Hypothesis: Laparoscopy has become the standard approach for surgical treatment of uncomplicated gastroesophageal reflux disease. Laparoscopic reintervention following failure of primary antireflux surgery (ARS) remains controversial. The purposes of this study were to assess outcomes in patients operated on for failed ARS, to describe reasons for failure of the primary surgery, and to identify factors predictive of failure of the revision.

Design: Retrospective analysis of prospectively collected data.

Setting: Tertiary-care teaching hospital.

Patients: A total of 176 patients (20 with multiple ARS) undergoing laparoscopic reintervention between September 12, 1993, and August 1, 2006, for failed ARS.

Interventions: Patients had preoperative subjective and/or objective documentation of failure after primary ARS: 131 patients had reoperative Nissen fundoplication, 28 patients had a partial wrap, and 17 patients had other procedures.

Main Outcome Measures: Preoperative and postoperative symptom scores and results of objective studies were prospectively collected. Postoperative patients with symptom scores of 2 or greater and/or abnormal 24-hour pH study results (DeMeester score > 14.7) were considered to have treatment failures. Logistic regression was performed to identify variables significant for poor outcomes.

Results: Median follow-up was 9.2 months in 145 patients (82.4%). One hundred eight patients (74.5%) demonstrated excellent symptomatic outcomes (P = .001). Twenty of 37 patients with failures had reflux symptoms and 23 experienced dysphagia. Sixty-seven patients had 24-hour pH and manometry studies; 18 (11 asymptomatic) patients had a DeMeester score greater than 14.7. Odds of failure were higher among patients presenting with dysphagia (odds ratio, 3.38; 95% confidence interval, 1.35-8.40; P = .009) or requiring an esophageal-lengthening procedure (odds ratio, 5.77; 95% confidence interval, 1.38-24.11; P = .02).

Conclusions: Laparoscopic reintervention following failed primary ARS provides excellent subjective and objective outcomes in most patients. Patients having laparoscopic reintervention for dysphagia relief or those requiring an esophageal-lengthening procedure have a significantly greater chance of a poor outcome.

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trials to support this evidence are lacking. The purposes of this study were to assess the subjective and objective outcomes in patients having laparoscopic reintervention after failed ARS and to identify preoperative and intraoperative factors significant for poor outcomes of the revision surgery. Analysis of findings at reoperation also elucidates patterns of failure of the primary procedure and helps to define important technical aspects of both primary and reoperative ARS that contribute to failure.

METHODS

PATIENTS

Patients were selected from a prospective database of 2391 patients who underwent antireflux procedures between October 9, 1991, and September 15, 2006, at our institution. Two hundred three reoperative antireflux procedures had been performed in 176 patients. Twenty patients had multiple previous ARS (13 patients with 2 previous repairs and 7 patients with 3 previous repairs). Of the revisions, 32.9% were of previous open procedures and 67.1% were of laparoscopic fundoplication. Most patients (n=148) were referred from other institutions. Twenty-eight patients had had a previous repair at our institution performed by or under supervision of 1 of us (L.L.S.).

OUTCOME MEASURES

All of the data were prospectively collected on standardized data collection forms and maintained in an electronic database system (Microsoft Access; Microsoft Corp, Redmond, Washington). Demographics and preoperative clinical data were obtained at the time of the initial office visit. Symptom assessment was performed using a standardized assessment tool that grades reflux, heartburn, and dysphagia on a scale of 0 to 4, with higher ordinal values representing greater frequency or severity of symptoms. Routine preoperative evaluation included esophageal manometry, 24-hour pH testing, and upper endoscopy. Upper gastrointestinal tract contrast radiography and/or a radionuclide gastric emptying study was ordered if indicated by the patient’s symptoms or to clarify anatomy. Operative data including time, findings, procedure performed, and intraoperative complications were entered at the time of surgery. Patients were seen 2 weeks and 6 weeks after surgery. A short-term symptom assessment form was administered at a 3-month visit. Patients were recalled after 6 months following surgery for esophageal manometry and 24-hour ambulatory pH testing at no charge. Long-term follow-up was by telephone interview annually, with symptomatic patients brought back for testing. Failure was defined as a symptom assessment score of grade 2 or greater, heartburn or reflux, an abnormal DeMeester score on postoperative pH testing, refractory dysphagia, or symptomatic mechanical failure of the fundoplication.

INTERVENTIONS

All of the procedures were performed by or under direct supervision of 1 of us (L.L.S.).

Most patients had a 360° Nissen fundoplication. Partial fundoplication (270° Toupet) was performed in patients with severe esophageal dysmotility (>70% ineffective peristalsis) and/or refractory dysphagia. In 3 patients with achalasia and a Nissen fundoplication (complete esophageal aperistalsis and esophageal dilation), a Heller myotomy was performed in addition to reversing the Nissen fundoplication. Table 1 summarizes the various procedures performed.

Surgical technique included reduction of hiatal hernias, complete takedown of the fundoplication, extended type II mediastinal dissection in virtually all of the patients, and a Collis gastroplasty if unable to obtain at least 2.5 cm of intrathoracic esophagus without tension. Collis gastroplasty was performed using an endoscopic linear stapler through the right or left chest as has been described previously. For patients with paraesophageal hernias (PEHs), the mediastinal sac was reduced and completely excised. Primary crural closure was performed with pledgeted horizontal mattress sutures posterior to the wrap. It is our standard practice now to reinforce the primary closure of large crural defects with a biologic mesh overlay (Surgisis Soft Tissue Graft; Cook Biotech Inc, West Lafayette, Indiana). In this series, mesh was used in 3 patients where primary closure of the crus was difficult owing to a very large hiatal defect. In patients with significantly delayed gastric emptying, a Heineke-Mikulicz pyloroplasty or a subtotal gastrectomy was performed. Seventeen complex patients required other procedures, including esophagectomy (Table 1).

Table 1. Reoperative Procedures and Their Indications

<table>
<thead>
<tr>
<th>Revision Surgery</th>
<th>Patients, No.</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary procedure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reoperative Nissen fundoplication</td>
<td>131</td>
<td>Loose wrap, wrap disruption, slipped Nissen, symptomatic or objective reflux, low-pressure LES</td>
</tr>
<tr>
<td>Conversion to Toupet fundoplication</td>
<td>26</td>
<td>Tight wrap, poor esophageal motility, dysphagia</td>
</tr>
<tr>
<td>No fundoplication</td>
<td>2</td>
<td>Tight wrap, poor esophageal motility, dysphagia</td>
</tr>
<tr>
<td>Conversion to a Hill repair</td>
<td>4</td>
<td>Short esophagus, partial gastrectomy, insufficient fundus for creating a wrap</td>
</tr>
<tr>
<td>Subtotal gastrectomy</td>
<td>6</td>
<td>Bile gastroopathy, severe gastric dysmotility</td>
</tr>
<tr>
<td>Esophagectomy</td>
<td>4</td>
<td>Megaesophagus, high-grade dysplasia</td>
</tr>
<tr>
<td>Endoluminal augmentation (Stretta or Endocynch)</td>
<td>3</td>
<td>Reflux despite adequate LES pressure</td>
</tr>
<tr>
<td>Additional procedure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEH repair</td>
<td>52</td>
<td>Giant or small paraesophageal herniation</td>
</tr>
<tr>
<td>Collis gastroplasty (thoracoscopic)</td>
<td>17</td>
<td>Inability to reposition GEJ below diaphragm despite extensive esophageal mobilization</td>
</tr>
<tr>
<td>Pyloroplasty</td>
<td>10</td>
<td>Delayed gastric emptying</td>
</tr>
<tr>
<td>Roux-en-Y gastrojejunostomy</td>
<td>1</td>
<td>Delayed gastric emptying</td>
</tr>
<tr>
<td>Heller myotomy</td>
<td>3</td>
<td>Complete esophageal aperistalsis (achalasia)</td>
</tr>
<tr>
<td>Highly selective vagotomy</td>
<td>1</td>
<td>Peptic ulceration, severe reflux despite adequate LES pressure</td>
</tr>
</tbody>
</table>

Abbreviations: GEJ, gastroesophageal junction; LES, lower esophageal sphincter; PEH, paraesophageal hernia.

a One patient had proximal gastrectomy.

b One patient had a Nissen fundoplication in addition to subtotal gastrectomy.

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pressure and relaxation were measured along with upper and lower esophageal body contractility with 10 wet swallows. Most studies were performed and interpreted in our esophageal laboratory.

STATISTICAL ANALYSIS

All of the data are reported either as proportions, means (standard deviations), or medians (ranges). The means of all of the continuous variables were compared using appropriate parametric or nonparametric tests. Categorical variables and proportions were compared using the chi² test or the Fisher exact test. Logistic regression modeling was performed to identify variables significant for the prediction of failure. Various factors included in the model were age, sex, weight, primary presenting symptom (heartburn or reflux vs dysphagia), complete vs partial wrap, ARS vs other procedures, previous multiple operations, PEH repair, and Collis gastroplasty. P ≤ .05 was considered to be statistically significant.

RESULTS

Average time to failure after primary ARS, manifested by onset of recurrent symptoms, was 38 months. Recurrent heartburn and/or reflux were the most common symptoms (98 of 176 patients [55.7%]). Fifty-six patients (31.8%) presented with persistent dysphagia as their main complaint and 22 patients (12.5%) had predominantly atypical symptoms (chest pain, respiratory problems, abdominal pain, or odynophagia). Eighty patients (45.5%) had abnormal preoperative pH study results and 28 (15.9%) had a primary motility disorder. Upper gastrointestinal tract radiography was performed selectively but showed a high incidence (80.6%) of wrap herniation. Patient demographics and findings from preoperative evaluations are listed in Table 2.

Trauma (motor vehicle crash) or strenuous lifting was suspected to have directly precipitated failure in 3 patients. Three patients associated early failure (within 1-2 months) after laparoscopic fundoplication with a vigorous bout of retching or coughing. Review of operative reports revealed potential surgical technical errors in 22 patients, which might have contributed to subsequent failure. In 8 patients, the short gastric vessels had not been divided. All of these patients except 1 were found at operation to have either a disrupted or twisted wrap. In 7 patients, operative reports suggested an inadequate or absent crural repair; in 1 case, absorbable suture was used for the repair. In 1 instance, the hiatal closure was found to be completely intact with the intact wrap herniated into the chest. In 2 cases, the presence of severe esophageal shortening and difficulty mobilizing sufficient esophagus into the abdomen was noted, but no lengthening procedure was performed. Three patients had PEH repairs without mediastinal sac excision. Finally, 4 operative reports suggested inadequate or absent subdiaphragmatic fixation of the wrap.

At reoperation, 73 patients (41.5%) were found to have wrap herniation. Seventeen patients had a giant wrap herniation (PEH), 48 patients had a PEH but still with complete wrap herniation, and 8 patients had a partial wrap herniation only. In 2 patients, the wrap had twisted more than 180° toward the left but remained intact in sub-diaphragmatic position. In 4 patients, the wrap appeared to have slipped onto the stomach while remaining intact and intra-abdominal; in another 8 patients, slippage of the wrap was seen in combination with hiatral herniation. In 2 cases, it appeared that a point too low on the greater curvature had been used to create the fundoplication, leading to misplacement of the wrap around the proximal stomach. In 10 cases, complete disruption or partial separation of the wrap was observed (4 patients with disruption only and 6 patients with disruption plus slippage and/or herniation).

There were no intraoperative or perioperative deaths. Mean (SD) operative time was 3 hours 45 minutes (1 hour 30 minutes). Only 2 patients required conversion to open (1 with 2 previous operations and 1 owing to dense adhesions). Mean estimated blood loss was 125 mL; in 5 patients, the estimated blood loss was greater than 300 mL. Mean (SD) postoperative stay was 2.5 (1.9) days. Five patients had prolonged stays (> 2 weeks).

Operative complications occurred in 43 patients (24.4%). Esophageal or gastric injuries were identified in 26 patients (12.8%) and repaired laparoscopically without serious consequences. One complex patient with a prior open transthoracic distal esophageal resection with

<table>
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<tr>
<th>Table 2. Patient Characteristics and Preoperative Data</th>
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<tbody>
<tr>
<td>Characteristic</td>
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<tr>
<td>Age, mean ± SD, y</td>
</tr>
<tr>
<td>Male/female, No.</td>
</tr>
<tr>
<td>BMI, mean ± SD</td>
</tr>
<tr>
<td>Previous operation, No.</td>
</tr>
<tr>
<td>Esophagitis, No. (mean ± SD Savary-Miller scale score)</td>
</tr>
<tr>
<td>Barrett esophagus, No. (%)</td>
</tr>
<tr>
<td>Stricture, No. (%)</td>
</tr>
<tr>
<td>Delayed gastric emptying, No. (%)</td>
</tr>
<tr>
<td>DeMeester score, mean ± SD</td>
</tr>
<tr>
<td>LES characteristics</td>
</tr>
<tr>
<td>Mean LES pressure, mean ± SD, mm Hg</td>
</tr>
<tr>
<td>Poor (&lt; 90%) LES relaxation, No.</td>
</tr>
<tr>
<td>Impaired esophageal motility, No. (%)</td>
</tr>
<tr>
<td>Nutcracker esophagus, No.</td>
</tr>
<tr>
<td>DES, No.</td>
</tr>
<tr>
<td>Achalasia, No.</td>
</tr>
<tr>
<td>Scleroderma, No.</td>
</tr>
<tr>
<td>IEM/NSEMD, No.</td>
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</tbody>
</table>

Abbreviations: ARS, antireflux surgery; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); DES, diffuse esophageal spasm; IEM, ineffective esophageal motility; LES, lower esophageal sphincter; NSEMD, nonspecific esophageal motility disorder; PEH, paraesophageal hernia.
an intrathoracic fundoplication had a gastrotomy incurred during a reoperative thoracoscopic Collis gastroplasty and Belsey repair. The gastrotomy was repaired at the time of surgery but subsequently leaked, resulting in empyema and a prolonged hospital stay. Another patient who had had a gastrotomy repaired during his operation had a prolonged hospital stay (2 weeks) owing to a small leak controlled with his closed-suction drain, which subsequently resolved without further intervention. A third patient had a distal esophageal leak identified during routine postoperative upper gastrointestinal tract radiography. This patient required laparoscopic re-intervention and was discharged after 2 weeks. Five patients had significant solid-organ injury (2 splenic and 3 liver lacerations) during difficult dissections. One needed reoperation for a prolonged bile leak and subsequent necrotizing infection of a trocar site requiring operative debridement. The subsequent hospital stay was 28 days. The 4 patients with excessive blood loss (>300 mL) during surgery had no further sequelae and required no transfusions. A colon injury occurred during a Hasson entry into an abdomen with multiple previous open operations. It was repaired at the time and the patient had no postoperative complications.

Of 5 patients who had an observed vagal trunk injury during dissection, 1 had mild but persistent dumping symptoms, 1 had persistent mild early satiety, and the other 3 had no specific symptoms. One patient required readmission owing to a pleural effusion that required no intervention. Another patient had significant postoperative diarrhea, not associated with infectious colitis, that resolved spontaneously after about 2 weeks. Another patient had a partial small-bowel obstruction 3 weeks after surgery that required readmission but no surgical intervention. Three patients required hospital stays of 4 to 5 days owing to atelectasis and mild hypoxemia.

One hundred forty-five patients (82.4%) had completed long-term postoperative follow-up. Median follow-up was 9.2 months. Eleven patients were operated on within the last 3 months and had short-term follow-up only. Twenty patients (all referred by other surgeons) were lost to follow-up after their first postoperative visit.

One hundred eight of 145 patients (74.5%) had complete relief of symptoms or had only occasional (once per month or less) symptoms (P = .001). Of the 37 patients with symptomatic failures, 20 (54.0%) had a significant improvement (P < .001) in their overall symptom frequency. However, 7 patients who presented with dysphagia as the predominant preoperative symptom developed reflux and/or heartburn symptoms postoperatively, whereas 8 patients who had reflux predominantly before surgery experienced dysphagia. Sixty-seven patients underwent 24-hour pH and manometry studies postoperatively. Eighteen (26.8%) of these patients had an abnormal DeMeester score (>14.7). Of the patients with objective failure, only 7 (38.9%) had symptomatic reflux while 11 other patients either were asymptomatic or had occasional reflux symptoms only (symptom frequency < grade 2). Among asymptomatic patients with an abnormal DeMeester score, 5 had undergone a Collis gastroplasty.

Multiple regression analysis demonstrated that odds of failure were significantly higher for patients who had dysphagia as the presenting symptom (odds ratio, 3.38; 95% confidence interval, 1.35-8.40; P = .009) or needed a Collis gastroplasty (odds ratio, 5.77; 95% confidence interval, 1.38-24.11; P = .02). Nine of 17 patients undergoing Collis gastroplasty had failure based on postoperative pH testing or symptom scores greater than 2 (only 4 of these patients were symptomatic: 1 patient had reflux, 2 had dysphagia, and 1 had both), and 5 had an abnormal DeMeester score without symptoms. Patients undergoing conversion to a partial fundoplication also had increased odds of failure; however, this was not found to be statistically significant (odds ratio, 1.76; 95% confidence interval, 0.73-4.24; P = .20).

Diarrhea was the most common adverse effect of the reoperative surgery. Seven patients (4.5%) presented with severe diarrhea (daily) and 22 (14.1%) had occasional diarrhea (once per week or less). However, 13 of the 29 patients had diarrhea even before the reintervention surgery. Twenty patients (12.8%) had significant nausea (≥ grade 2) during early postoperative follow-up, and 9 patients had occasional symptoms of bloating (once per month or less).

### COMMENTS

#### MECHANISMS OF FAILURE OF PRIMARY FUNDOPLICATION

The success rates for primary laparoscopic fundoplication are excellent in most series, ranging between 85% and 95%. Nevertheless, given the large number of anti-reflux procedures performed, the morbidity and healthcare costs associated with a 5% to 15% failure rate are enormous. Several retrospective reviews have attempted to identify various preoperative, intraoperative, and/or postoperative predictors of failure after primary fundoplication with varying success. There have only been a few attempts to describe patterns of failure based on analysis of postoperative objective testing or operative findings at the time of reoperation for failed fundoplication. The current study provides insight into mechanisms of failure of primary fundoplication based on operative findings and analysis of operative reports of previous operations. A review of operative reports from previous surgery revealed possible technical errors or omissions in 22 patients, which might have been avoided by meticulous attention to technique during the primary repair (Table 3).

Several points should be made regarding prevention of failure of the primary ARS:

- Recent experience with PEH repairs has shown that the reinforcement of the crural closure with biologic mesh dramatically reduces recurrent herniation; we now use this routinely on large hiatal defects. This experience also led us to begin using biologic mesh in a similar fashion for recurrent hiatal disruption.
- While the necessity of dividing the short gastric vessels during primary fundoplication is debated, there were several failures directly attributable to torsion from undivided vessels. We feel that there is little to be lost...
from dividing the short gastric vessels, as it is easy and as a complication from such mobilization is exceedingly rare in our experience.

- Of particular interest were the 3 patients with dysphagia who were found to have achalasia. None of the 3 patients had esophageal manometry studies before their Nissen fundoplication, which had been performed based on symptoms of gastroesophageal reflux disease alone. Such avoidable errors stress the importance of thorough preoperative objective evaluation in all patients undergoing first or subsequent ARS.

### OUTCOMES OF LAPAROSCOPIC REOPERATION FOR FAILED ARS

This article describes outcomes of a large series of patients undergoing reoperative surgery for failed ARS. Overall, 74.5% of patients had good to excellent symptomatic outcome (either totally asymptomatic or had only rare [once per month or less] symptoms), and another 13.8% of patients demonstrated a significant ($P < .001$) improvement in the frequency and severity of symptoms. Only 11.7% of patients demonstrated no change or worsening of their symptoms. Objective assessment demonstrated a similar success rate of 74.2%. However, as we have shown before, there is little overlap between subjective- and objective-failure patient groups. If we were to include the 11 patients with abnormal 24-hour pH study results who were completely asymptomatic, our absolute success rate would decrease to about 67%. However, 5 of these 11 asymptomatic patients had a Collis gastroplasty and should not be counted, as we have shown previously that it is gastric mucosa within the neo-esophagus that causes abnormal pH test results in these patients and not gastroesophageal reflux.

The role of the laparoscopic approach in the surgical management of patients with a failed fundoplication is controversial at present. Dense adhesions and distorted anatomy make reoperative ARS technically difficult. In addition, fibrosis and scarring of the distal esophagus from prior surgery and recurrent reflux disease can contribute to esophageal shortening, further compromising outcomes. Finally, a few patients require more complex operations such as partial gastrectomy or esophagectomy.

Reoperative ARS has been shown to have higher morbidity and mortality than primary fundoplication and the success rate is relatively lower, ranging between 70% and 85%. Furthermore, results are worse with increasing numbers of prior antireflux operations. These issues have led some investigators to advise against a laparoscopic approach, or at least for a limited role for laparoscopy, in these patients.

After having gained substantial experience with laparoscopic ARS, we felt comfortable with approaching failed fundoplications laparoscopically starting in 1994. Since then, we have successfully approached all reoperative cases laparoscopically. The literature also increasingly supports the use of laparoscopy for reoperative antireflux surgery. Hunter et al reported a success rate of 85% in 71 patients. In a prospective study, Grandeth et al reported significant improvement in the quality of life in 49 patients undergoing laparoscopic refundoplication. Recently, in the largest described series, Iqbal et al reported a success rate of 74% to 94% following laparoscopic repair of 104 failed antireflux operations. Several other investigators have also reported similar results in anecdotal series. These studies and our own results support the contention that equivalent results to open revision can be achieved with laparoscopic approaches. Our conversion rate of 1.1%, no mortality, and a perioperative morbidity of 24.4% (mostly minor) show the laparoscopic approach to be safe and possible in almost all cases. The operative time of 3 hours 45 minutes is comparable to most reports of open surgery, and a relatively short mean (SD) postoperative hospital stay of 2.5 (1.9) days supports the concept that the laparoscopic approach benefits patients.

The recognition of complex anatomy, the analysis of mechanisms of failure, and the determination of the correct reoperative procedure require significant experience. We relied on the experience gained by the operating surgeon (L.L.S.) from having performed more than 2300 laparoscopic esophageal procedures during the last 14 years, and we strongly advocate that laparoscopic reoperative ARS should be performed by surgeons with extensive experience in primary esophageal surgery, reoperative surgery, and the more extensive and irreversible operations such as gastrectomy or esophagectomy that are occasionally indicated. We also stress the need for a

### Table 3. Technical Problems That Led to Failure of the Initial Antireflux Surgery

<table>
<thead>
<tr>
<th>Findings at Reoperation</th>
<th>Patients, %</th>
<th>Possible Technical Error at First Surgery</th>
<th>Proposed Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crural disruption or wrap herniation</td>
<td>41.5</td>
<td>Inadequate crural closure; postoperative stressors; short esophagus</td>
<td>Permanent crural sutures; extensive esophageal dissection or Collis gastroplasty; biologic mesh reinforcement of hiatus; postoperative antiemetics; activity restriction</td>
</tr>
<tr>
<td>Slipped or misplaced wrap</td>
<td>4.0</td>
<td>Improperly created wrap (2 patients); inadequate fixation to esophagus; short esophagus</td>
<td>Accurate identification of anatomy; proper creation of fundoplication; extended esophageal dissection; Collis gastroplasty</td>
</tr>
<tr>
<td>Wrap disruption</td>
<td>3.4</td>
<td>Repairs under tension (undivided short gastrics, short esophagus, poor crural repair)</td>
<td>Esophageal mobilization; reinforced crural repair; short gastric division; Collis gastroplasty</td>
</tr>
<tr>
<td>Twisted wrap</td>
<td>1.1</td>
<td>Undivided short gastrics</td>
<td>Routine short gastric division</td>
</tr>
<tr>
<td>Dilated, poorly emptying esophagus</td>
<td>1.2</td>
<td>Missed achalasia</td>
<td>Routine preoperative manometry</td>
</tr>
</tbody>
</table>
comprehensive evaluation before undertaking a revision antireflux procedure. Review of the original operative record, a careful interview and examination using a standardized symptom assessment tool, and a thorough evaluation of esophageal and gastric physiology are all necessary to optimize outcomes. Esophageal manometry, 24-hour pH studies, and upper endoscopy are mandatory for all patients, with additional tests such as gastric emptying, cine-esophagram, and impedance pH studies used as indicated.

The overall intraoperative complication rate (22.7%) in our series, although higher than reported with primary fundoplication, was comparable to results in most studies presenting outcomes of reoperation for failed ARS.4,6,12-16 The complication rate was mainly owing, unsurprisingly, to gastric or esophageal injury that occurred during the difficult dissection around the gastroesophageal junction. Most complications (89.6%) were successfully managed at the time and had no further consequence to the patient. Overall, only a small proportion (5.7%) of patients had perioperative complications that contributed to postoperative morbidity. Postoperatively, diarrhea was observed in a large number of patients but only 7 had severe diarrhea and 13 had diarrhea even before surgery. A high incidence of postoperative diarrhea may be related to unrecognized vagus nerve injury, which probably happens relatively frequently during reoperative surgery. We routinely counsel all of our patients that vagal injury is a significant risk with reoperative ARS.

Multiple regression analysis identified preoperative dysphagia and Collis gastroplasty as the only factors significantly predictive of failure following reoperative surgery. Iqbal et al16 also reported less satisfactory results significantly predictive of failure following reoperative surgery. The complication rate was mainly owing, unsurprisingly, to gastric or esophageal injury that occurred during the difficult dissection around the gastroesophageal junction. Most complications (89.6%) were successfully managed at the time and had no further consequence to the patient. Overall, only a small proportion (5.7%) of patients had perioperative complications that contributed to postoperative morbidity. Postoperatively, diarrhea was observed in a large number of patients but only 7 had severe diarrhea and 13 had diarrhea even before surgery. A high incidence of postoperative diarrhea may be related to unrecognized vagus nerve injury, which probably happens relatively frequently during reoperative surgery. We routinely counsel all of our patients that vagal injury is a significant risk with reoperative ARS.

Reoperative laparoscopic antireflux surgery, while technically challenging and qualitatively different from primary antireflux surgery, is feasible and in expert hands provides results equivalent to open revisions while preserving the patient benefits of a minimally invasive approach. Reoperation reveals that failure of a primary ARS results from intrinsic patient characteristics, environmental stressors, and technical problems with the surgery. Patients presenting with dysphagia as a cause of failure of primary surgery and those requiring Collis gastroplasty should be counseled regarding the likelihood of a higher chance of failure of their revision surgery.

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Author Contributions: Study concept and design: Khajanchee and Swanstrom. Acquisition of data: Khajanchee, O’Rourke, Cassera, Gatta, and Swanstrom. Analysis and interpretation of data: Khajanchee, O’Rourke, Gatta, Hansen, and Swanstrom. Drafting of the manuscript: Khajanchee and O’Rourke. Critical revision of the manuscript for important intellectual content: Khajanchee, O’Rourke, Cassera, Gatta, Hansen, and Swanstrom. Statistical analysis: Khajanchee. Administrative, technical, and material support: Swanstrom. Study supervision: Swanstrom.

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CONCLUSIONS

REFERENCES

Richard J. Finley, MD, Vancouver, British Columbia, Canada: Dr Khajaneehee and his colleagues from one of the premier foregut centers in the world have carried out a retrospective review of prospectively collected data on the subjective and objective outcomes in 176 consecutive patients who underwent laparoscopic reintervention for failed antireflux surgery.

The reasons for reoperation were heartburn or reflux (56%), dysphagia (32%), and atypical symptoms such as chest pain (12%). The mechanical causes of failure found at reoperation were disruption of crural repair with wrap herniation (56%), dysphagia (32%), and atypical symptoms such as chest pain (12%).

Mean operative time was 3 hours 45 minutes. Twenty-nine patients suffered esophageal or gastric injuries and 5 patients had solid-organ injuries. There were no perioperative deaths.

Eighty-two percent of the patients were available for follow-up at a median of 9.2 months. Excellent symptomatic outcomes were documented in 75% of patients. Twenty patients had residual heartburn and 23 had dysphagia. Of the 67 patients undergoing 24-hour pH and manometry, 18 (26%) demonstrated normal reflux. Multiple regression analysis showed that the odds of failure were significantly higher among patients initially presenting with dysphagia or those undergoing esophageal-lengthening procedure.

I have some comments about the paper and questions for the authors.

In your study, 32.9% of the revisions were of previous open procedures and 67.1% were of laparoscopic fundoplications. Did patients who had previous open operations have increased operating times and complications due to the dense adhesions commonly found after open procedures on the esophagogastric junction? It would be helpful to put previous open procedures into your multiple regression analysis because I think that actually is a very important factor in relationship to outcome.

Dr Hansen: One of the distinctions would also be the length of time. Obviously those patients done open were done earlier in the series, and the ones done laparoscopically were done later in the series. But, we could certainly add them.

Dr Finley: The incidence of recurrent symptoms following laparoscopic antireflux surgery averaged about 1% to 2% per year. It doesn't matter where you come from; they come back to see you. And, some symptoms such as dysphagia with weight loss or pain secondary to gastric torsion or incarceration required immediate postoperative intervention, and others such as heartburn may be managed conservatively. In your study, what percentage of the patients had symptoms of gastric torsion and incarceration in the chest, and what percentage just presented with ordinary reflux or reflux esophagitis?

Dr Hansen: Again, I don't have the exact numbers on that. There were 2 patients who actually presented in this study with gastric torsion or required an emergency surgery.

Dr Finley: What are your indications then for reoperation on patients after failed antireflux procedures?

Dr Hansen: To a large degree, they are the same as the indications for the original operation. That is, there is an objective finding of a dysfunctional lower esophageal sphincter; it is either too tight, it's too loose, or it has slipped up into the chest. There is some mechanical problem that we are trying to fix.

Dr Finley: And finally, reoperative antireflux surgery is ruled by the law of diminishing returns. Good to excellent results are observed in approximately 90% of patients after the first operation, 70% after the second, and less than 60% after the third. Some surgeons like Mark Orringer say, "After 2 reoperations, I am going to take their esophagus out." What are your indications for esophagectomy after a failed antireflux procedure?

Dr Hansen: We will still go after those patients. We had similar outcomes in patients. Some of these patients had 2 and 3 antireflux procedures previously. We still were able to generate some patients with a good outcome. The patients who underwent esophagectomy in this series were patients who essentially had a blown-out esophagus. They had a very dysfunctional esophagus that was not motile.

Dr Finley: I would like to congratulate you on the paper. This group of patients is very difficult to manage.

Lawrence W. Way, MD, San Francisco, California: I have a question about the strategic philosophy. These operations are very difficult, and if the problem is not solved this time, a third operation faces a substantially higher risk of failure. The surgeon's overriding priority must be to make it right this time, which would relegate the short-term benefits of doing it laparoscopically of much less importance. I wonder, therefore, whether it might be reasonable to modify your unreserved commitment to a laparoscopic approach, at least in situations where your laparoscopic repairs were less successful, for example, for the high-risk patients with dysphagia who received Collis gastroplasties. We have not found this unattractive operation to be necessary when performing secondary repairs through a laparotomy.

Dr Hansen: Those are excellent comments. I think it is a philosophical step for the lead surgeon. I think it is a judgment call. We did do some esophagectomies in this group, and I think in those selected cases, the lead surgeon felt that your comments were exactly right, that this is our last chance.

Dr Way: Well, I was particularly thinking about the patients where you were forced to do a Collis or in patients with dysphagia. You had select groups there. Maybe some of those patients should have been done open.

Dr Hansen: We could go back and reanalyze those. It is an excellent point. Again, Dr Swanstrom is really, when we get to these really difficult cases, he is the one who tends to be the lead surgeon on these, and he is very comfortable with these fairly aggressive laparoscopic approaches, maybe not correct, but it would be difficult to randomize something like that because he certainly does far more laparoscopic cases than open at this point.
John G. Hunter, MD, Portland, Oregon: Herein are 2 reasons prompting my move to OHSU [Oregon Health and Science University] 6 years ago. The first is to be able to attend this meeting, and the second is to have a superb center for redo laparoscopic surgery in Portland besides our own. This is indeed a difficult operation, and we are happy to share the wealth.

The opportunity to look at the population of patients undergoing redo Nissen at a referral center gives one the opportunity to look at the patients undergoing their first antireflux procedure at that institution. From this analysis, a surgeon may determine their own failure rate and may detect patterns of failure that may be corrected in future primary operations. In addition, this analysis allows the surgeon to better counsel patients before surgery about their likelihood of needing another operation. I didn’t see these data in your presentation. For your own primary antireflux surgical patients, what was the redo rate and what were the reasons for failure?

Dr Hansen: Twenty-eight of those 176 patients were our own patients. In thinking about the numbers, we have a database with 2300 patients in it; about 1800 are kind of Nissen-type first-time or Nissen repair esophageal hernia–type first-time approaches. We expect about an 8% failure rate in our hands. That is what we are seeing when we are following these patients up. So that would give us about 150 who we would expect to fail. Of those, we ended up reoperating on 28. So, it is about a sixth of the patients who came back with symptoms, had mechanical problems, who we then ended up operating on.

Carlos A. Pellegrini, MD, Seattle, Washington: Paul, you mentioned that some patients had an esophagectomy. I personally have the philosophy that it is a lot better, easier, and safer to do a gastrectomy than an esophagectomy, and I submit to you that very few if any patients ever need an esophagectomy after a failed antireflux operation. I think a total gastrectomy will prevent acid and bile from getting to the esophagus and is a better operation than a partial gastrectomy. I noted you treated some patients with partial gastrectomies and wonder when you consider total gastrectomy. We propose this option (total gastrectomy) for patients who have experienced 2 failures of antireflux procedure or/and do not show a clearly identifiable anatomic abnormality that can be corrected. We find that over time, as Dr Way was just trying to point out, that is the final solution. I approach reoperations laparoscopically because I think laparoscopy is far better than open for the dissection part of the operation, but then I convert it whenever we are ready to do the anastomosis or some other parts of the gastrectomy that are safer done open.

Dr Hansen: Maybe I am misunderstanding part of the question.

Dr Pellegrini: The question is, do you do total gastrectomies, and if so, when? If you don’t do them, why not? Why would you take the esophagus out rather than the stomach? It’s easier and safer to take the stomach out and you achieve the same result.

Dr Hansen: I think the distinction in my mind is where the pathology lies. If the patient has gastric atony, those are the patients who are going to get the gastric emptying study. Of the esophagectomies that were done, at least 3 of them had pretty clear achalasia, and they were probably misdiagnosed initially at the time of their original surgery. It is really looking at where the pathology lies.

Marco G. Patti, MD, San Francisco: Were the gastrectomies and esophagectomies planned, or did you decide to remove the esophagus because you had an esophageal perforation or other problems during the takedown?

Dr Hansen: No, they were planned ahead of time. There were no conversions because of some sort of intraoperative problem.

Dr Patti: The second question is regarding the 28 patients who had a primary esophageal motility disorder such as diffuse esophageal spasm or achalasia. These are primary motility disorders, which means by definition that there is no reflux. So, why were these patients included in this study? In addition, in patients with achalasia, why did you decide to perform an esophagectomy rather than try to undo the fundoplication and perform a myotomy? An esophagectomy can always be done in the few patients who fail this simpler operation, which has minimal morbidity and mortality.

Dr Hansen: Several of the patients had Heller’s. I would agree that we thought that it would be reasonable to just go ahead and do a Heller myotomy and open it up so that they could drain adequately. We did at least 6 of those procedures. The esophagectomies were performed in patients who had an advanced, blown-out esophagus and were basically pooling fluid in their chest.

J. Augusto Bastidas, MD, Los Gatos, California: Could you expand a little bit on the point about postoperative activity that you restrict (I think you listed restricted activity as one of your elements of postoperative care) and also comment on whether you have the same restriction for first-time antireflux patients?

Dr Hansen: The more important comment rather than restriction is really just a very aggressive treatment of nausea and emesis. Interestingly, when you look at some of these recurrences, several of them were after mechanical traumas or some event that increased the abdominal pressure, like a car accident or a sporting activity or something like that. They will actually pop the esophagus or wrap up into the chest. Restricting those is a little bit difficult. You obviously are not going to tell people not to drive, but you might tell them that if they are going to be participating in some sort of physical activity like sports, like playing rugby, that they have some slightly increased incidence of recurrence.

Justin Wu, MD, San Diego, California: Would you discuss your technique and the biologic mesh? What type of mesh do you use, and how do you suture that to the crura?

Dr Hansen: This is a little bit of a newer development. Over the last couple of years, we have participated in a study; actually, Dr Pellegrini was the lead author. Surgisis is the particular type of mesh that is used. We basically take a small piece of the Surgisis (I believe it is about 6 × 10 cm) and cut a little pant leg in the top. Then we repair the crus, we lay the mesh over the top of the repair behind the gastroesophageal junction, and then we suture it with pledged sutures along to the crus.

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