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Laparoscopic Posterior Partial Fundoplication for Gastroesophageal Reflux Disease

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Abstract

Gastroesophageal reflux disease (GERD) is a common condition that greatly impacts quality of life. Management options include medical and surgical therapies. Nonoperative management typically relies on longitudinal use of acid-suppressive medications such as proton pump inhibitors, which is associated with a significant financial burden and an increasing number of recognized side effects.

The surgical management of GERD is focused on correction of the lower esophageal sphincter dysfunction by means of a fundoplication, thus limiting acid and nonacid gastroesophageal reflux. Multiple techniques have been described, including use of complete (360°) fundoplication or partial fundoplication in either an anterior (180°) or posterior (220–270°) position. Recent studies have shown that the total and the partial fundoplications are similarly effective in controlling GERD. A partial fundoplication may also be advantageous when treating patients with GERD and poor esophageal motility. This article focuses on the posterior partial (modified Toupet) fundoplication, with attention to the key elements of the preoperative workup, appropriate patient selection, and important technical steps that are associated with the best outcomes.

Keywords: gastroesophageal reflux disease, GERD, heartburn, esophageal manometry, ambulatory pH monitoring, laparoscopic partial fundoplication, esophageal dysmotility

Introduction

Approximately twenty percent of Americans suffer from symptoms of gastroesophageal reflux disease (GERD) at least once per week.[1] Proton pump inhibitors (PPIs) are the most effective and most frequently utilized medications, with an estimated market of $12 billion annually.[2] Although PPIs control heartburn in most patients, regurgitation and atypical symptoms such as cough, chest pain, and wheezing are often refractory, particularly in patients with large hiatal hernias.[3]

For many years, PPIs were considered safe for long-term use. Recently, data are accumulating implicating PPIs in several health problems. For example, long-term treatment with PPIs has been associated with clostridium difficile infection, community-acquired pneumonia, hip fractures, vitamin B_{12} deficiency, and hypomagnesemia.[4] PPI use has also been associated with heightened risk of myocardial infarction, particularly in patients with unstable coronary syndromes and stents who are treated with clopidogrel.[5,6] It can also cause a form of interstitial nephritis.[7] In addition, an association between PPI use and dementia has been suggested, especially in the elderly.[8] As side effects of chronic antisecretory therapy become better understood, it is likely that providers and patients will seek alternatives to lifelong medical treatment of GERD. Therefore, we predict there will be enhanced interest in the surgical management of GERD.

A variety of surgical antireflux procedures has been developed since the 1950s. The common element of these operations is their focus on re-establishing an effective antireflux valve at the esophagogastric junction. In 1956, Rudolph Nissen described a 360° (complete) fundoplication fashioned from the gastric fundus.[9] In 1963, Toupet described a posterior partial fundoplication, using a similar technique to Nissen but attaching the two parts of the gastric fundus to the esophagus and not to each other[10] (Fig. 1). At approximately the same time, Dor described an anterior partial fundoplication.[11] To improve postoperative dysphagia and bloating, the total fundoplication was later refined to the so-called ''floppy'' version.

Based on decades of experience, most authors now agree that the total and partial posterior fundoplications have similar effectiveness in controlling GERD, whereas some advocate a possible improvement in early dysphagia in the

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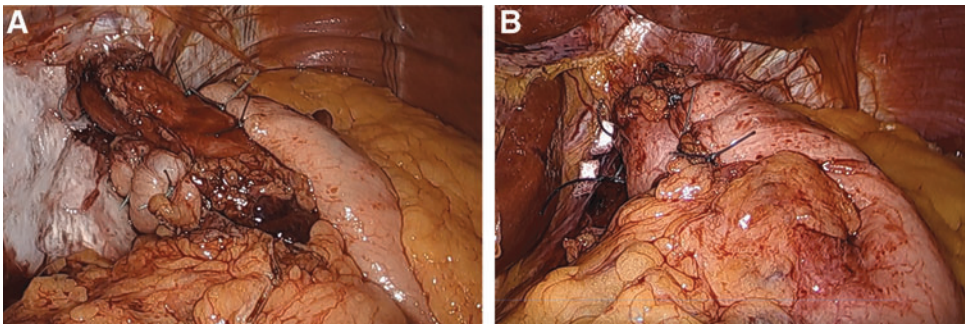

FIG. 1. Types of fundoplications. **(A)** Posterior partial fundoplication. **(B)** Complete fundoplication.

partial fundoplication group, particularly in patients with preoperative dysphagia.[12–14] In addition to the type and degree of GERD symptoms, the presence of dysphagia or esophageal dysmotility is typically taken into account when deciding the best antireflux procedure for a particular patient. This tailored approach has been proposed for patients with significant esophageal motility disturbance for many years.[15–17] In these patients, the use of partial fundoplication is believed to provide sufficient antireflux capacity without causing persistent esophageal outflow obstruction and protracted dysphagia.

This article focuses on the preoperative evaluation and on the technical elements of the Toupet fundoplication, both of key importance to obtain a successful outcome.

Preoperative Workup

A complete anatomic and physiological preoperative workup is needed to define (1) the anatomy of the gastroesophageal junction; (2) the presence of esophagitis, stricture, or Barrett's esophagus; (3) the underlying function of the lower esophageal sphincter (LES) and the esophageal body; and (4) the reflux profile with objective measurement of abnormal reflux and correlation between reflux episodes and patient symptoms.

In 2013, a multidisciplinary panel provided consensus guidelines for the preoperative evaluation for a fundoplication[18]:

- Symptom evaluation: Patients may have typical (esophageal) symptoms such as heartburn, regurgitation, and dysphagia, and atypical (extraesophageal) symptoms such as cough, hoarseness, and wheezing. A surgeon should carefully record these and their response to PPIs. Response to PPIs is an important prognostic factor for the success of a fundoplication,[19] whereas lack of response should raise concerns for an alternative diagnosis, such as achalasia.[20,21] However, symptoms and PPI response alone do not prove that pathological reflux is present, as many studies have shown that assessment of symptoms alone has low sensitivity and specificity in diagnosing GERD, with incorrect diagnosis in 30%–50%.[20–22]
- Upper endoscopy: This test allows identification of esophageal mucosal damage, including esophagitis and stricture. In addition, the presence of biopsy-proven Barrett's esophagus is a sign of severe GERD, and mandates postoperative surveillance.
- Barium swallow: This test defines the anatomy of the gastroesophageal junction and is most helpful for characterizing the presence, size, and type of a hiatal hernia. Such information helps in the operative planning and patient education, as larger hiatal hernias may require a more complex operation and adjunctive measures to achieve a satisfactory and durable repair.
- Esophageal manometry: This test measures esophageal peristalsis and length, along with the pressure and relaxation of the LES. Surgeons who advocate a tailored strategy for the fundoplication will take into account the frequency and strength of esophageal peristalsis when deciding whether a complete or a partial fundoplication is preferred.
- Ambulatory pH monitoring: This test is considered the gold standard for GERD diagnosis, as it can detect abnormal amounts of gastroesophageal reflux and determine the correlation between symptoms and reflux episodes. A drawback of this test is that it requires 5–7 days of PPI cessation to allow maximum sensitivity and specificity.
- Gastric emptying studies: This test is used selectively, particularly in patients with connective tissue disorders or diabetes, to rule out gastroparesis.[18] In some cases of severe gastroparesis, a pyloroplasty may be added to the fundoplication to improve gastric emptying.[23]

Overall, the presence of typical GERD symptoms, responsiveness to PPIs, and objective evidence of pathological reflux by pH-monitoring are the best predictors of a successful outcome after fundoplication.[19]

Indications for Operation and Procedure Selection

Antireflux surgery is indicated in patients with proven GERD who want to reduce medication requirements or who suffer breakthrough symptoms. In some cases, patients may have concerns about the expense or complications of lifelong PPI therapy. In others, there may be incomplete control of certain symptoms, such as regurgitation with aspiration episodes. Although PPIs function by changing the pH of the gastric refluxate, reflux through an incompetent LES may still occur and cause symptoms.[24]

Care must be exercised in patients who report a complete lack of PPI effect. Although these individuals may be classified as having ''refractory GERD,'' the surgeon must consider other conditions, such as achalasia, eosinophilic esophagitis, visceral hypersensitivity, irritable bowel syndrome, or cholelithiasis.[20–22]

When preoperative esophageal manometry finds very abnormal peristalsis, a partial fundoplication is the preferred operation.[25] Traditionally, the threshold used by many surgeons was a distal esophageal amplitude < 30 mmHg or esophageal peristalsis in <60%–70% of wet swallows.[26] In the era of high-resolution esophageal manometry, esophageal motility is characterized by the distal contractile integral (DCI), which is the product of amplitude, duration, and span of the distal esophageal contractions. In the Chicago classification 3.0, esophageal dysmotility is defined as either ≥ 50% ineffective swallows (failed or weak—DCI < 450 mmHg · sec · cm) OR ≥ 50% fragmented swallows (DCI within the normal range but with ≥ 5 cm breaks in peristaltic contour).[27,28]

A recent meta-analysis comparing partial versus complete fundoplication for the treatment of GERD found lower postoperative dysphagia in the partial (Toupet) group despite higher rates of preoperative dysphagia.[29] Several variables may be associated with postoperative dysphagia, including preoperative dysphagia, poor esophageal contractility, and delayed bolus transit on barium swallow.[26] For these patients, a partial fundoplication provides similar reflux control with reduced dysphagia.[14,30] However, some studies suggest that the durability of partial fundoplication may be less reliable than complete fundoplication; therefore, most surgeons are selective in applying these options.[31–33]

The treatment of GERD is challenging in patients with morbid obesity. The pathophysiology of GERD in such patients may be different, as there is a contribution from the increased pressure gradient between the stomach and the esophagus (thoracic-abdominal pressure gradient), which contributes to reflux.[34,35] For this reason, a Roux-en-Y gastric bypass is preferred in most morbidly obese GERD patients, as it isolates the parietal cell mass in the distal stomach from the small proximal gastric pouch in continuity with the esophagus, and it limits bile reflux by use of a long Roux limb. In addition, resultant weight loss serves to reduce the pressure gradient noted earlier.

Key Technical Elements of Posterior Partial Fundoplication

Patient preparation

The patient is given general anesthesia and appropriate thromboembolism and antibiotic prophylaxis. An orogastric tube is placed to decompress the stomach. The legs are abducted using a split-leg table or stirrups. Pressure points are well padded. The operating surgeon stands between the patient's legs and the first assistant is to the patient's left side. Five trocars are used for the operation (Fig. 2). The bed is placed in reverse Trendelenburg position for gravity-assisted exposure of the upper abdomen.

Access

The abdomen is entered preferentially through a left upper quadrant stab incision and Veress technique to achieve pneumoperitoneum to 15 mmHg with CO_2. In patients with prior upper abdominal operations alternative approaches, such as open or optical methods, are considered. A 12 mm port is placed 15 cm below the xyphoid process and through the left rectus to admit a 10 mm 30° laparoscope. All remaining ports and a liver retractor are placed under direct vision in a specific order. A 5 mm port laterally along the left costal margin for the first assistant. A 12 mm port 11 cm down the mid-left costal margin for the surgeon's right hand. A 5 mm port 15 cm down the lateral right costal margin, and through this an articulating liver retractor is positioned beneath the left lobe of the liver and secured by a table-mounted mechanical arm. A final 5 mm port about 6 cm down the mid-right costal margin for the surgeon's left hand (placed right-to-left through the falciform ligament, and beneath the leading edge of the left lobe of the liver if needed to keep it well elevated).

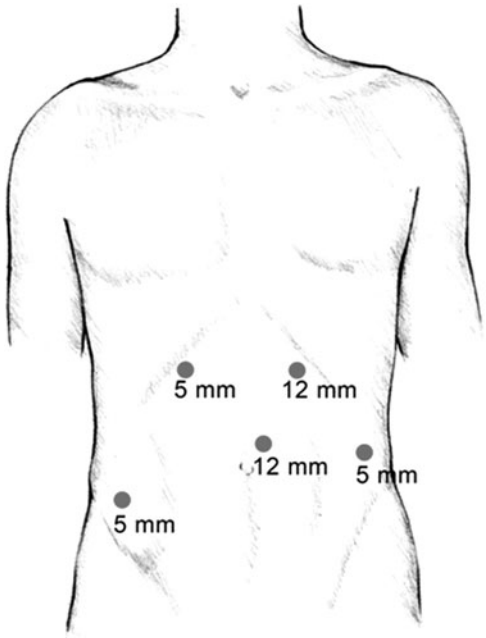

FIG. 2. Position of trocars for laparoscopic fundoplication.

Dissection

Using a bipolar tissue-sealing device, the gastro-hepatic ligament is divided all the way to the right pillar of the crus (Fig. 3A, B). If a replaced left hepatic artery is present, it is preserved. The right pillar is then bluntly separated away from the esophagus and the mediastinum is entered. The phrenoesophageal membrane overlying the esophagus is elevated and divided, taking care not to injure the underlying esophagus and anterior vagus nerve (Fig. 3C). The left pillar is also bluntly separated from the esophagus. The angle of His is taken down with hook cautery or bipolar energy.

Fundus mobilization

The greater curvature of the stomach is mobilized by entering the lesser sac about one-third of the way down from the angle of His, and then dividing the short gastric vessels and posterior fundic attachments all the way to the base of the left pillar (Fig. 3D, E). Care is taken to avoid injury to lesser sac structures and the spleen and its associated blood vessels.

Safe retraction of the esophagus

With further blunt dissection, the retroesophageal space is opened widely just below the diaphragm (Fig. 3F), and a Penrose drain is passed around the distal esophagus inclusive of

FIG. 3. Key technical elements of posterior partial fundoplication. **(A)** Gastrohepatic ligament. **(B)** Right crus. **(C)** Phrenoesophageal membrane. **(D)** Greater curvature. **(E)** Posterior attachments of fundus. **(F)** Retroesophageal space. **(G)** Penrose deployment. **(H)** High mediastinal dissection. **(I)** Hiatal suture placement. **(J)** Hiatus closed. **(K)** ''Shoe-shine'' maneuver. **(L)** Intracorporeal suturing of partial fundoplication.

both vagus nerves, and then secured anteriorly with a clip or a pretied ligation loop (Fig. 3G). The Penrose drain is then grasped with a locking grasper by the first assistant, who can provide caudad retraction and lateral adjustments to aid in the mediastinal dissection.

Mediastinal dissection

Once the mobilization of the gastroesophageal junction is completed, the circumferential dissection is extended into the mediastinum (Fig. 3H) until there are a minimum of 3 cm of intra-abdominal esophageal length without tension. During this esophageal ''lengthening,'' both vagus nerves are maintained in a peri-esophageal position and are carefully preserved.

Hiatal closure

The right and the left pillars are then re-approximated using interrupted, nonabsorbable, pledgeted sutures, placed posterior to the esophagus (Fig. 3I). Intracorporeal knot tying

Table 1. Technical Elements of Antireflux Operations

Extent of mobilization: mediastinum, short gastric vessels
Location of the gastroesophageal junction: 3–4 cm below hiatus
Closure of hiatus: nonabsorbable sutures
Space around wrap: 0.5 cm
Length of fundoplication: <2 cm
Size of bougie: 56–60 F
Type of wrap: total or partial

with a slip knot is very helpful to maintain appropriate apposition. An automatic suturing device may also be used based on surgeon preference. The closure should just allow a 5-mm instrument to pass into the mediastinum without resistance (Fig. 3J).

Creating a posterior partial fundoplication

A 56 – 60 F bougie may be passed down the esophagus into the stomach under laparoscopic visualization to help calibrate the fundoplication. The use of the bougie has been shown to decrease the incidence of postoperative dysphagia[36]; however, some very experienced surgeons do not use this routinely. The mobilized gastric fundus is passed through the retroesophageal window and rocked back and forth to confirm adequate mobilization (the so-called ''shoe-shine'' maneuver, Fig. 3K). This allows the experienced surgeon to verify sufficient fundic laxity and avoid leaving a segment of fundus above the wrap. A 220–270° posterior hemifundoplication is then adjusted just above the gastroesophageal junction, using three nonabsorbable sutures to affix each fundic limb to the corresponding anterolateral face of the esophagus (Fig. 3L). The total length of the fundoplication assessed anteriorly should be <2 cm (Figs. 1, 3L and Table 1).

Symptom Response and Durability

Antireflux surgery is successful in ~90% of patients.[37] Several randomized clinical trials (RCTs) for the past two decades have compared outcomes after laparoscopic complete versus partial fundoplication.[12,14,38,39] Based on these and on pooled meta-analyses,[13,40–42] a few conclusions can be drawn.

Both complete and partial fundoplications are highly effective at reducing reflux symptoms and esophageal acid exposure. A recent RCT comparing laparoscopic complete and partial fundoplications showed significant improvement in gastrointestinal symptoms at 5-year follow-up, with no differences between the procedures.[14,43] In parallel, esophageal exposure by 24-hour esophageal pH monitoring at 12 and 36 months was similarly reduced after both interventions. Some studies also show lower postoperative dysphagia in the partial fundoplication group, particularly in patients with preoperative esophageal dysmotility[40]; however, pooled data from a recent meta-analysis suggest that these changes are no longer evident at the >3-year timeframe.[42]

Laparoscopic complete and partial fundoplications are both safe, with low rates of complication and reoperation. Hakanson et al. showed no differences in intraoperative complications, including pneumothorax, small bowel injury, or splenic injury.[14] In addition, at a mean follow-up of 5 years, the authors found similar reoperation rates of 2.2% (5 out of 229 patients) and 1.8% (4 out of 227 patients) for partial and total fundoplication groups, respectively. An earlier meta-analysis of seven RCTs showed a similarly low rate of reoperations and a <10% postoperative dilation rate in both groups, with a slightly lower dilation rate in the partial fundoplication group.[41] Of note, one of the RCTs in this pooled study significantly deviated from these results, with higher rates of reoperation and postoperative dilation for dysphagia.

Fundoplications result in a significant and persistent reduction in PPI use. Hakanson et al. demonstrated a decrease from 86% and 82% PPI use for the partial and total fundoplication cohorts, respectively, to 10% and 12%, respectively, at the 6-week postoperative period, ultimately reaching 23% and 22% at the 3 years follow-up.[14] These data echo other studies and meta-analyses indicating the effectiveness of antireflux operations.[37]

Conclusions

The laparoscopic partial fundoplication is an effective option for the surgical treatment of GERD. It is most often utilized in situations where there is substantially disordered esophageal motility. For all antireflux procedures, success is based on a careful preoperative evaluation and patient selection, and on the performance of a procedure that respects the key technical elements identified. The posterior partial fundoplication provides similar long-term outcomes to a complete fundoplication, achieving successful control of reflux symptoms in >90% of patients, whereas reducing concerns for postoperative dysphagia.

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