and abnormal esophageal pH had a slipped fundoplication detected with barium swallow, and required reoperation. Overall patient satisfaction in this study was excellent at 97%. A follow-up satisfaction survey at 1 year was 91%, whereas esophageal motility and esophageal pressure was improved in 75% of patients, but worse in 10%.[6] Two percent of patients (five patients) developed postoperative dysphagia or reflux as a result of an intact fundoplication herniating into the chest. They required repeat operation. Major and minor complications were reported to be 6% and 2%, respectively.[6]

A variation of Nissen fundoplication is laparoscopic Nissen-Rossetti fundoplication. This type of fundoplication was reported in 148 patients.[7] Sixteen percent (19 of 117) of the patients that were followed from 3 to 31 months had adverse symptoms, four of which required laparoscopic reoperation, and five who needed endoscopic dilatation. Overall 18 (12.5%) had intraoperative complications, with bleeding as the most common (12 patients), followed by pleural opening (five), whereas 14 (9.5%) patients had various postoperative complications (e.g., bleeding, dysphagia, pleural effusion, wound infection, diarrhea, and tachycardia). Nonetheless, these authors suggest that this procedure can be carried out safely and effectively, with similar results to the open technique.

LNF was successful in 207 patients in another series of 230 patients.[8] Twenty-three (10%) of the patients underwent reoperation, with 10 of those for paraesophageal hernia and persistent dysphagia. There was one death in this series, due to superior mesenteric thrombosis and celiac artery thrombosis, and four cases of pulmonary embolism. In order to decrease the rate of complications these authors suggested routine repair of the posterior paraesophageal hernia, reduction of diathermy usage around the hiatus when possible, and avoidance of vigorous retraction of stomach. Overall relief of GER symptoms was reported in 98% of patients with a follow-up ranging up to 40 months (median 16 months), and 88% in those undergoing single operation respectively.[8] Laparoscopic FP has also been proven to be applicable with good outcome in infants and children.[9]

Partial or Complete Fundoplication: Does It Matter?

Fundoplication for GER has undergone multiple modifications. The results of each technique appear to depend on the surgeon's level of comfort performing the chosen technique.[10] The issue of partial or complete

laparoscopic fundoplication, which is similar to an open technique, continues to generate debate.[11] In a study of 231 patients, short-term results were similar when laparoscopic partial fundoplication (PFP) was compared with laparoscopic Nissen-Rosetti fundoplication (NRFP).[2] It is interesting that these authors reported fewer side effects with PFP than they did with NRFP as demonstrated by an earlier return to normal diet, a lower dysphagia rate and overall higher satisfaction.[2] Other studies have reported better results with Toupet FP when compared with NRFP when short gastric vessels were not divided, although esophageal pH measurements were similar.[12] In this study postoperative LES pressures were higher in NRFP. Complete FP without short gastric division was also associated with a higher degree of dysphagia and gas-bloating. In a randomized, prospective study comparing NFP with Toupet fundoplication,[13] no advantages were found when complete or partial FP (modified Toupet) after the division of short gastric vessels, was performed. Laparoscopic NRFP was also associated with higher rates of failure, recurrent disease, or severe dysphagia.[14] In a study of 503 patients, seventeen of 19 patients who failed antireflux surgery had NRFP.[14]

Larger scale studies and long-term follow-up do not allow us to draw clear cut conclusions of the superiority of partial versus complete fundoplication or dividing or not dividing short gastric vessels. Some regard partial posterior FP and total FP, with division of short gastric vessels, to be associated with better outcome when patients are selected appropriately;[14] however, it is clear that which ever technique is used it must last a life time.[11]

Perioperative Complications

Complications of laparoscopic fundoplications are grouped into intraoperative, postoperative, and long-term complications. Specific intraoperative complications in NFP are bleeding from the liver, pneumothorax, and perforation of the esophagus or the stomach. Intraoperative bleeding from the site of trocar insertion, left lobe of the liver, retroesophageal mobilization, pleural opening, and gastric perforation was reported in (12.5%) patients.[7] A retrospective review of short-term results of 2,453 patients showed that 1% had an esophageal or gastric perforation and 1.1%[15] had bleeding complications that required blood transfusion, whereas 0.2% required further surgery for persistent bleeding, 0.4% for a missed perforation, and 0.9% for crural perforation, paraesophageal herniation, or gastric volvulus.[15] The mortality of patients in this large series was 0.2%. The causes of death were missed duodenal perforation, a missed esophageal perforation, ischemic bowel with mesenteric thrombosis, or myocardial infarction.[15] Perforations of the viscus and bleeding from trocar-induced injuries are avoidable by strict application of well-learned tech-

niques of inducing proper pneumoperitonenum and direct visualization of the trocars as they enter.[1] Injuries from the placement of the Veress needle are abdominal wall vascular injuries such as epigastric artery lacerations, rectus muscle hematomas, visceral organ injuries, or major vascular injuries in the abdomen.

These complications should become very rare with experience gained in the laboratory and in the operating room. Although it is alarming, subcutaneous emphysema is of no clinical value and is usually self-limited. On the other hand, massive subcutaneous emphysema may be complicated with hypercarbic acidemia, which may be a cause for prolonged intubation and ventilatory support in a patient with underlying pulmonary disease. Mediastinal emphysema is more common in patients with large hiatal hernia that require extensive dissection, but it might also occur in the absence of mediastinal dissection.

Pneumothorax occurs in up to 5% of cases[16] and is usually caused by dissection into the mediastinum and pleura. Chest tube placement is rarely required because the majority of these patients will be asymptomatic. Air embolism is a potentially deadly complication if it is not identified and treated promptly. It may happen when there is a major venous injury, which allows the access of carbon dioxide to central circulation. Careful monitoring of the patient by the anesthetist and monitoring of end-tidal CO_2 will identify this complication early and allow prompt treatment.

Other perioperative laparoscopic complications are pulmonary. These complications are similar to but are less frequent than those with the open technique (e.g., atelectasis, pleural effusion, and pneumonia). Wound infections are also reported at a significantly lower rate. Most early, large clinical series of LFPs reported that incidence of superficial wound infection is lower than it is with open technique.[1] Analysis of 758 patients that underwent LFP revealed that wound infection was present in 0.1%.[17]

Postoperative Complications

Dysphagia is the most common postoperative complication of this operation with incidence of up to 24%.[3] The failure of this operation is defined as the inability to swallow normally, experience of upper abdominal discomfort during after meals and has persistent or recurrence of symptoms. Other complications include gas bloating, inability to belch, increased flatulence, early satiety, nausea, dietary restriction, diarrhea, and delayed gastric emptying.

In most cases dysphagia is related to edema in the area of GE junction and hypomotility. Late postoperative dysphagia occurred in 5.5% of 2,453 patients.[15] In most cases this complication resolves within several days, but it may persist for up to 2–4 weeks. A liquid diet may mitigate the symptoms of persistent dysphagia; however, some patients may require esophageal

dilatation. This dilatation, however, should be avoided for at least 6 weeks because complete disruption of the wrap may occur. Patients with poor esophageal motility and emptying in addition to dysphagia will eventually require reoperation. In a large series of patients reported, reoperation for dysphagia was required in less then 1%. In addition, patients who continue to have persistent dysphagia or evidence of aspiration for more than 1 year should also be considered for operative revision. Other postoperative complications within 30 days include acute paraesophageal herniation, gastric perforation, and mesenteric thrombosis.[8] Early reoperation (i.e., within 3 months) in this series[8] was performed for paraesophageal hernia (2.2%), dysphagia (1.7%), gastric obstruction (0.9%), and other reasons, including recurrent reflux, bleeding, and mesenteric thrombosis.

Summary

Where do we really stand with laparoscopic fundoplication? The results of studies in laparoscopic fundoplication show that safety is comparable and favorable when compared to an open technique.[18] Furthermore, the incidence of complications, morbidity, and mortality are similar to an open technique; however, LFP has other significant advantages over the open technique: less postoperative pain, shorter hospital stay, and earlier return to normal activities. This technique certainly has a great potential for further refinement and improvement of reflux disease. It is becoming a procedure of choice when surgical treatment of GER is indicated.

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