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Laparoscopic fundoplication for gastro-oesophageal reflux

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The initial teaching and learning experience of four surgeons performing a laparoscopic Nissen fundoplication is reported. A total of 33 patients underwent the laparoscopic approach for Nissen fundoplication. Two patients also underwent concomitant cholecystectomy. A loose 360° fundoplication secured by three or four sutures was performed, with 29 patients also undergoing posterior crural repair. Three operations were converted to open procedures. Two patients required subsequent surgery, one when the fundoplication and proximal stomach slipped into the chest and one for oesophageal obstruction. No other complications occurred. All patients are well and free of reflux symptoms at follow-up ranging up to 10 months (median 5 months). Operating time ranged from 47 min to 154 min (median 81 min) for fundoplication alone. The laparoscopic fundoplications with cholecystectomy required 145 and 170 min. Postoperative stay ranged from 3 to 12 days (median 3 days).

Laparoscopic Nissen fundoplication is feasible in the management of gastro-oesophageal reflux disease. These early results demonstrate that this new technique may reduce some of the morbidity associated with open antireflux surgery. A prospective randomised study has been started to assess efficacy and benefits more thoroughly.

Since fundoplication was reported by Nissen in 1956 *(1,2)*, it has become the most common surgical procedure for gastro-oesophageal reflux disease, achieving long-term relief of reflux symptoms in 90% of patients *(3–5)*. To reduce the incidence of post-fundoplication sequelae, Nissen's original procedure has been modified by shortening the fundoplication, creating a loose 'floppy' wrap, and dividing the short gastric vessels *(3)*.

With the advent of laparoscopic cholecystectomy *(6)* and its rapid adoption worldwide *(7)*, it has become clear that much of the morbidity associated with upper abdominal surgery is wound-related. The laparoscopic approach avoids this to a large extent. With cholecystectomy, a more rapid recovery, and earlier return to normal activity has been achieved *(6–8)*. In 1991 Dallemagne *et al. (9)* extended the application of laparoscopy by reporting an initial experience with 12 laparoscopic fundoplications demonstrating the feasibility of this technique. Several other early reports have presented encouraging short-term results *(10–13)*, although the median operating time has ranged from 120 min to 210 min.

Our initial teaching and learning experience involving four surgeons is reported.

Patients and methods

Between March and December 1993, 33 patients (17 male and 16 female) underwent attempted laparoscopic Nissen fundoplication. Although these patients were the first to undergo this procedure at the Royal Hallamshire Hospital, one surgeon (DIW) had performed laparoscopic fundoplications at another centre *(13)* and was directly involved in all of the operations performed. The three other surgeons who performed these procedures were all experienced in laparoscopic cholecystectomy, having all performed more than 60 operations before commencing laparoscopic fundoplication. Patient age ranged from 23 years to 76 years (median 50 years) and

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weight ranged from 43 kg to 102 kg (median 76 kg). Twelve patients had undergone previous open abdominal surgery (two upper, eight lower, two both).

Preoperative management

All patients had symptomatic gastro-oesophageal reflux documented by endoscopy and 24 h ambulatory pH monitoring, and underwent preoperative oesophageal manometry to assess oesophageal motility. Hiatal hernias were present in 24 patients, and greater than 5 cm in length in eight. The duration of reflux symptoms ranged from 9 months to 30 years (median 6 years). All patients had undergone long-term treatment with H_2 receptor antagonists, cisapride or omeprazole before surgery, with unsatisfactory symptom control (28 patients) or an expressed wish to avoid lifelong medical therapy (five patients).

Operative technique

Before embarking on laparoscopic fundoplication, surgeons could practice the technique on pig viscera using a specially designed rig.

The operation is performed with the patients in the lithotomy position, the table tilted 30° head up, and the surgeon standing between the patient's legs. The instrumentation for all procedures comprised a standard laparoscopic cholecystectomy set with the addition of only three extra instruments; a 10 mm ratcheted Babcock grasper (Micro-France, Bourbon L'Archamboult, France), a Johann 5 mm atraumatic grasping forceps (Micro-France), and a 5 mm needle holder (Ethicon® Endosurgery, Edinburgh, UK). All procedures were completed using the 0° laparoscope only. No special curved instruments or dissectors were used. After placing an orogastric tube to deflate the stomach, a Veress needle is inserted at the left costal margin, and the abdomen is insufflated with CO_2 gas to a maximum pressure of 12 mmHg. Five ports are placed (Fig. 1). A 10 mm port (A) for the laparoscope is introduced just to the left of the midline, midway from the xiphisternum to the umbilicus. Additional ports are placed under vision; 5 mm ports are placed in the midclavicular line just below the right costal margin (B) for a grasping forceps used as a liver retractor, and in the epigastrium just below the xiphisternum (C) for a grasping forceps used by the surgeon. A 10 mm port is placed in the left anterior axillary line just below the costal margin (E) for the passage of a 10 mm Babcock grasper. The fifth port is a 10 mm port placed in the left midclavicular line just below the costal margin (D) for use as the principal operating port for dissecting and suturing.

The first assistant, standing on the patient's left, controls the laparoscope and the stomach just below the cardia with the Babcock grasper to facilitate oesophageal dissection. The second assistant (or scrub nurse) stands on the patients' right, elevating the left lobe of the liver with the shaft of a 5 mm grasper to display the oesophageal hiatus.

Dissection commences by opening the transparent window forming the superior part of the lesser omentum above the hepatic branch of the vagus nerve. This enables rapid identification of the right crus. Dissection then extends across the phreno-oesophageal ligament to display the oesophagus and crura. With the cardia retracted caudally and alternatively to the left and right, the crura and oesophagus are dissected, aiming to continue posteriorly around the distal oesophagus, thereby opening a 'window' behind. Further oesophageal dissection is facilitated by the passage of a nylon tape around the distal oesophagus to lift it forward. This is passed through the epigastric port, to a grasper passed behind the oesophagus from the right subcostal port, pulled behind the oesophagus, and then passed back to the epigastric grasper. Both ends are then brought out through the epigastric port which is then removed and replaced alongside the tape so that the tape emerges from the same abdominal incision without passing through the port. The ends are secured extracorporeally with an ordinary artery forceps and the tension can be adjusted appropriately. This manoeuvre facilitates dissection and suturing of the crura behind the oesophagus. A posterior crural repair is carried out before the fundoplication using interrupted 2/0 prolene sutures. A large window is dissected behind the oesophagus to allow easy passage of the stomach and ensure a tension-free fundoplication.

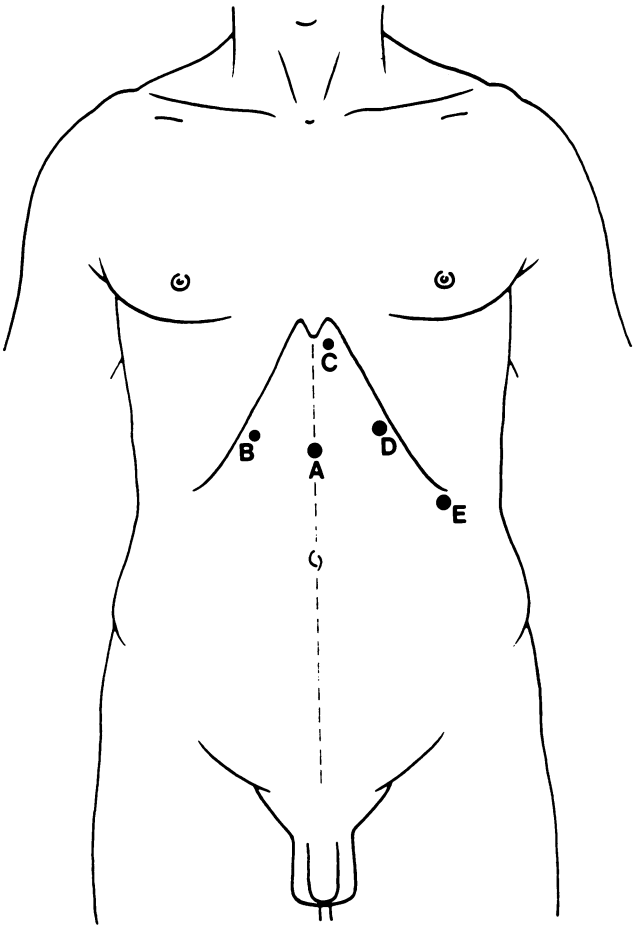

Figure 1. Port placement for laparoscopic fundoplication.

The atraumatic Johann grasper is passed behind the oesophagus via the right upper quadrant port, and the anterior wall of the fundus is passed to it, enabling the fundus to be pulled around behind the oesophagus. It is essential to take steps to ensure that the fundus and not the body of the stomach has been selected. The fundus is approximated to the anterior wall of the stomach in front of the oesophagus, forming a loose 360° wrap. This was achievable in all patients without division of short gastric vessels. A 52G mercury-weighted Maloney bougie is placed through the gastro-oesophageal junction before suturing.

Three or four interrupted 2/0 prolene sutures (25 mm curved needle) are placed with an extracorporeal knotting technique, creating a 2 cm long fundoplication. One or two sutures pick up the oesophageal wall to fix the fundoplication. A modified Weston knot is used to secure the sutures *(14)*. A minimum 90 cm suture length is necessary for this technique as the knots are tightened using a hollow knot pusher. Nasogastric tubes were not used in any patient.

Postoperative management

Oral fluid intake is started on the 1st postoperative day, and soft solids on the 2nd day. Patients leave hospital as soon as they are well enough, continuing with a soft diet for the next 4 weeks.

Results

Thirty-three consecutive Nissen fundoplications were attempted laparoscopically by four surgeons. Twenty-nine patients also underwent concomitant posterior crural repair. Three procedures required conversion to open surgery. In one patient with obesity the standard laparoscopic instruments were too short for suturing to be performed. One procedure required conversion to laparotomy due to a combination of perioesophagitis and obesity preventing safe dissection behind the oesophagus. Bleeding from a lacerated inferior phrenic vein accounted for the third conversion. Operating time ranged from 47 min to 154 min (median 81 min) for 31 patients undergoing fundoplication. Two patients underwent combined laparoscopic fundoplication and cholecystectomy, requiring 145 min and 170 min to complete.

The median postoperative hospital stay for all patients was 3 days (range 3–12 days). The three patients whose operations were converted to open procedures were discharged 4, 4 and 5 days postoperatively. Of the other 30 patients, 24 were discharged on the 3rd postoperative day. For those patients whose operations were completed by the laparoscopic technique, the median time until normal physical activity was resumed was 2 weeks (range 3 days to 4 weeks). Median follow-up was 5 months (range 1–10 months). All patients are currently free of reflux symptoms.

Postoperative complications occurred in two patients, both requiring revisional surgery. The proximal stomach and fundoplication of the first patient migrated into the chest. As no hiatus hernia was evident at the original operation, no crural repair had been performed. While, the patient remained free of reflux, her appetite was reduced and pain occurred after eating due to partial gastric obstruction at the diaphragm. A laparotomy was performed 14 weeks after the original procedure to resite the stomach and fundoplication in the abdomen. The other patient suffered complete oesophageal obstruction at the level of the fundoplication. Barium swallow and reoperation on the 6th postoperative day revealed that the fundoplication had rotated 90°, twisting the oesophagus to which it was sutured. This was revised successfully and the patient was discharged 12 days after the original procedure. Both patients made full recoveries and are doing well.

Of the 33 patients, ten had early dysphagia for solids when reviewed 4 weeks after surgery. Of these 10 patients, six have been followed for more than 3 months with complete resolution of this symptom. The remaining four have been followed for less than 3 months. Gas bloat has not been a problem for any patient. No respiratory morbidity occurred.

Postoperative gastroscopy has been performed in 12 patients, revealing a satisfactory fundoplication on direct inspection and the absence of oesophagitis in all instances.

Discussion

Laparoscopic and other minimally invasive approaches to abdominal surgery have the potential to reduce surgical morbidity, and result in earlier return to full activity *(6–8)*. Several laparoscopic antireflex operations have been discribed *(9–13,15–19)*. However, not all of these reproduce the criteria demonstrated to provide effective control of reflux with open surgery. Stein and DeMeester *(20)* have stated that the established principles of antireflux surgery should not be jettisoned in order to perform a procedure laparoscopically. They state that the 'construction of a loose 360° fundoplication' should be the goal. Dallemagne *et al (9)*. demonstrated the feasibility of this in their initial series of 12 patients. Geagea *(10)*, Falk *et al. (11)* and Bagnato *(12)* all reported good initial results in preliminary series of 10, 7 and 16 patients, respectively. Nathanson *et al. (17)* have shown that this procedure can be performed in patients with large hiatal hernias. Weerts *et al. (21)* have recently published a large series of 132 patients followed for up to 3 years, reporting good relief of reflux symptoms with low perioperative morbidity.

The laparoscopic operation we have performed is the same as originally described by Nissen *(1)*, except for shortening the fundoplication to 2 cm and using a 52G bougie in the oesophagus when constructing the fundoplication. It achieves the goals stated by Stein and DeMeester *(20)*. The anterior wall of the stomach has been utilised for the loose fundoplication without dividing any short gastric vessels, as originally described by Nissen *(1)*. Dallemagne *et al. (9)* and Falk *et al. (11)* describe

division of these vessels, although a loose fundoplication was achieved in all of our patients without dividing these vessels. Geagea *(10)* also found it unnecessary to divide any short gastric vessels when constructing a loose laparoscopic fundoplication. While the issue of division of these vessels has been controversial in the era of open surgery, there is evidence that good results can be achieved without dividing short gastric vessels if the fundoplication is loose and short *(22–24)*.

This series is primarily a teaching and learning experience, documenting the introduction of laparoscopic Nissen fundoplication into a new institution. Although follow-up is short, it does demonstrate the feasibility of performing a Nissen fundoplication laparoscopically. The procedure can be introduced successfully without requiring excessive operating time or resulting in increased morbidity. Instruments were acquired without great expense, as only three extra instruments were needed which were not readily available on a standard laparoscopic cholecystectomy set. Specifically, no curved instruments were required for oesophageal mobilisation and any need for a 30° laparoscope was avoided by high placement of the port for the laparoscope, achieving a more direct view of the hiatus.

Suturing with an extracorporeal knot tying technique has proved easy to learn and quick to perform. The use of a modified Weston knot *(14)* has enabled secure knotting of monofilament, non-absorbable sutures without the technical difficulties of intracorporeal knot tying. The median operating time of 81 min is good in this early experience, and theatre time has not been greatly prolonged compared with the equivalent open procedure. It is likely that this is related to an experienced surgeon being present for all operations, shortening the learning time for the other surgeons involved, and the availability of a training rig for practice using pig viscera.

While follow-up has not exceeded 10 months, the short-term clinical results are promising, with all patients free of reflux symptoms. Nevertheless, two patients did require further surgery. After the first reoperation we endeavoured to avoid the problem of slippage into the chest by performing a posterior crural repair on all patients irrespective of whether or not they had a hiatus hernia. This was feasible whenever it was attempted.

Even though these early results demonstrate a good symptomatic outcome, with acceptable operating time and early discharge, for laparoscopic fundoplication to be widely adopted it should be shown to be cost-effective, as well as beneficial to patients by reducing the morbidity of surgery *(25)*, with no reduction in efficacy. Longer times in the operating theatre should not cancel gains achieved by a shorter time on the ward. A recent editorial *(26)*, discussing the impact of laparoscopic surgery, has stated that 'new surgical procedures must be tested' and that 'only controlled studies can form the basis of any decision making'. The same author questions whether it is ethical to 'advise patients to have an operation that has not been formally tried and tested'. It is important not to lose sight of the fact that the success of surgery for gastro-oesophageal reflux is determined by the long-term relief of symptoms. Short-term gains achieved by shortening hospital stay and returning to work earlier must be achieved without compromising long-term success. To investigate these aspects further we have started a randomised trial of open *versus* laparoscopic Nissen fundoplication for gastro-oesophageal reflux disease. We believe that such evaluation is important before this procedure is routinely performed laparoscopically.

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