Review

Analysis of the Causes of Failed Antireflux Surgery and the Principles of Treatment
A Review

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IMPORTANCE Although the diagnostic evaluation and technical elements for a successful laparoscopic fundoplication have been clearly identified, 10% to 20% of patients will eventually experience recurrence of their symptoms. The management of patients who fail antireflux surgery is complex and not well codified.

OBJECTIVE To provide an evidence- and experience-based analysis of the causes of failed antireflux surgery and to underscore the principles of treatment.

EVIDENCE REVIEW PubMed was searched for articles published between 1980 and 2014. The search terms included were the following: *heartburn*, *regurgitation*, *dysphagia*, *gastroesophageal reflux disease*, *cough*, *aspiration*, *laryngitis*, *GERD*, *GORD*, *endoscopy*, *manometry*, *pH monitoring*, *proton pump inhibitors*, and *Nissen fundoplication*.

FINDINGS Before planning therapy, a careful workup is necessary to determine whether the symptoms are due to recurrent reflux and to understand what caused the recurrence. Subsequently, therapy needs to be individualized based on the symptoms and on the findings of the workup. In some patients, a nonesophageal cause will be identified. Among patients with recurrent reflux, some will do well with acid-reducing medications and others will need another operation.

CONCLUSIONS AND RELEVANCE Laparoscopic antireflux surgery is a very effective and long-lasting treatment for gastroesophageal reflux disease. Its success is based on a careful preoperative evaluation and on the performance of a fundoplication that respects the key technical elements. Patients who are still symptomatic postoperatively must be thoroughly evaluated to identify the cause of failure, and treatment must be individualized.

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A laparoscopic fundoplication is a very successful treatment modality for patients with gastroesophageal reflux disease (GERD), with control of symptoms in about 80% to 90% of patients.[1-4] However, about 10% to 20% of patients experience persistence or recurrence of their symptoms, and between 3% and 6% eventually need a second antireflux operation.[5,6]

The management of patients who fail antireflux surgery is complex and not an easy task. Thus, the goal of this review was to provide an evidence- and experience-based analysis of the causes of failure and to underscore the principles of treatment.

Methods

We searched PubMed for articles published between 1980 and 2014. The search terms included were the following: *heartburn*, *regurgitation*, *dysphagia*, *gastroesophageal reflux disease*, *cough*, *aspiration*, *laryngitis*, *GERD*, *GORD*, *endoscopy*, *manometry*, *pH monitoring*, *proton pump inhibitors*, and *Nissen fundoplication*.

This review is qualitative and selective in the studies included. We relied on Eva's approach to a critical review of the literature, which is based on the ability of the expert to "identify knowledge that is well established, highlight gaps in understanding, and provide some guidance regarding what remains to be understood."[7]

Why Some Patients Experience Persistent or Recurrent Symptoms After Surgery

Most experts would agree that failure of a fundoplication to resolve symptoms is generally owing to 1 of the following causes: (1) wrong indications for the operation; (2) wrong preoperative workup; and (3) failure to execute the proper technical steps.

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Wrong Indications

Indications for surgery result from an accurate clinical and diagnostic evaluation of the patient with symptoms of GERD. While we address the characteristics of the clinical and diagnostic workups in the next section, we anticipate that patients who have symptoms not responsive to proper medical therapy, patients with bloating or epigastric pain, and patients with normal preoperative ambulatory pH monitoring results will likely be dissatisfied with their operation. In fact, Davis et al[8] reviewed 13 randomized clinical trials that assessed the outcome of laparoscopic antireflux surgery (LARS) (4 studies had a follow-up of ≥60 months) and found that the presence of atypical symptoms and poor response to medical therapy were identified as causes of failure in more than 60% of the studies. In addition, body mass index (calculated as weight in kilograms divided by height in meters squared) greater than 30 or 35 correlated with poor outcome in 33% of studies.[8] On the other hand, based on studies such as that of Campos et al,[9] most agree that a fundoplication is indicated when typical symptoms of GERD, such as heartburn and regurgitation, are the main symptoms and when extraesophageal symptoms of GERD due to high reflux and aspiration are present (eg, cough and hoarseness). In addition, the operation is usually recommended to patients who have complications secondary to proton pump inhibitors (PPIs), such as osteoporosis, *Clostridium difficile* infections, pneumonia, or hypomagnesemia with cardiac arrhythmias, and to young patients who do not want to take medical therapy for their entire life. Finally, it has been extensively shown that GERD in the setting of morbid obesity should not be considered an indication for a fundoplication. In these patients, the surgical treatment of GERD, independent from the primary achievement of weight loss, may result in the failure of the fundoplication, a more difficult conversion to a bariatric operation at a later time, and would not resolve other comorbidities.[10] Conversely, in patients with new GERD symptoms that coincide with weight gain, who do not meet the criteria for morbid obesity, and who have failed lifestyle modifications (eg, diet modification and weight loss), a fundoplication is appropriate with no specific body mass index cutoff below the threshold of morbid obesity.

Wrong Preoperative Workup

A proper preoperative workup should include an accurate clinical history (including the evaluation of the response to PPI therapy), barium swallow, upper endoscopy, esophageal manometry, and ambulatory pH monitoring. This recommendation is based on guidelines published in 2013 by a panel of expert gastroenterologists and surgeons.[11] This panel prepared an evidence- and experience-based consensus that recommended performing in all patients a symptomatic evaluation, barium swallow, upper endoscopy, esophageal manometry, and ambulatory pH monitoring. Conversely, the panel recommended that a gastric emptying study and combined multichannel impedance pH should be performed in selected patients only.[11]

Still, many believe that GERD can be securely diagnosed by the clinical history and an upper endoscopy only and that additional tests are not necessary. However, many studies have shown that even typical symptoms, such as heartburn and regurgitation, have low accuracy, leading to a wrong diagnosis of GERD in 30% to 50% of patients.[12,13] For instance, Patti et al[12] found that among 822 consecutive patients referred for esophageal function tests because of a clinical diagnosis of GERD (based on symptoms and endoscopic findings), abnormal reflux by pH monitoring was present in 70% of patients. Heartburn and regurgitation were equally frequent in both groups of patients with and without GERD. Many patients with normal esophageal acid exposure had been treated with expensive medications on the assumption that gastroesophageal reflux was the cause of their symptoms, masking other diagnoses such as irritable bowel syndrome, gallstone disease, and coronary artery disease. In addition, some patients who had been referred for antireflux surgery because they did not improve with PPI therapy were found to have achalasia.[14] These patients are frequently labeled as having refractory GERD and they are treated for a long time with PPIs or they might undergo an antireflux operation if esophageal function tests are not performed. Bello et al[15] analyzed the sensitivity and specificity of symptoms, endoscopy, barium esophagography, and manometry as compared with ambulatory 24-hour pH monitoring in 138 patients referred for LARS. Four patients were excluded as they were found to have achalasia. Of the remaining 134 patients, 56 (42%) were found to have normal pH monitoring results and 78 (58%) had a pathologic amount of reflux. When these 2 groups were compared, there was no difference in the incidence of symptoms, presence of reflux and hiatal hernia on esophagogram, endoscopic findings, and esophageal motility. This study clearly indicated that 24-hour pH monitoring should be routinely performed as part of the preoperative workup of patients suspected of having GERD.[15] In addition, the preoperative identification of abnormal reflux by pH monitoring is predictive of a successful fundoplication.[9] Campos and colleagues[9] demonstrated that the 3 most important predictors of successful outcome of antireflux surgery are the presence of typical symptoms (heartburn and regurgitation), a good relief of symptoms with PPI therapy, and the presence of a pathologic amount of reflux as determined by pH monitoring.

Failure to Respect the Proper Technical Elements

In 1999, Soper and Dunnegan[16] were among the first, to our knowledge, to categorize the anatomic causes of failure of a fundoplication. They performed a fundoplication in 290 patients during a 6-year period: in the first part of their experience (53 patients in group 1), the short gastric vessels were divided selectively, and the diaphragmatic crura were approximated only when a large hiatal hernia was present. In the subsequent 237 patients (group 2), these 2 steps were performed in all patients. The authors reported a 7% anatomic failure rate of the fundoplication, mostly secondary to intrathoracic migration of the wrap with or without disruption of the fundoplication. Anatomic failure was associated with technical shortcomings, large hiatal hernias, and early postoperative vomiting.[16]

Since then, the key technical elements of a laparoscopic fundoplication have been clearly identified.[17] They include the following:

- Dissection in the posterior mediastinum. It is essential to have 3 to 5 cm of esophagus without tension below the diaphragm.[18]
- Identification and preservation of both vagi nerves during the hiatal dissection.
- Transection of the short gastric vessels. A prospective randomized trial performed in Australia on 102 patients comparing the outcome of LARS performed with (50 patients) and without (52 patients) the division of the short gastric vessels showed similar symptom control and incidence of postoperative dysphagia at 10-year follow-up.[19] However, most surgeons feel more comfortable with the division of these vessels.

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- Approximation of the right and left pillars of the esophageal crus. This step is important for 2 reasons: (1) it avoids herniation of the wrap in the posterior mediastinum and (2) because the diaphragm has a synergistic action with the lower esophageal sphincter protecting against sudden increases in intra-abdominal pressure such as during coughing.[20]
- Creation of the wrap over a bougie (56-60F). Jarral et al[21] reviewed the literature and found 34 studies, of which 8 represented the best evidence, to address the use of bougie during a fundoplication. The authors concluded that there is some evidence to suggest that both the use and size of the bougie might affect postoperative dysphagia. The authors also stated that their findings were in accordance with the 2010 Guidelines for Surgical Treatment of Gastroesophageal Reflux Disease by the Society of American Gastrointestinal and Endoscopic Surgeons who classify the placement of the bougie as a grade B recommendation.[21]
- Choice of the correct wrap. In the early 1990s, a tailored approach to antireflux surgery was used, whereby a total fundoplication (360°) was performed in patients with normal peristalsis, while a partial fundoplication (Toupet, 240° posterior; Dor, 180° anterior) was chosen if abnormal peristalsis was present.[17,22] However, subsequent studies showed that reflux recurred in about 50% of patients 5 years after a partial fundoplication[23-25] and that a total fundoplication could be performed even in patients with abnormal peristalsis, without a higher incidence of dysphagia.[23-25] Based on these data, in the United States today, a total fundoplication is the procedure of choice, while a Toupet or a Dor fundoplication are chosen mostly for patients with absent peristalsis such as in achalasia or scleroderma.[26,27] Interestingly, data from Europe and Australia show similar results for both procedures in terms of reflux control and the incidence of postoperative dysphagia.[28] As far as the long-term results of partial and total fundoplications, data suggest that both a Nissen and an anterior fundoplication are durable and provide good long-term results and that at 10 years, they both have the same control of reflux and dysphagia rates. A study of 2261 patients (53.5% who underwent a total fundoplication and 43.2% who underwent an anterior fundoplication) at mean follow-up of 7.6 years showed that after an anterior fundoplication, heartburn was slightly worse (and reoperation for this symptom was more common) and the dysphagia rate was lower (and reoperation for this symptom was less common).[28]
- A key step of the operation is to choose the correct part of the stomach to bring around the esophagus and the gastroesophageal junction. If a point too low along the greater curvature is chosen, the surgeon will have the illusion of creating a floppy wrap but will indeed leave part of the stomach above the wrap itself.[29] A shoeshine maneuver helps to avoid this mistake.[1] The total length of the anterior portion of the wrap should measure about 2 cm, as a longer wrap increases the risk for postoperative dysphagia.[30] This is accomplished by approximating the right and left sides of the fundoplication with 3 interrupted sutures of nonabsorbable material placed at 1 cm of distance from each other.

Evaluation of Patients With Persistent or Recurrent Symptoms

A thorough evaluation in every patient allows us to understand why patients are symptomatic and to plan treatment accordingly.

Symptomatic Evaluation

As stressed by Horgan et al[31] in their analysis of failures of LARS, patients usually present because of (1) heartburn and/or regurgitation (suggestive of recurrent reflux due to an incompetent cardia); (2) dysphagia (suggestive of defective esophageal emptying); and (3) a combination of the 2. If the patient is again taking a PPI, it is important to assess the response because this has significant therapeutic implications.

Barium Swallow and Upper Endoscopy

The combination of these 2 tests usually identifies possible anatomic problems, such as a herniated wrap, or a wrong configuration of the fundoplication.

Esophageal Manometry

This test is important to assess the pressure and relaxation of the lower esophageal sphincter and the quality of the esophageal peristalsis. This is particularly essential if the patient experienced preoperatively severe dysphagia in addition to heartburn to rule out achalasia.[15] Finally, an achalasia-type picture can be caused by a too-tight or long fundoplication.[32]

Ambulatory pH Monitoring

If a patient experiences heartburn after a fundoplication, it is usually assumed that the operation has failed, and acid-suppressing medications are prescribed.[33] However, it has been shown that this approach is wrong in most patients and exposes them to improper and costly medical therapy or redo surgery.[34-36] Many studies have in fact shown that when patients with recurrent heartburn are tested by ambulatory pH monitoring, abnormal reflux is present in only 23% to 39%.[34-36] Based on these data, objective evidence of abnormal esophageal acid exposure should always be documented by esophageal function tests before prescribing acid-suppression medications or planning to redo a fundoplication.

Anatomic Causes of Failure

Horgan and colleagues[31] have proposed an anatomic classification of failures based on the results of the preoperative workup and the operative findings. This classification does not impact the choice of reoperation for failed fundoplications but it helps in understanding why the fundoplication failed the first time. The following are the classifications with explanations of the different types of hernia and their anatomic characteristics:

- Type IA hernia: Both the gastroesophageal junction (GEJ) and the wrap are located above the diaphragm.
- Type IB hernia: The wrap is located below the diaphragm, while the GEJ is located above. Both anatomic findings can be caused by limited mediastinal dissection, with only 1 or 2 cm of esophagus below the diaphragm, a short esophagus, and inadequate closure of the hiatus (**Figure 1**).
- Type II hernia: This occurs when part of the stomach is located above the wrap and it is herniated above the diaphragm. This problem usually is caused by a faulty closure of the hiatus and by a redundant fundoplication. This can occur unintentionally because the surgeon does not realize that a point too low along the greater curvature has been brought around the esophagus or it can be done intentionally in an attempt to create a very floppy fundoplication. A shoeshine maneuver can avoid this mistake in most cases (**Figure 2**).

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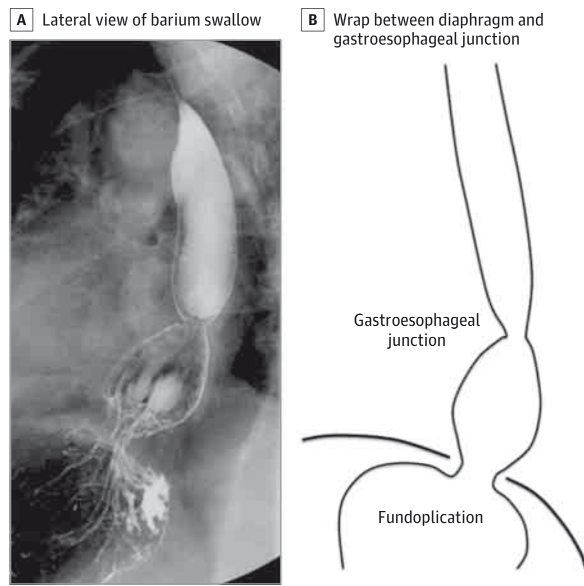
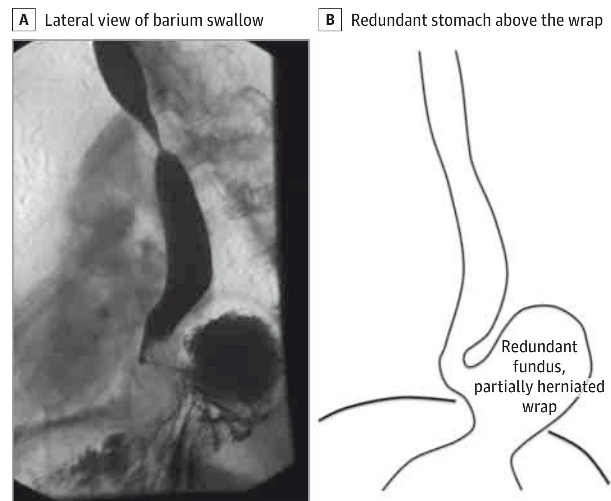
Figure 1. Type IB Recurrence



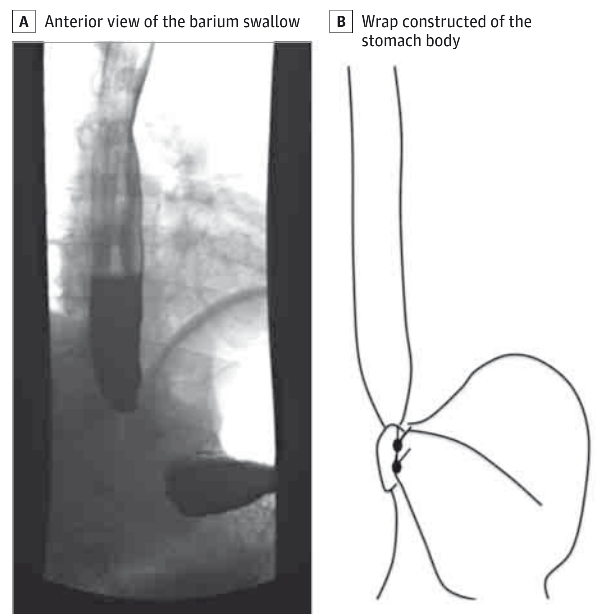
A, Lateral view of the barium swallow of a patient who presented with recurrent heartburn and regurgitation 5 years after a laparoscopic Nissen fundoplication. B, The wrap is located below the diaphragm, while the gastroesophageal junction is located above it.

Figure 2. Type II Recurrence



A, Lateral view of the barium swallow of a patient who presented with recurrent heartburn and regurgitation 3 years after a laparoscopic Nissen fundoplication. B, The redundant stomach is located above the wrap and it is herniated above the diaphragm.

Figure 3. Type III Recurrence



A, Anterior view of the barium swallow of a patient who presented with no heartburn and regurgitation but with new-onset dysphagia 2 months after a laparoscopic Nissen fundoplication. B, The body rather than the fundus of the stomach was used to construct the wrap and the short gastric vessels were not divided during the initial operation. Any attempts to treat dysphagia by pneumatic dilatations were ineffective.

- Type III hernia: This occurs when the body, rather than the fundus of the stomach, is used to construct the wrap. This represents an exaggeration of a type II problem, although in this case, both the wrap and the GEJ are in a subdiaphragmatic position (**Figure 3**).

Management

Figure 4 illustrates the treatment algorithm for patients with recurrent symptoms after LARS. If heartburn is the main symptom and it is well controlled by medications, a second operation can be avoided. However, if severe regurgitation and dysphagia are present and a clear anatomic problem has been identified, a reoperation is not unreasonable. In these cases, an extensive and detailed discussion with the patient should be entertained about the complexity of the procedure, the risk for damage to the esophagus with potential esophageal resection or to the stomach and vagus nerves, and about the outcome. Also, while some surgeons feel very comfortable with a laparoscopic approach, others prefer a conventional laparotomy.[37,38] In general, a review of the operative approaches during a redo fundoplication entails, in most cases, taking down the prior wrap, bringing the fundus of the stomach to its original position in the left upper quadrant, and assessing the hiatal closure and the position of the GEJ in respect to the diaphragm.[38] If the GEJ is still too high, a higher mediastinal dissection should be performed; if the gastroesophageal junction is still not reduced below the diaphragm, a Collis-Nissen lengthening procedure might then be necessary (**Video**). The role of mesh repair is controversial; nevertheless, a mesh repair should be considered in revisional surgery when the cause is determined to be an inadequate closure of the hiatus. A pyloroplasty may be considered in severe cases of gastroparesis after vagal disruption; an esophagectomy is usually the last resort after multiple failed redo fundoplications. Finally, the choice of the wrap, total vs partial, should depend on the quality of esophageal peristalsis (a partial wrap is indicated in those with an achalasia or scleroderma-type picture) and on the condition of the fundus after the dissection

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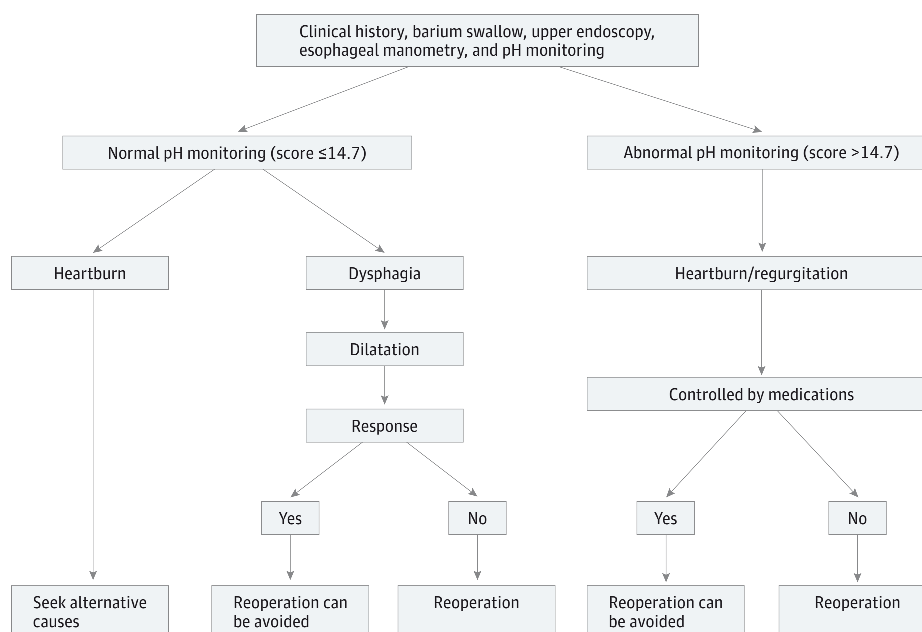
Figure 4. Treatment Algorithm for Patients With Recurrent Symptoms After Laparoscopic Antireflux Surgery



is completed. Finally, in patients who have gained weight and have become morbidly obese, reflux and symptoms often recur because of an increased gradient between the abdomen and the chest.[39,40] In these patients, a Roux-en-Y gastric bypass is a good option and preferred to a sleeve gastrectomy, which is effective for weight loss but ineffective for GERD and can even induce GERD in previously asymptomatic patients. In fact, DuPree et al[41] documented that after a sleeve gastrectomy, 84.1% of patients continued to have GERD symptoms and that 8.6% of those without GERD developed it postoperatively. Conversely, GERD resolved in 62.8% of patients after a laparoscopic Roux-en-Y gastric bypass because this operation avoids both acid reflux (as there are very few parietal cells in the small gastric pouch) and bile reflux (because of the long Roux-en-Y configuration).[42,43]

Outcomes

A redo operation is a complex operation, often with higher morbidity and longer hospital stay compared with the primary fundoplication.[44] Furnée et al[44] reviewed the literature on redo antireflux surgery (81 studies with 4584 reoperations in 4509 patients). They reported a mortality rate of 0.9%, an intraoperative complication rate of 21.4%, and a postoperative complication rate of 15.6%. In addition, the success rate was around 65% to 70%, clearly lower than that of the primary operation (around 85% to 90%).[44] Finally, while many studies have shown the feasibility of a redo laparoscopic fundoplication, very few have discussed the long-term results.[45,46] Dallemagne et al[46] assessed the outcome of redo laparoscopic fundoplication in 129 consecutive patients by radiology, endoscopy, symptom questionnaire, and quality-of-life index at a minimum follow-up of 12 months (mean, 76 months). Objective and subjective evaluation showed a failure rate of 41%, confirming that laparoscopic repair of a failed fundoplication has a high failure rate that increases over time.

Conclusions

Laparoscopic antireflux surgery is a very effective and long-lasting treatment for GERD. Its success is based on careful patient selection that takes into account a thorough preoperative evaluation and on the performance of a fundoplication that respects the key technical elements. Patients who are still symptomatic postoperatively must be thoroughly evaluated to identify the cause of failure, and treatment must be individualized.

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