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Is Reoperative Laparoscopic Fundoplication an Effective Treatment for Previously Failed Anti-Reflux Procedures?

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Abstract

Introduction: Given the great number of fundoplications undertaken since the advent of minimally invasive surgery, the small percentage of failed fundoplications translates to a significant number of patients requiring additional care, including reoperative fundoplications. Herein, we report our experience with "redo" fundoplications for failed anti-reflux surgery.

Materials and Methods: From 1992 to 2016, patients having undergone a reoperative fundoplication were prospectively followed. Patients scored their frequency/severity of reflux symptoms before and after reoperative fundoplication using a Likert scale (0= never/not bothersome, 10= always/very bothersome).

Results: Two hundred and thirty six patients underwent reoperative fundoplication, with a median age of 58 years. The leading indication (46% of patients) for reoperative fundoplication was wrap failure. Frequency/severity of heartburn was rated 8/8 preoperatively and 0/0 after fundoplication, respectively. Patients' symptoms entirely resolved in 34%, occurred less than once a month in 39%, and less than once per week in 16%. Of all patients, 77% were "very satisfied" or "satisfied" with their reoperative fundoplication and 87% would undergo the operation again knowing what they know now.

Conclusion: For patients suffering from persistent, recurrent, or new symptoms and/or excessive acid reflux after their initial fundoplication, a reoperative fundoplication significantly decreases the frequency/severity of symptoms. These results strongly encourage reoperative fundoplication after failed anti-reflux surgery.

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Introduction

Gastroesophageal Reflux Disease (GERD) is a common problem in the United States. In a population-based survey, 22% of respondents reported that they had heartburn or regurgitation within the last month [1]. Perpetual reflux of gastric acid and other gastric contents into the esophagus is associated with considerable morbidity, and can lead to distal esophageal injury and metaplasia in the esophageal epithelium. These initially reversible changes can ultimately lead to irreversible dysplasia and malignant esophageal adenocarcinoma [2]. In the United States, it is estimated that 16,910 patients will be diagnosed with, and 15,690 will die from, esophageal cancer annually [3].

Laparoscopic fundoplication is the "gold standard" treatment for gastroesophageal reflux disease. The goals of anti-reflux fundoplications are to reduce any hiatal hernia and to construct a valve mechanism, securing it in the relatively "high pressure" zone of the abdomen [4]. Laparoscopic Nissen fundoplication is extremely efficacious, usually resulting in resolution of reflux symptoms, high patient satisfaction, and improved quality of life [5]. Since the advent of minimally invasive surgery, fundoplications have been more frequently applied in treating gastroesophageal reflux disease. Although laparoscopic Nissen fundoplication is a safe, efficacious, and reproducible operation, a small proportion of patients fail anti-reflux surgery. Minimally invasive fundoplication is estimated to have a 3% to 6% failure rate after a five-year follow-up, although reported failure rates vary widely [6,7]. However, given the great number of fundoplications undertaken, even these small percentages of failing fundoplications equate to a significant number of patients. Thereby, there exists a small, but real, population of patients who are presenting for consideration of a "redo" operation, after failure of the original fundoplication.

This study was undertaken to report and analyze our outcomes with reoperative fundoplication as a therapy for persistent or recurrent GERD and/or recurrent significant hiatal hernia. Our

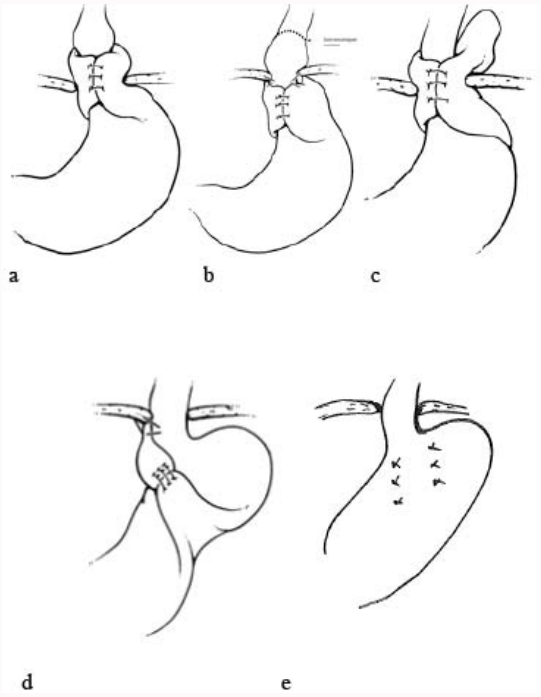

Figure 1: Anatomic causes of failure. (a) Type IA; (b) Type IB; (c) Type II; (d) Type III; (e) Type IV.

hypothesis in undertaking this study was that the efficacy and safety of reoperative fundoplications promotes its continued application.

Materials and Methods

With Institutional Review Board approval, patients undergoing reoperative fundoplication for a failed anti-reflux procedure were prospectively followed from 1992 to 2016. Demographic data for these patients were recorded along with self-evaluations of their symptoms. In the failed anti-reflux operations, the nature of the failure was noted. Failures can be either anatomical or functional in nature (Figure 1), and are defined as follows [8].

Types of Failure

Anatomical

An anatomical failure occurs when the anatomic orientation of the fundoplication or hiatal reconstruction has deteriorated from its intended form:

Type Ia: Herniation of all or part of the fundoplication into the chest occurs when both the (all of or part of) fundoplication, which remains intact, and the Gastroesophageal (GE) junction are cephalad to the hiatus. This subtype results when the reconstruction of the esophageal hiatus fails. Patients usually present with reflux symptoms, but may also present with dysphagia (Figure 1a).

Type Ib: Also known as a "slipped Nissen", the GE junction "slips" cephalad into the chest, above the esophageal hiatus, while the intact fundoplication remains below the hiatus. These patients often present with symptoms of reflux or dysphagia due to fundoplication failure or esophageal obstruction, respectively (Figure 1b).

Type II: A paraesophageal hernia, with or without a sliding hiatal hernia, occurs when the posterior fundus of the stomach herniates above the hiatus, while the GE junction may remain below the hiatus. This type of failure is believed to be secondary to an excessively floppy fundoplication or poor crural repair with inadequate fixation of the wrap [5,8]. Patients with a Type II failure may present with dysphagia due to compression or displacement of the distal esophagus, making esophageal emptying difficult. Notably, because of esophageal displacement and obstruction, this type of failure is usually not associated with reflux. Figure 1c -shown without sliding hiatal hernia).

Type III: Failure occurs when the body, rather than the fundus, of the stomach is used in the construction of the fundoplication resulting in an ineffective and often deleterious wrap. Consequently, the wrap is around the body of the stomach, instead of the lower esophagus, forming a loose wrap that is an inadequate anti-reflux mechanism. These patients generally suffer from symptoms of reflux and regurgitation (Figure 1d).

Type IV: Failure involves total disruption of the wrap. This is often seen in combination with complete dissolution of the hiatal reconstruction.

Combinations of the above subtypes: Often, when anti-reflux surgery fails, the mechanism of failure involves various combinations of the aforementioned subtypes. For example, a type Ib and III could be seen as a recurrent hiatal hernia with the wrap sitting at the level of the body of the stomach.

Functional

Functional causes of failure occur when the fundoplication is still intact; however, patients still present with persistent, recurrent, or new symptoms, or excessive acid reflux. One example is when the fundoplication is constructed too tightly, resulting in delayed passage of food from the esophagus (i.e., dysphagia). Another example is when the fundoplication is constructed too loosely, so that acid reflux remains excessive, though the wrap appears intact. It can also occur with a twisted wrap, when the posterior fundus attempts to return to its original position, twisting the lower esophagus counter-clockwise along with it, and thus creating a lower esophageal sphincter that is functionally too tight for food to pass through it.

Diagnostic techniques

To ensure that reoperation would benefit the patient, diagnostic tests were performed to assess their symptoms and to determine if their symptoms correlated with anatomical findings. Patients were comprehensively evaluated prior to reoperation utilizing 48 h Bravo pH study [9], esophageal manometry, Upper Gastrointestinal (UGI) contrast study (often with a barium-laden food bolus), and Esophagogastroduodenoscopy (EGD).

As a surrogate for formal manometry testing, we often utilize a standardized barium esophagogram to assess clearance of a food bolus in the upright and Trendelenburg position [10]. "Normal" clearance is defined as the passing of a food bolus with one or two stripping motions of esophageal peristalsis [10]. Patients with normal esophageal motility underwent a Nissen fundoplication, and patients with diminished esophageal motility underwent a Toupet fundoplication [10-12].

Prior to and after reoperation, all patients scored the frequency and severity of their symptoms using a detailed validated questionnaire. Utilizing a Likert scale (0= never/not bothersome, 10= always/very bothersome), patients scored the frequency and severity of their symptoms including dysphagia, chest pain, regurgitation, choking, and heartburn. Patients were followed prospectively in clinic and by phone or mail at one week, three months, and semiannually to

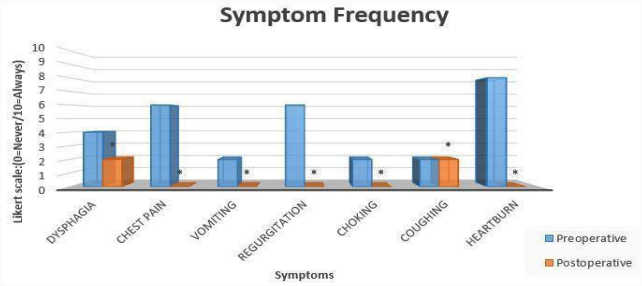

Figure 2: Patients scored symptom frequency using a Likert scale (0= never/not bothersome to 10= always/very bothersome), before and after reoperative fundoplication. *p<0.05 denotes less than before reoperative fundoplication.

annually after fundoplication. Outcomes were graded by patients as "Excellent" (complete resolution of symptoms), "Good" (symptoms less than once per month), "Fair" (symptoms less than once per week) and "Poor" (symptoms did not improve, were worse than prior to reoperative fundoplication, or new troublesome symptoms occurred). Patients graded their satisfaction as "Very satisfied", "Satisfied", "Neither satisfied nor unsatisfied", "Unsatisfied" or "Very unsatisfied". Postoperatively, patients were also queried as to whether they would undergo reoperative fundoplication again, knowing what they know now. The questionnaire also determined symptom free survival by monitoring frequency of heartburn. (0= never, 1= rarely, 2= monthly, 3= weekly, 4= daily, 5= every time I eat) A score of 2 or below was considered to be symptom free.

For this manuscript, we have defined the term "complication" very inclusively. We have included under this term, events which may not have extended hospitalizations or caused morbidity to avoid the erroneous impression we were not forthcoming. Some "complications" are clear and obvious, while others, with our attempts at full disclosure, are not; an uneventful cardiac dysrhythmia is potentially serious and this must, in our opinion, be documented. As well, an intraoperative gastrotomy is certainly unplanned and potentially morbid (though it may not have been), and thus we have included such events herein as "complications". Complications were classified through the use of the Clavien-Dindo grading system.

Data was maintained in a secure Microsoft Excel database (Microsoft Corp, Redmond, WA, USA). Statistical analysis was undertaken utilizing GraphPad Prism 8 software. (Graphdad Software Inc., San Diego, CA, USA). Statistical analysis was completed using a Mann-Whitney U test; Wilcoxon matched pairs test, and Fischer Exact test as indicated, on Graphpad InStat (Graphpad Software, Inc). Significance was accepted with 95% probability. Where appropriate, for illustrative purposes, data are presented as median (mean ± standard deviation).

Results

This study includes 236 patients (76 Men and 160 Women) with a median age of 58 years (58 ± 13.6), and a median BMI of 26 kg/m^2 (26 ± 4.7). Of the patients, ages ranged from 18 to 95 years and 84 patients were 75 years or older.

The median DeMeester score before reoperation was 41 (60 ± 58.6), with 67 (35%) patients reporting that they were on daily anti-acid therapy (Table 1). DeMeester scores ranged from 0.3 to 260, with 25 patients having DeMeester scores less than 14.7. Failure of the previous fundoplication was primarily due to wrap failure (Type

Table 1: Descriptive data of patients undergoing reoperative fundoplication.

001	236
Sex (Men/Women)	76 (32%) / 160 (68%)
Age(years)	58 (58 ± 13.6)
BMI (Kg/m^2)	26 (26 ± 4.7)
Preoperative DeeMeester Score	41 (60 ± 58.6)
Length of operation (minutes)	136 (148 ± 69.8)
Length of stay (days)	2 (5 ± 7.8)
Conversions to open (%)	6%

Data format: median (mean ± SD)

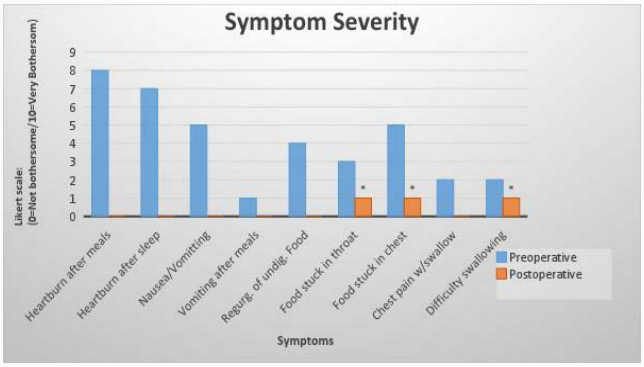

Figure 3: Patients scored symptom severity using a Likert scale (0= never/not bothersome to 10= always/very bothersome), before and after reoperative fundoplication. *p<0.05 denotes less than before reoperative fundoplication.

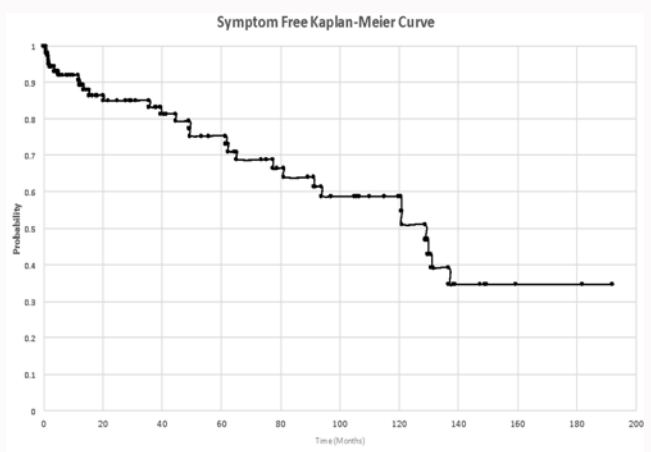

Figure 4: Kaplan-Meier curve demonstrating patients' symptom free survival.

IV, (Figure 1) which occurred in 108 (46%) patients and hiatal failure alone (Type 1a, Figure 1) occurred in 66 (28%) patients. Twenty-eight (12%) patients had paraesophageal hernia (Type II, Figure 1), six (<3%) patients had the body of the fundus used in original construction of the fundoplication (Type III, Figure 1), and ten (4%) patients had a "slipped Nissen" (Type 1b, Figure 1). Eighteen (8%) patients had an excessively tight fundoplication causing dysphagia (i.e., functional failure) with normal DeMeester scores. The vast majority of patients presented because of recurrent or persistent symptoms of reflux, consistent with the reported DeMeester scores; dysphagia was an uncommon sole indication for revision but occurred more often in patients with large paraesophageal hernias or in patients with herniation of their stomach (with or without intact fundoplication) into the mediastinum such that there was compression or deviation

Table 2: Reoperative fundoplication complications.

Intraoperative complications	No of Patients	% Patients	Clavien Dindo Grade
Gastrotomy	9	4%	n/a
Capnothorax	10	4%	n/a
Esophagotomy	2	1%	n/a
Spleen Tear	1	<0.5%	n/a
Arterial Bleeding	1	<0.5%	n/a
Postoperative Complication	**No of Patients**	**% Patients**	**Clavien Dindo Grade**
Edema	7	3%	I
Abdominal pain	5	2%	I
Cardiac Dysrhythmia	5	2%	I
Urinary Retention	4	2%	I
Death	3	1%	V
Wrap Failure	2	1%	IIIb
Dysphagia	2	1%	IIIa
Vomiting	1	<0.5%	I
Delayed Gastric Emptying	1	<0.5%	I
Hypoxia	1	<0.5%	I
Ileus	1	<0.5%	I
Pleural Effusion	1	<0.5%	I
Sepsis	1	<0.5%	II
Urinary Tract Infection	1	<0.5%	II
Surgical Site Infection	1	<0.5%	I
Influenza	1	<0.5%	I
Fever	1	<0.5%	I

of the esophagus.

Preoperatively, patients scored the frequency and severity of their symptoms (Figure 2 and 3). Symptom frequency and severity was notable preoperatively; heartburn was the most frequent (Figure 2) and severe (Figure 3) symptom reported, with a frequency of 8 (6 ± 3.6) and a severity of 8 (7 ± 3.4).

Overall, 212 (90%) underwent operative revision, and 24 (10%) patients underwent Transoral Incisionless Fundoplication (TIF). Reoperative fundoplication was completed *via* 'conventional' multitrocar multiport laparoscopy in 133 (56%) patients, while 63 (27%) patients underwent Laparo-Endoscopic Single Site (LESS) reoperative fundoplications; sixteen patients (7%) underwent "open" reoperative fundoplications, due to significant history of multiple abdominal operations leading to dense adhesions or difficulty of the reoperative procedure (e.g., because of mesh placed during the original hiatal reconstruction). Overall, a 360°C Nissen fundoplication was undertaken on 168 (71%) patients who had normal esophageal motility, and a partial fundoplication, in the form of 270°C Toupet fundoplication, was undertaken in 63 (27%) patients, who all had abnormal esophageal motility. The median length of operation was 136 (148 ± 69.8) minutes. Intraoperative complications occurred in 23 (10%) patients including nine (4%) gastrotomies, and two (1%) esophagotomies (Table 2). Bioprosthetic 'mesh' was utilized in one patient because of poor tissue constitution at and around the hiatus; the bioprosthesis was placed an 'on lay' patch after reconstruction the hiatus with a posterior cruroplasty. Postoperative complications after reoperative fundoplication occurred in 38 (16%) patients, with

Table 3: Postoperative questionnaire data of patients who would still have the reoperation or not have the reoperation.

Question	Still Have the Operation	No have the Operation	P-value
Post-op Chest Pain Frequency	1 (1 ± 1.3)	3 (4 ± 2.1)	0.02
Post-op Vomiting Frequency	1 (0 ± 1.0)	1 (1 ± 1.6)	0.35
Post-op Regurgitation Frequency	1 (0 ± 1.5)	2(3 ± 2.0)	0.04
Post-op Choking Frequency	1 (0 ± 1.3)	2 (1 ± 2.1)	0.18
Post-op coughing Frequency	1 (1 ± 1.6)	2 (1 ± 1.9)	0.38
Post-op Heartburn Frequency	1 (1 ± 1.5)	3 (4 ± 1.8)	0.01
Post-op food struck in chest Severity	2 (1 ± 3.1)	4 (5 ± 3.6)	0.07
Post-op Bitter taste Severity	2 (0 ± 3.1)	5 (5 ± 3.3)	0.02
Post-op Difficulty Swallowing Severity	2 (0 ± 2.9)	4 (4 ± 3.4)	0.11
Post-op Asthma Severity	2 (1 ± 3.2)	2 (0 ± 3.5)	0.98
Post-op Gas/Bloating Severity	5 (4 ± 3.7)	8 (9 ± 3.2)	0.01

Data format: median (mean ± SD)

edema at the GE junction delaying food passage occurring in seven (3%) patients (Table 2). For the complications, 84.2% were Clavien-Dindo grade 0, 13% were grade I, 1% were grade II, 0.8% were grade IIIb, and 1% were grade V. The overall median length of stay was two days. Hospitalization was generally delayed beyond one day because of ill health and deconditioning or management of self-limiting complications.

Median length of follow-up was 39 months and with a range of 6 days to as long as 15 years (which excludes patients over 75 years of age). This was documented by most recent office visit, by mail, and/or by phone interview.

Postoperatively, patients reported a significant reduction in both the frequency and severity of their symptoms (Figure 2 and 3). After their "redo" operations, heartburn was scored with a frequency of 0 (2 ± 3.2) and severity as 0 (2 ± 3.1), and regurgitation frequency was scored as 0 (2 ± 3.0) and severity of 0 (2 ± 3.1) (Figure 2 and 3). Seventy-three percent of patients rated their symptom resolution as "Excellent" or "Good". Seventy-seven percent of patients rated their overall experience as either "Very Satisfying" or "Satisfying". Eighty-seven percent of patients reported that they would still have undergone reoperative fundoplication, knowing what they know now. Similarly, after TIF, heartburn frequency and severity significantly decreased to 1 (2 ± 1.9) and 1 (4 ± 3.9), respectively. After TIF, 76% of the patients noted their experience as either very satisfying or satisfying. This was similar to that after reoperative fundoplication (with 77% noting similar satisfaction after reoperative fundoplication). Willingness to undergo reoperation again, knowing what they know now, was not different for patients undergoing reoperative fundoplication (87%) *vs.* TIF (71%, p=0.20). Delayed gastric emptying was not a clinical issue in our patients, but no provocative (i.e., gastric emptying scans) were undertaken. After undergoing a redo fundoplication, patients' median symptom free survival was 2.7 years (Figure 4).

Patients were then divided into those who would undergo the procedure again and those who would not. Patients who would undergo the revisional interventions again were of age 59 (60+14.4) years. Patients who would not, were younger of age 50 (51+13.5) years (p=0.02); other than age, nothing predicted this unwillingness. The type of anatomic failure did not predict postoperative satisfaction. Patients who wouldn't undergo the operation again had some

pronounced postoperative symptoms at follow up. For example, they scored their postoperative chest pain as 3 (3+2.1) while those who would undergo the intervention again scored 1 (1+1.3) (p=0.02) (Table 3). Similarly, patients willing to undergo reoperative intervention had better scores for postoperative regurgitation, heartburn, bitter taste in mouth, and gas and bloating (Table 3). With each consecutive survey, patient's answers did not change when asked if they would undergo the operation again knowing what they know now.

Discussion

In spite of the relatively low failure rates after anti-reflux operations, the tremendous increase in the numbers of these operations undertaken over the last 20 years makes the absolute number of failed operations significant, thus creating a need for reoperative anti-reflux procedures. With over twenty years of experience in undertaking reoperative fundoplications, this current study is the longest prospective study of laparoscopic reoperative fundoplication for recurrent gastroesophageal reflux disease. Our data provide evidence that laparoscopic "redo" fundoplication is an excellent option to provide long-term amelioration of recurrent symptoms of reflux or failed anti-reflux surgery and is associated with very high patient satisfaction. Similarly, after TIF application for recurrent reflux satisfying outcomes can be expected.

Anti-reflux operations are an effective treatment for GERD, and are associated with low rates of failure [4]. Several reports have shown that primary laparoscopic fundoplication provides excellent palliation of GERD symptoms with high patient satisfaction and significant decrease in the use of anti-acid medications [13,14]. The basic tenets of an effective fundoplication include reduction of the hiatal hernia, when present, reconstruction of the esophageal hiatus, and construction of a tension-free fundoplication around the distal esophagus that produces a robust gastroesophageal flap valve mechanism relocated in the 'high pressure' abdomen [15,16]. Recurrent symptoms or new disabling symptoms develop in 3% to 6% of patients after anti-reflux surgery [5,6].

The majority of patients in this study were women in their late 50's with an average BMI within the "overweight" range. Patients presented with complaints of recurrent symptoms of reflux or new symptoms of dysphagia, consistent with other reports [17]. Patients were noted to have various types of failures, of which the most commonly observed pattern was a combination of both a hiatal reconstruction failure and a wrap failure (i.e. Type Ia plus Type IV, Figure 4). The importance of identifying the type of failure is paramount, as it becomes the "roadmap" for reoperative fundoplication. Barium esophagograms are a predictor of successful outcomes for patients undergoing fundoplication. Barium esophagogram was utilized as a proxy for manometry studies [10].

Reoperative fundoplications are technically challenging procedures for many reasons: they are often associated with large hiatal hernias, usually there are relatively defuse adhesions from previous operations, and they are often associated with technical issues, such as the inclusion of mesh which leads to more and often excessive scaring, in the initial hiatal reconstruction [18,19]. Furthermore, normal anatomy is distorted. In the current study, the majority of reoperative fundoplications were undertaken laparoscopically, with a few being converted to "open". These "open" procedures were generally undertaken early in our experience and in patients who had previous "open" fundoplications, multiple previous abdominal operations, or mesh used in their hiatal reconstruction. Laparoscopic revisions are possible, probable, and preferable after failed "open" fundoplications. Conversion to "open" after starting laparoscopically was unusual and occurred in roughly 5% of patients; such conversions should not be considered as failures, but as sound judgment, though conversions to open should occur in a small minority of patients. The conversions occurred more frequently in patients with extensive adhesions resulting from multiple previous abdominal operations, including their previous fundoplications or from mesh used in hiatal reconstructions. Notable intraoperative complications occurred in a distinct minority of patients. Similar to our experience, a recent meta-analysis of reoperative fundoplications found that the most common intraoperative complications were injuries to the esophagus and stomach [20]. Smith et al. [18] reported that patients who were converted from a laparoscopic reoperation to an "open" procedure were more likely to have experienced notable intraoperative complications. Furthermore, in that report, patients had more postoperative complications after "open" reoperations than after laparoscopic reoperations. It seems to reason that the most difficult operations will be burdened with the most notable complications. Nonetheless the vast majority of our complications herein were Clavien-Dindo grade 0. In our experience, as reported in a previous study we published more than a decade ago, the length of stay for patients undergoing reoperative fundoplication was longer than those undergoing fundoplication for the first time [5]; generally, this was more related to patient health and wellbeing than to the specifics of their redo fundoplication.

Notably, the frequency and severity of reflux symptoms significantly decreased after reoperative fundoplication; there is a tremendous salutary benefit associated with reoperative fundoplication. Furthermore, dysphagia scores were relatively low. Patients who wouldn't undergo reoperative fundoplication again had some symptoms which were worse than those reported by patients willing to undergo fundoplications again, knowing what they know now, specifically, postoperative symptoms of chest pain, regurgitation, and heartburn, bitter taste in mouth, and gas and bloating. From what we know now, there seems no way to predict who will have an unsatisfying outcome or who will be unwilling to undergo reoperative fundoplication, knowing what they know now. Only age was such a predictor, and while ages among those willing and those unwilling to undergo fundoplication again was different, it doesn't seem meaningfully different. Multiple variable regression analysis added nothing to this. Some of the patients who were "Unsatisfied" after reoperative fundoplication were found to have a variety of issues that were not directly related to their symptom improvement, or lack thereof; when further queried, a number of patients complained about their hospital bill, insurance company, inconveniences of travel, or time off work. Though there seems to be some relatively increased morbidity associated with reoperative fundoplications, as opposed to "first-time" fundoplications, symptom resolution and improvement is impressive, and overall satisfaction is notable, and quite similar to after "first-time" fundoplications.

We have rigorously defined symptoms resolution herein and have found an overwhelming majority of our patients to have had complete resolution of symptoms, symptoms no more than once per month or once per week. Symptom free survival is impressive. Symptom free survival depends on survival and the lack of symptoms; we operated on patients as old as 95 years and more than one third of our patients were reoperated on at age 75 or older! In all, the

great majority of patients reported they would choose to undergo a reoperative fundoplication again, knowing what they know now; this is interesting because some patients not satisfied with their outcome would undergo reoperative fundoplication again. Thus, there seems to be a modest disconnect among symptom resolution, satisfaction, and the willingness to undergo reoperation again. From our records, none of our patients herein have received revisional procedures or operations.

There have been reports of adjunctive measures being utilized when performing reoperative fundoplications. For example, some surgeons use various forms of biological prostheses or 'mesh' to buttress the repair of large hiatal defects [21,22]. However, Koch et al. [22] have commented that long-term follow-up of patients receiving bioprosthetic mesh in the repair of large hiatal defects shows that reherniation after reoperative hiatal reconstruction is higher than after primary fundoplication, denoting that the application of bioprostheses is not a "panacea". It has not been our practice to use mesh, unless necessary to close the hiatal defect without tension, in fear of placing a foreign body next to the esophagus. Overall, only a handful of patients in our experience of well more than 2000 fundoplications have had mesh used in their hiatal reconstruction. Some authors advocated performing Collis-Nissen fundoplication [23,24]. We have found that the esophagus can be mobilized sufficiently to deliver about 8 cm of esophagus into the peritoneal cavity nearly 100% of the time that is always our goal. Therefore, no Collis-Nissen procedures were undertaken in our series or our overall experience with anti-reflux surgery. We don't think esophageal lengthening procedures have any role in anti-reflux surgery, and we discourage their use.

There are less invasive approaches to failed fundoplications, including endoscopic suturing [25] and radiofrequency ablation [26], also known as the Stretta procedure. Other endoluminal procedures, such as the Transoral Incisionless Fundoplication (TIF), do/should improve symptoms but may not restore lower esophageal pressures to normal. Patients herein did well after TIF, but it is very important to remember that patients undergoing TIF had much, much less severe problem(s), as TIF is applicable only after failures of type IV without hiatal hernia. Though promising experience is growing, endoscopic approaches are indicated only in patients without a notable hiatal hernia (i.e., less than 2 cm), and are best applied in patients needing minor adjustments, primarily for modest reflux (functional failure) and symptom management. In a recent report, we have shown that TIF undertaken in selected patients is a safe and efficacious means of controlling symptoms of GERD, leading to similar dramatic symptom resolution seen with primary Nissen or Toupet fundoplication [27].

Medical therapy for GERD after fundoplication is often, even generally, resumed without objective indications because of vague symptoms of indigestion or dyspepsia. There is often a perceived lack of options by the practitioner [28,29]. Lord et al. [29], found that of 86 patients receiving anti-acid therapy for persistent symptoms following Nissen fundoplication, only 23% had objective documented evidence of abnormal esophageal acid exposure by 24 h pH monitoring [30]. Non-surgeons should be more aggressive in seeking objective evidence of reflux justifying anti-acid therapy, given the risks of long term "open ended" PPI or H2-blocker therapy.

Laparoscopic fundoplication is the gold standard treatment for GERD. Given that the number of patients having undergone anti-reflux operations is great, the relatively small percent of patients failing fundoplications constitutes a substantial number [30]. This study was undertaken to review our 20 years of experience with reoperative fundoplications. These data promote the application of reoperative fundoplication, since it is a very effective "low-risk, high return" treatment for failed fundoplications. With positive outcomes denoted by improved frequency and severity of symptoms, the results herein demonstrate that reoperative fundoplication proves efficacious, and can safely be undertaken with expected salutary benefits, therefore promoting its application in the treatment of failed operations for GERD.

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