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Long-term results of laparoscopic antireflux surgery

Surgical outcome and analysis of failure after 500 laparoscopic antireflux procedures

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Abstract
Background: It is estimated that laparoscopic antireflux surgery has replaced the open approach in centers worldwide. Findings show it to be an established treatment option for chronic gastroesophageal reflux disease with an excellent clinical outcome and success rates between 85% and 95%. This prospective study aimed to evaluate surgical outcome and analysis of failure after 500 laparoscopic antireflux procedures followed up for as long as 5 years.
Methods: Between September 1993 and May 2000, 500 laparoscopic antireflux procedures were performed in our surgical unit. In 345 patients, a laparoscopic "floppy" Nissen fundoplication was performed, and in 155 patients, a Toupet fundoplication was carried out with standard mobilization of the upper part of the gastric fundus and with division of the short gastric vessels. Preoperative and postoperative data including 24-h pH monitoring, esophageal manometry, and analysis of failure were prospectively reviewed.
Results: Conversion to open surgery was necessary in two patients (0.4%). Morbidity was 7%, including 24 patients (4.8%) for whom a laparoscopic redoprocedure was necessary because of failed primary intervention. There was no mortality. During a follow-up period of 3 months to 5 years, 24-h pH monitoring and esophageal manometry showed normal values in 95% of the patients including patients who had undergone redosurgery.
Conclusion: The results of the current study demonstrate that laparoscopic antireflux surgery is feasible and effective, and that it can be performed safely without mortality and with low morbidity, yielding good to excellent results over a follow-up period up to 5 years.

Key words: Gastroesophageal reflux disease — Laparoscopic antireflux surgery — Long-term outcome

The past 10 years have witnessed a significant change in the role of surgery for gastroesphageal reflux disease (GERD). Initially, antireflux surgery was reserved only for patients who had failed every kind of medical therapy. Currently, surgery is a common and regular part of the treatment algorithm. Generally, treatment has changed from a more conservative to a more aggressive approach: from controlling acid secretion to restoring the physiologic antireflux barrier without long-term side-effect, and therefore better prevention or treatment of GERD complications [12].

New advances in the knowledge concerning the pathophysiology of the gastroesophageal junction and variations in the surgical techniques have essentially eliminated side effects and increased the effectiveness of antireflux surgery [12]. The laparoscopic approach to antireflux surgery has made the operation more acceptable to both patients and their referring physicians [11]. Many thousands of laparoscopic antireflux procedures have been reported with excellent outcome and a significant improvement in patients quality of life [1, 18]. Midterm and early long-term results of laparoscopic antireflux surgery (LARS) show success rates similar or even better than those reported in long-term studies after open antireflux surgery [3, 8, 7, 14].

This report reviews preoperative, operative, and postoperative data of 500 antireflux procedures prospectively over a follow-up period of 5 years including surgical outcome and analysis of failure.

Materials and methods

Between September 1993 and May 2000, 500 laparoscopic antireflux procedures, including 24 redoprocedures for failed primary interven-

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tion, have been performed for 476 patients in the Department of General Surgery at the General Hospital Zell am See. All these patients had a long history of GERD symptoms (mean 7.9 ± 6.6 years) and had been receiving medical therapy (20–80 mg of omeprazole daily) with proton pump inhibitors for a mean period of 16.4 ± 5.8 months. Heartburn was the major symptom, and the associated symptoms were typical, as shown in Table 1.

Basic requirements before LARS for all patients included an evaluation of GERD symptoms, esophagogastroduodenoscopy with biopsy and histologic examination of the gastroesophageal junction, 24-h esophageal pH monitoring, and esophageal manometry. Additionally, a barium swallow was performed in all patients before laparoscopic refundoplication or in patients with hiatal hernia. Laparoscopic "floppy" Nissen fundoplication (345 procedures) was performed in all patients with normal esophageal motility. Patients with poor esophageal motility (< 30 mmHg in the lower esophageal segments in response to wet swallows) or severely disordered peristalsis (> 40% simultaneous contractions during wet swallows) underwent laparoscopic Toupet fundoplication (155 procedures), with a tailored approach to antireflux surgery.

Since December 1998, in cases of potential disruption to the hiatal closure, we have reinforced the crura in all patients with a 1 × 3 cm polypropylene mesh [10]. Indications for surgery were persistent or recurrent GERD symptoms despite optimal medical treatment, persistent or recurrent complications of GERD, increased esophageal exposure to gastric juice and weak pressure in the lower esophageal sphincter (LES), or recurrent symptoms or complications after a previous antireflux operation.

Surgical technique

Laparoscopic fundoplication is performed with the patient under general anesthesia in lithotomy position. The surgeon is positioned between the patient's legs, allowing comfortable access to the abdominal esophagus through the upper midline and midsubcostal ports. The operation is assisted by a nurse on the left side of the patient to handle the camera and retract the stomach and esophagus. All the steps of the procedure are standardized and performed equally in every patient.

After the patient is positioned, pneumoperitoneum is established through a supraumbilical incision using a Verres needle. A system with five 11-mm ports is used. A 30° laparoscope is placed through the supraumbilical port. A liver retractor is placed through the rightmost port to elevate the left lobe of the liver off the hiatus. The surgeon operates through the upper middle ports, and the nurse retracts the stomach and/or esophagus through the leftmost port.

The first step of the operation is to divide the gastrohepatic omentum close to the liver and to dissect the peritoneum along the free edge of the right crus, along the circumference of the diaphragmatic crura, and onto the left crus. Circumferential mobilization of the esophagus is performed by careful dissection of the phrenogastric and phrenoesophageal attachments off the crura. After identification of the anterior and posterior vagus nerves, the posterior vagus nerve is dissected carefully off the back side of the esophagus.

The next step is to create a window below the left crus between the posterior wall of the esophagus, the posterior vagus nerve, and the stomach wall. After this, crural closure is performed using one to three interrupted 2-0 sutures. The number of stitches depends on the size of the hiatal hernia. Since 1998, a 1 × 3 cm polypropylene mesh has been placed on the hiatus behind the esophagus to reinforce the hiatal crura. The crural closure is performed in front of the posterior vagus nerve to trap the nerve and thus prevent slippage of the stomach through the valve into the chest.

Short gastric vessel division starts on the greater curvature of the stomach approximately 10 cm distally to the angle of His. The short gastric vessels are dissected using the harmonic scalpel (Ultracision, Ethicon, Germany). A Babcock clamp is used in the surgeon's left hand to retract the stomach in the area of initial dissection. The assistant retracts the gastric mesentery anteriorly and laterally. After complete dissection up to the left crus, the fundus is well mobilized and pulled easily by a Babcock clamp passed behind the esophagus. After the "shoeshine" maneuver, the wrap is fashioned. The left limb of the wrap should be selected by using a part of the proximal fundus near the divided gastric vessels to prevent a rotation or torsion at the cardia.

Table 1. Percentages of gastroesophageal reflux disease (GERD)-related symptoms before and after laparoscopic antireflux surgery (LARS)

	Before LARS (n = 500)			6 Weeks postop (n = 435)			3 Months postop (n = 500)			1 Year postop (n = 500)			3 Years postop (n = 150)			5 Years postop (n = 103)		
Symptoms	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2
Heartburn	2.8	10.1	86.1	100	0	0	99.3	0.7	0	100	0	0	97.2	1.4	1.4	97.2	2.8	0
Regurgitation	8.8	58.0	33.2	94.9	4.3	0.8	98.5	1.0	0.5	100	0	0	96.1	1.4	2.5	94.6	3.6	1.8
Chest pain	10.2	63.0	26.8	87.2	12.1	0.7	87.8	10.1	2.1	83.9	16.1	0	92.0	8.0	0	92.0	5.6	2.4
Dysphagia	68.7	22.4	8.9	87.0	9.6	3.4	95.1	4.9	0	97.1	2.9	0	96.0	4.0	0	95.2	4.8	0
Early satiety	52.7	9.6	37.7	53.6	31.6	14.8	70.5	18.1	11.4	83.8	10.2	6.0	85.0	8.8	6.2	84.4	10.6	5.0

postop, postoperative
0, *none*; 1, *mild to moderate*; 2, *severe*

Table 2. Mean DeMeester scores and mean lower esophageal sphincter (LES) pressures before and after both types of laparoscopic antireflux procedures

DeMeester score	Before LARS	3 Months after LARS	1 Year after LARS	5 Years after LARS
Nissen	68.0 (±27.8) n = 345	11.8 (±3.3) n = 345	9.8 (±6.3) n = 345	9.7 (±2.9) n = 64
Toupet	58.1 (±25.7) n = 155	13.1 (±6.9) n = 155	13.9 (±4.1) n = 151	13.4 (±6.2) n = 39
LES pressure (mmHg)				
Nissen	3.3 (±2.0) n = 345	13.1 (±3.8) n = 345	14.8 (±4.2) n = 345	14.6 (±2.8) n = 64
Toupet	2.1 (±1.7) n = 155	12.1 (±2.8) n = 155	12.4 (±3.9) n = 151	12.3 (±3.2) n = 39

LARS, laparoscopic antireflux surgery

The fundus is then brought together in front of the abdominal esophagus and held in place using two Babcock clamps.

For Nissen fundoplication, 360° loose wrap must be performed. To fashion the wrap, the surgeon starts with a U-stitch passing the fundus–esophagus–fundus and returning with nonabsorbable polypropylene sutures. Two further stitches are used for completion of the wrap. One stitch is placed above the U-stitch, and the other is placed below, ensuring a loose fundoplication 2 cm long.

After complete mobilization of the gastric fundus the stomach is brought behind the esophagus and then directed, caudad and to the left side of the patient. Three sutures are placed between the right crus and the fundus, beginning 1 to 3 cm up the crus. A 270° partial fundoplication then is fashioned by fixing the anterior wall of the gastric fundus to the front of the esophagus at 9.00 viewed from below. The sutures extend over 2 to 3 cm of esophagus. The same sutures then are placed on the left side of the esophagus to bring the stomach up and create a posterior 270° hemifundoplication.

At the conclusion of this procedure, the instruments are removed from the abdomen, and the skin is reapproximated.

Symptom evaluation

In addition to traditional outcome criterias such as DeMeester score and LES pressure, we evaluated the subjective extent of the following symptoms: heartburn, early satiety, regurgitation, chest pain, and dysphagia. The subjective degree of symptoms were evaluated using a simple verbal rating scale with the descriptions "none," mild to moderate, "and" severe.

Statistical analysis

The SPSS program was used for statistical analysis. Treatment results were analyzed with repeated measure procedures as appropriate. A p-value less than 0.05 was regarded as significant. Data are reported as mean ± standard deviation, range, or percentage.

Follow-up evaluation

Patients were evaluated 6 weeks after surgery with esophagogastroduodenoscopy surveillance (some patients were assessed by their local gastroenterologist), including evaluation of symptoms. Additionally, we performed 24-h pH monitoring and esophageal manometry 3 months and 1 year after surgery in all patients. A list of symptoms was distributed at the same time. Five years after LARS, the same outcome was assessed as that evaluated 3 months or 1 year after surgery.

Results

The complete follow-up evaluation was obtained for 500 patients at 3 months, and then at 1 year after surgery. At this writing, 5 years after surgical intervention, complete data for 103 patients (20.6%) are available.

The 500 laparoscopic antireflux procedures were performed on 476 patients (200 women and 276 men). The mean age of these patients was 49.2 years (range, 29–79 years). Of these patients, 24 (4.8%) had to undergo laparoscopic redosurgery for failed primary antireflux surgery.

Functional outcome

The esophageal manometry data and 24-hour pH monitoring for the complete follow-up elevation are shown in Table 2.

Morbidity

Overall morbidity was 7%, including 24 patients (4.8%) in whom a laparoscopic refundoplication was necessary because of failed primary surgery. Six patients (1.2%) experienced moderate dysphagia more than 3 months after surgery. They underwent pneumatic dilation and were found free of symptoms up to 5 years after surgery. A nonsymptomatic recurrent hiatal hernia developed in three patients (0.6%). So therapy was not necessary. In one patient (0.2%), a perforation of the esophagus occurred intraoperatively because of a leiomyoma. This patient could be treated conservatively and was free of symptoms up to 5 years after surgery. In another patient (0.2%), a necrosis of the gastric wall developed because of an acute telescopephenomenon 1 year after primary intervention. After reoperation, this patient was asymptomatic.

Symptom evaluation

The leading symptoms before surgery that patients graded to be severe were heartburn (86.1%), early satiety (37.7%), regurgitation (33.2%), chest pain (26.8%), and dysphagia (8.9%), which improved significantly ($p < 0.001$) after surgery. The grading of GERD symptoms found in our patients before and after LARS is listed completely in Table 1.

Redosurgery

Redosurgery was necessary in 24 patients (4.8%) because of a problem that developed after the original fundoplication. In 8 patients (1.6%) who underwent primary laparoscopic Nissen fundoplication, recurrent reflux was the reason for reoperation. The underlying morphologic failure was a rupture of the hiatus with intrathoracic migration of the wrap into the chest.

Table 3. Morphologic complications and gastrointestinal symptoms before laparoscopic redosurgery

Morphologic complication	Gastrointestinal symptoms		
	Rereflux	Rereflux and dysphagia	Dysphagia
Telescopephenomenon (n = 2)	0	2	0
Rupture of hiatus (n = 17)	8	2	7
Too-tight wrap (n = 5)	0	0	5
Total (n = 24)	8	4	12

In 12 patients (2.4%), dysphagia was the major symptom. Intraoperative findings were a hiatal disruption in seven patients (1.4%). In five of these patients, a laparoscopic Nissen fundoplication was the primary procedure, whereas two patients underwent primary laparoscopic Toupet fundoplication. A too-tight wrap was found in five patients (1.0%). In these patients, a Nissen fundoplication was the primary procedure. They underwent redosurgery with a laparoscopic Toupet fundoplication and were free of symptoms up to 5 years after surgery.

Four patients (0.8%) suffered from recurrent reflux combined with severe dysphagia. The correlating morphological findings were a telescopephenomenon (primary Nissen fundoplication) in two patients (0.4%) and a hiatal disruption (primary Toupet fundoplication) in two patients (0.4%). In 18 of these patients (75.0%), redosurgery was necessary within the first 12 months after the primary intervention. The remaining six patients underwent laparoscopic refundoplication 2 to 4 years after their initial surgery. Morphologic complications and gastrointestinal symptoms before redosurgery are shown in Table 3.

Discussion

Findings have shown LARS to be an established treatment option for chronic GERD. During recent years, LARS has become the standard procedure for treating severe GERD in centers worldwide. Several short- and midterm follow-up studies have been published recently, reporting good to excellent results, with healing rates of 85% to 100% and a low percentage of morbidity and mortality [3, 8, 11]. However, only a few studies with long-term follow-up evaluation after laparoscopic antireflux surgery have been published (9, 14).

Many long-term studies for open antireflux surgery were published previously. DeMeester et al. [4] showed in a study with a mean follow-up period of 45 months, a 91% success rate for the Nissen fundoplication. Luostarinen et al. [15] showed that after Nissen fundoplication, 71% of patients remained free of reflux for a follow-up period of 20 years. Also, Johansson et al. [13] reported an overall success rate of approximately 84% for patients after Nissen fundoplication during a follow-up period of 5 years. Nevertheless, antireflux surgery may require reoperation for failure in 3% to 6% of cases [19]. In large studies of laparoscopic antireflux surgery, the success rates of antireflux redo-surgery generally range from 75% to 90%, although in most of these studies, an open fundoplication was performed. Some reports of laparoscopic refundoplication experiences and results have been published [5, 16, 17, 19]. In this report of 500 laparoscopic antireflux procedures, we describe the results of laparoscopic "floppy" Nissen or Toupet fundoplication, with preoperative and postoperative evaluation of LES pressure. DeMeester scores, and analysis of failure and a complete 5-year follow-up evaluation for 103 patients.

As our results show, LES pressure and DeMeester scores improved significantly. The improvement persisted after LARS and was comparable to that in healthy individuals. No relevant differences in surgical outcome were achieved after Nissen or Toupet fundoplication in patients treated successfully and free of any symptoms. Along with other authors [17] we found technical errors in the performance of primary surgery or an incorrect choice of procedure as the main reason for failure.

One of the most frequently occurring anatomic failures after primary fundoplication is migration of the wrap into the chest [8, 9, 16, 17]. This intrathoracic migration may result from an adequate closure of the diaphragmatic crura or a rupture of the sutures placed at the crura. If there is a thorough preoperative evaluation with a correct diagnosis and an experienced surgeon performing the optimal surgical procedure, it has been suggested that some technical aspects in LARS can prevent postoperative complications. Routine hiatal closure will reduce the occurrence of postoperative paraesophageal hiatus herniation and intrathoracic wrap migration. Therefore, surgeons performing LARS generally agree that hiatal closure should be performed routinely, whether a hiatus hernia is present or not [20].

This study of 500 laparoscopic antireflux procedures with routine hiatal closure in our surgical unit has shown that postoperative herniation of the Nissen valve into the chest is the most common reason for failure of LARS. The relatively high frequency of this complication led us to the use of a 1 × 3 cm polypropylene mesh for hiatal closure routinely since December 1998 in every patient undergoing laparoscopic antireflux surgery. In a nonrandomized study, patients with nonabsorbable polypropylene sutures for hiatal closure and patients with mesh hiatoplasty for hiatal closure were prospectively reviewed. It was shown that the occurrence of postoperative wrap herniation into the chest decreased significantly after polypropylene mesh was used for hiatal closure [10]. Besides a careful selection of the patients, the main factors in preventing surgical failures are a basic knowledge of the principles of LARS and the physiologic aspects of GERD. Postoperative dysphagia

was found only in patients who underwent Nissen fundoplication, whereas recurrent reflux occurred in patients after Toupet fundoplication. In five patients found to have symptoms of recurrent reflux after laparoscopic Toupet fundoplication, LES pressure was normal, but the DeMeester score was pathologic. These patients underwent a laparoscopic redoprocedure with Nissen fundoplication and were free of sptoms at follow-up evaluation. After laparoscopic redosurgery, the functional parameters became comparable with those of patients who underwent successful surgical treatment.

It has been shown that reoperation for failed antireflux surgery usually is necessary within the first postoperative year. In a 5-year follow-up study by Lafullarde et al. [14], nearly 56% of the patients had to undergo redosurgery within the first postoperative year. In our study, redosurgery was necessary within the first 12 months after the primary intervention in 75% of the patients.

The results of the current study demonstrate that laparoscopic fundoplication and refundoplication with previous open or laparoscopic antireflux surgery are feasible, and effective, and that they can be performed safely without mortality and with low morbidity, as evidenced during a follow-up period lasting up to at least 5 years. Careful patient selection and a standardized LARS technique offer patients the chance to live a normal life without medical treatment, long-term side effects, or a reduced lifestyle.

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