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# Laparoscopic Nissen's fundoplication: preliminary report on ten cases

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**Summary.** We present our experience with ten cases of laparoscopic Nissen's fundoplication. Reflux esophagitis is a very common disease and is associated with a lack of response to medical treatment in a significant number of cases, yet the rate of referral to a surgeon is extremely low. We believe that the endoscopic treatment of this disease is much less invasive and more cost-effective and is associated with lower rates of complications. Indeed, our patients left the hospital at 24–48 h post-surgery and were involved in their regular activities at 4 days to 1 week thereafter. Neither mortality nor complications associated with the procedure were encountered. We believe that the feasibility and the benefits of this procedure will lead to earlier referral and hence to avoidance of long-term complications of gastroesophageal reflux disease.

**Key words:** Nissen's fundoplication – Laparoscopy – Reflux esophagitis

Until 3 years ago, laparoscopy was done only by gynecologists for diagnostic purposes as well as for the treatment of a number of gynecologic problems. In the last 3–4 years, the use of the laparoscope has been expanded by general surgeons to include many procedures that had previously been carried out by laparotomy. This expansion has partly been made possible because of recent developments in endoscopic equipment that have enabled surgeons to use laparoscopy in treating conditions that previously could be managed only by conventional surgery. When general surgeons started to use the laparoscope, they realized that visualization was much improved over that achieved during laparotomy, mainly because the laparoscope can be moved and placed directly over the surgical field, easily providing a view that has occasionally been quite difficult to obtain by the open technique. Because of the major advantages this procedure has over laparotomy for the patient, general surgeons all over the continent have started to use the laparoscope to carry out multiple intra-abdominal as well as intra-thoracic procedures.

The first digestive procedure that was done using the laparoscope was an appendectomy performed by Semm in 1982 [6]. In 1987 in Lyon, Mouret proceeded with the first laparoscopic cholecystectomy on a human being. Since then, a cascade of laparoscopic intra-abdominal procedures have expanded the spectrum of laparoscopic surgery, and with the increasing numbers of procedures that have been done, the more obvious the advantages for the post-operative recovery of the patient have become. Other advantages include a decrease in hospitalization time, a reduction in costs, an early return to regular activities and results that are similar to those obtained following laparotomy procedures.

Advances in laparoscopic surgery have led some surgeons to proceed with new anti-reflux procedures, one of which involves wrapping the distal part of the esophagus using the round ligament; another procedure used laparoscopically constitutes the positioning of an Angelchick prosthesis around the distal part of the esophagus. The long-term results of the round ligament procedure are not yet known. Although placement of the Angelchick prosthesis is an old technique for the treatment of gastro-esophageal reflux, it has never gained wide acceptance. These concerns together with the high incidence of gastro-esophageal reflux in our area led us to initiate a cure for reflux esophagitis using a modified Nissen's fundoplication, which has stood the test of time to become the most accepted and most widely used anti-reflux procedure in North America as well as in the rest of the world. Our rationale was that if this operation were feasible laparoscopically, its application would be better than the creation of a new anti-reflux procedure due to the long-term follow-up period required to establish the effectiveness of the latter. The present report describes our experience with ten patients suffering from reflux esophagitis who were treated by laparoscopic Nissen's fundoplication.

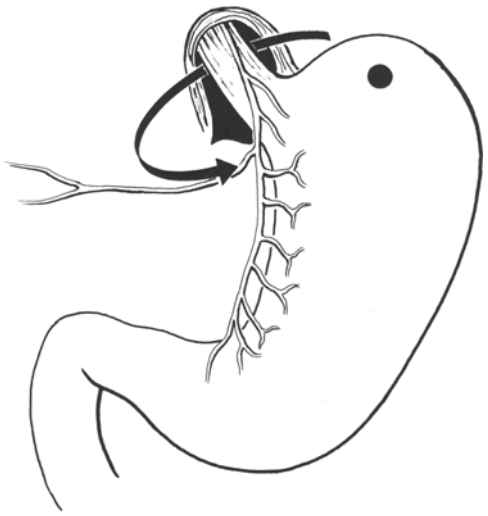

**Fig. 1.** Minimal dissection around each side of the esophagus and use of the anterior wall for construction of the wrap

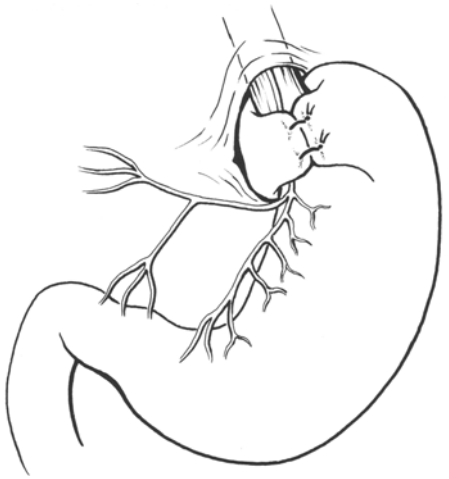

**Fig. 2.** Wrap completed using two stitches placed 1–2 cm apart

## Patients and methods

### *Technique*

Laparoscopically, we proceed with the same steps used to perform our modified Nissen's fundoplication by laparotomy. The minor modification described by Nissen et al. [5] makes the technique easier as well as less destructive to the gastro-esophageal area. The major difference involves the use of solely the anterior wall of the fundus of the stomach to construct the fundal wrap instead of using both the posterior and the anterior wall. This enables much less dissection to be done on each side of the esophagus. On the left side there is no need to ligate the short vessels to obtain a wrap without tension, and on the right side there is no need to dissect the lesser curve of the stomach, thus avoiding ligation and sacrifice of the left gastric veins as well as, most importantly, the hepatic branch of the anterior vagus nerve. In addition, the preservation of these two structures enables their use in holding the fundal wrap above the gastro-esophageal junction without the necessity of fixing it on the wall of the esophagus, thus practically eliminating the possibility of its subsequent displacement. Passage of the anterior wall of the fundus of the stomach above and behind the esophagus enables the angle of Hiss to hold the fundal wrap quite firmly above the gastro-esophageal junction, which also prevents displacement of the valve. We have used this modification of Nissen's fundoplication to proceed with a 360° fundal wrap around a 60-F bougie for a distance of 1–2 cm for the last 5 years in >200 patients and have obtained excellent results. The use of a large bougie and a short wrap has been proven to lessen the side effects and is as effective as the application of the original 5-cm wrap around a 48-F bougie [2] (Figs. 1, 2).

Because of the excellent results obtained using this technique by laparotomy, we decided to follow the same steps laparoscopically. For this procedure, the patient is positioned with legs apart, with the surgeon standing between them. One assistant is on each side of the patient and a video screen is facing the operator. Five trocars are used, three measuring 10 mm in diameter and two measuring 5 mm. The first 10-mm trocar is positioned halfway between the xiphoid bone and the umbilicus and is used to introduce the laparoscope. Another 10-mm trocar is introduced slightly higher and on the lateral border of the rectus sheath on the left side. The other 10-mm trocar is introduced immediately underneath the costal rib margin on the mammary line on the left side. One 5-mm trocar is positioned on the right side on the mammary line immediately underneath the costal rib margin, and the other is introduced immediately underneath the xiphoid bone in the midline (Fig. 3). The three 10-mm ports are used for the introduction of the dissecting instruments, the hook cautery or the laparoscope, depending on the step of the procedure. The 5-mm subxiphoid trocar is used to introduce a palpating probe or a fan retractor for retraction of the liver. The 5-mm trocar on the right-hand side is used to introduce graspers as aids in the dissection of the gastro-esophageal junction.

The operation is started by retracting the gastro-esophageal junction downwards and opening the phreno-esophageal membrane above the junction using the hook cautery. Applying the hook cautery as well as blunt dissection, the anterior wall of the esophagus is then freed for a distance of at least 5–7 cm. The dissection is commenced on the right side of the esophagus as well as on its posterior wall so as to dissect the areolar tissue between the esophagus and the aorta, with care being taken to stay above and away from the left gastric vein. In difficult cases, this dissection is sometimes facilitated by opening the pars flaccida of the lesser omentum, passing underneath the hepatic branch of the vagus nerve as well as the left gastric vein and opening the peritoneum between the right crus and the esophagus. The entire posterior wall of the esophagus can be separated quite easily from the aorta. After this has been done, the dissection is commenced on the left side of the esophagus to liberate it from the left crus of the diaphragm. During dissection on each side of the esophagus, the pleura is always visible and care should be taken not to puncture it because of the constant positive intra-abdominal pressure that is used to maintain pneumo-peritoneum.

The next step involves passing a grasper from the 5-mm trocar on the right-hand side behind the esophagus to the left side of the esophagus, grasping an appropriate site of the anterior wall of the fundus and bringing it behind and onto the right side of the esophagus. A 60-F bougie is positioned in the esophagus and, using another grasper introduced through trocar 3, the fundal wrap is fashioned around the 60-F bougie. Mersilene suture is introduced through trocar 2 and the fundal wrap is sutured with two stitches lying 1–2 cm apart. The knot can be tied using either the intra-corporeal or the extra-corporeal knot-tying technique. A graduated palpator is used to measure the length of the fundoplication, which is determined by the distance between the two stitches. The trocars are extracted, and simple and subcuticular stitches are used to close the different introduction sites.

### *Patients*

The surgical procedure was attempted on ten patients, including five men and five women whose age ranged from 27 to 59 years and whose weight varied between 140 and 270 lbs. All of the patients exhibited an extremely long history of chronic reflux esophagitis that had shown no response to medical treatment, including a full course of Omeprazole and Cisapride. Four patients had ulcerative esophagitis. Eight subjects underwent a preoperative 24-h pH study. Only two patients who had ulcerative esophagitis refused the test. Because the diagnosis was obvious, we did

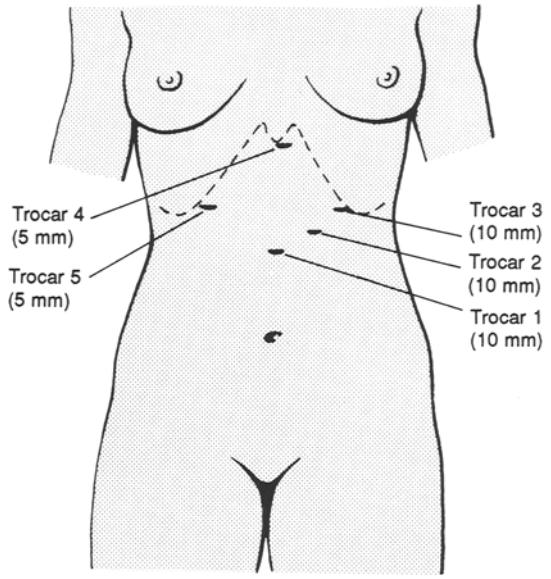


**Fig. 3.** Positioning of trocars for the introduction of instruments

not want to impose this test on them. All patients underwent a pre-operative endoscopic assessment of their esophagitis. Four subjects were classified as having grade 2 esophagitis and four, grade 1 esophagitis; the esophagus of the other two patients appeared normal endoscopically, but the results of the 24-h pH study were pathological in both cases.

The only case that was converted to an open procedure involved a 30-year-old patient; at 1 h into the procedure, the end tidal $CO_2$ pressure showed a continuous increase and the anesthetist could not bring it down. For reasons of safety, we decided to stop the insufflation of $CO_2$ and to proceed with an open fundoplication.

## Results

When fundoplication was performed alone, the duration of the procedure varied from 75 min to 110 min. In one patient the procedure was carried out concomitantly with a posterior truncal vagotomy and an anterior seromyotomy for a chronic duodenal ulcer and the overall procedure lasted 4.5 h. The delay was due mainly to a technical problem that arose during the vagotomy and not to the fundoplication itself.

The oral intake of fluids was resumed on day 1 post-surgery after the patient had fully awakened, and the progressive diet was started on the 2nd post-operative day. Neither mortality nor post-operative complications were encountered. All of the patients were discharged at 48 h post-surgery and could return to work at 5–10 days following the procedure. All ten subjects were clinically asymptomatic after the operation; although it is very difficult to convince an asymptomatic patient to undergo a 24-h pH study, four patients volunteered to undergo this test post-operatively. The pre- and post-operative DeMeester scores of these subjects are shown in Table 1.

**Table 1.** Pre- and post-operative DeMeester scores

| Patient | Pre-operative | Post-operative |
|---|---|---|
| 1 | 65 | 0 |
| 2 | 44 | 3 |
| 3 | 74 | 2 |
| 4 | 19 | 0 |

## Discussion

Esophageal reflux disease is a very common disorder that occurs in at least one-third of the population and significantly interferes with the normal life style of at least 5% of the individuals affected. Hiatal hernia was previously blamed for this disorder because of its frequent association with the complex of reflux esophagitis symptoms. The causal relationship of hiatal hernia with gastroesophageal reflux disease was dispelled in the 1960s, when manometry demonstrated that a weak lower esophageal sphincter is the actual etiology [7]. Currently, esophageal sphincter incompetence, poor esophageal clearance and various gastric features, including hyper-secretion, are known to be causative factors for esophageal reflux disease [1].

Although upper gastro-intestinal endoscopy is one of the most important tests used for the diagnosis of gastroesophageal reflux disease, normal endoscopy cannot exclude reflux as a cause of the symptoms, as the majority of patients complaining of heartburn or other symptoms of reflux disease exhibit no histological or endoscopic evidence of esophagitis yet are symptomatically indistinguishable from those suffering from severe esophagitis. It is estimated that at least 40%–50% of patients who suffer from gastroesophageal disease show no sign of esophagitis on upper gastro-intestinal endoscopy. There is no difference in the severity or type of symptoms in reflux patients who exhibit inflammation and those who do not. Especially in these cases, 24-h pH monitoring best defines gastroesophageal reflux disease [4]. Specific acid pH levels and the number and duration of reflux episodes differentiate normal from abnormal patients; thus, the 24-h pH study is considered to be the most sensitive test for gastroesophageal reflux disease. If there is evidence of severe gastroesophageal reflux disease on endoscopy, 24-h pH monitoring is not mandatory for diagnosis of the disease. This test is also extremely helpful in the diagnosis of non-cardiac chest pain, which can be caused by esophageal reflux.

A large percentage of patients respond adequately to medical treatment; only 5%–10% show either no response whatsoever or severe complications of the disease. Recently, Omeprazole has been found to reduce very significantly intra-gastric acidity, and it is now frequently used for the treatment of gastroesophageal reflux disease. The drug is very successful in the immediate treatment of gastroesophageal reflux, and it reverses the associated symptoms as well as the histological changes of reflux esophagitis in a large proportion of patients; however the recurrence rate is >80% at 6 months after the drug has been stopped [3]. The long-term use of this agent is not advisable at this point because of the high incidence of carcinoid tumor reported in rats that have received it, although some investigators have used the drug on a long-term basis and claim that it is safe. Cisapride, a new pro-kinetic agent, may be helpful to some symptomatic patients despite the

drugs they require to lower the acidity in their stomach. The administration of Omeprazole or Cisapride produces differing side effects, albeit slight, and differing degrees of intolerability; thus, some patients cannot tolerate these drugs on a long-term basis. Moreover for subjects who require the continuous intake of drugs to remain asymptomatic, the cost of these drugs plays a very important role in the choice of the long-term treatment used.

Surgery for gastroesophageal reflux disease controls the symptoms and eliminates the problem in >90%–95% of cases. Nissen's fundoplication is one of the most common operations used in North America for the control of this disease. Technical refinement has decreased the development of post-operative dysphagia and has all but eliminated the need for dilatation; moreover, the gas-bloat syndrome, although annoying, almost always resolves with time [2]. Despite the quite good results obtained using anti-reflux surgery and the post-operative satisfaction of the patient, the referral rate remains extremely low, with <5% of subjects being referred for surgery. Perhaps the development of a less invasive procedure that would result in minimal pain and a very rapid return to normal activities might lead to earlier referral and thus to avoidance of the severe complications caused by gastroesophageal reflux disease. Considering our first ten patients, who experienced minimal post-operative pain and could almost immediately return to their regular activities, we think that laparoscopic Nissen's fundoplication represents a major step towards the achievement of this goal.

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