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Original Research Article

Laparoscopic Nissen fundoplication in the management of gastroesophageal reflux disease: a single centre experience

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ABSTRACT

Background: Laparoscopic Nissen fundoplication is currently the surgical treatment of choice for gastro-esophageal reflux disease (GERD) in properly selected patients.
Methods: Laparoscopic Nissen fundoplication was performed in 36 patients of GERD, Government Medical College over a period of 2 years. Pre-operative evaluation included baseline investigations and clinical assessment by using GERD Questionnaire and specific investigations i.e., barium esophagram, esophago-gastroduodenoscopy, esophageal manometry and 24 hour ambulatory pH monitoring of the esophagus. All patients underwent laparoscopic Nissen Fundoplication. Patients were evaluated at three months after surgery with symptom scoring questionnaire.
Results: Mean age of patients in our study was 38 years and most common symptoms were heartburn and regurgitation. Four patients (11%) developed complications. The conversion rate to laparotomy was 2.7% (1 patient). Average symptom scores decreased from 10/18 to 0/18 after fundoplication (<0.0001) and all the eight patients who underwent postoperative endoscopy had normal results.
Conclusions: Laparoscopic Nissen's fundoplication is a safe and effective procedure for GERD, having an acceptable hospital stay with consistently improved short term symptomatic and endoscopic results.

Keywords: Gastro-oesophageal reflux, Laparoscopy, Nissen fundoplication

INTRODUCTION

Gastroesophageal reflux disease (GERD) as defined by Montreal Consensus Conference is a condition that develops when there is reflux of stomach contents into the esophagus causing troublesome symptoms, complications or both.[1] It is now known to be a chronic disease requiring lifelong treatment in 25% to 50% of patients.[2]

The two sphincteric components of esophagogastric junction i.e., lower esophageal sphincter (LES) and crural diaphragm, act in concert and maintain a pressure gradient between intrathoracic esophagus and stomach by creating an intervening high pressure zone especially during straining and inspiration.[3,4] Transient lower esophageal sphincter relaxation (TLESR), a vago-vagally mediated motor pattern, in response to many stimuli especially gastric distention causes rapid relaxation of LES, esophageal shortening and inhibition of crural diaphragm and is a physiologic mechanism by which stomach vents gas.[5,6] The acid reflux during TLESRs, is higher in frequency, in patients of GERD, especially in patients with associated hiatus hernia, as compared with

healthy controls.[7] A hiatus hernia, which is associated with more severe GERD and its complications like severe erosive esophagitis and Barrett esophagus, hampers the capacity of EGJ to prevent reflux by separating the high pressure zones of LES and the crural diaphragm.[8-10]

Chief symptoms of GERD are heartburn and acid regurgitation. GERD can be accurately diagnosed by history of classical symptoms of heartburn and/or regurgitation and a positive response to antisecretory therapy.[1] Atypical symptoms of GERD, such as dysphagia, hoarseness, nocturnal cough, and gastric asthma, can also occur.[11] The complications include severe esophagitis, stricture, or Barrett's Esophagus at the initial endoscopy.[12,13]

The barium esophagram which is used for the assessment of esophageal emptying, presence and type of hiatal hernia, foreshortening of the esophagus motility, stricture or mucosal ring, presence, cause, height, and persistence of reflux.[14]

Esophagoscopy is indicated for detecting the presence of esophagitis and Barrett esophagus. Almost two thirds of patients with GERD have nonerosive disease and a normal endoscopy.[15]

Esophageal manometry is a widely used technique to examine the motor function of the esophagus and its sphincters. Esophageal reflux monitoring (24 hour ambulatory pH monitoring and impedance pH monitoring) is an important component in the armamentarium for the diagnosis of GERD. Extending the testing period to 96 hours also allows for a single test to be completed both on (2 days) and off (2 days) PPI.[16,17]

Laparoscopic antireflux surgery is indicated in patients with complications of GERD (esophagitis, stricture, recurrent aspiration, Barrett esophagus) which are unresponsive to medical therapy with associated GERD-related symptoms, continued symptoms despite maximal medical treatment, symptomatic paraesophageal hernia, patient desire to discontinue PPI therapy because of financial burden, lifestyle choice, young age, and intolerance or adverse events related to acid suppressive medications.[18]

The aim of our study was to see the effectiveness of Laparoscopic Fundoplication to relieve the symptoms of GERD and patient satisfaction.

METHODS

Study design: Prospective observational.

Study area: Department of Surgery, Govt. Medical College, Srinagar.

Study duration: The study was done over a period of two years between September 2013 and July 2015.

Study sample: The study was performed in thirty six patients.

Inclusion criteria

Inclusion criteria were patients not responding to medical therapy; patients with EGD documented grade 3 esophagitis or Barret esophagus; patients with extra-esophageal symptoms like reflux cough, reflux laryngitis, reflux asthma, reflux dental erosions; patients having hiatus hernia with associated GERD.

Exclusion criteria

Exclusion criteria were patients with esophageal motility disorder; patients with previous gastro-esophageal surgery.

All patients underwent proper preoperative evaluation and baseline investigations before being taken up for surgery. GERD questionnaire (Table 1) was used for diagnosis and symptom scoring. Score of ≥ 8 was taken as cut off for diagnosis of GERD and such patients underwent further work up.

Table 1: GERDQ self-assessment questionnaire.

Symptoms (in previous week)	Symptom presence			
Question	**0 days**	**1 day**	**2-3 days**	**4-7 days**
How often did you have a burning feeling behind your breastbone?	0	1	2	3
How often did you have stomach contents moving upwards to your throat or mouth?	0	1	2	3
How often did you have a pain in the center of the upper stomach?	3	2	1	0
How often did you have nausea?	3	2	1	0
How often did you have difficulty getting a good night's sleep because of your heartburn and/or regurgitation?	0	1	2	3
How often did you take additional medication for your heartburn and/or regurgitation other than what the physician told you to take (such as Maalox)?	0	1	2	3

Barium esophagram was used to study the gross anatomy, motility, presence/absence of stricture, hiatus hernia and demonstration of reflux.

Esophagogastroduodenoscopy (EGD) was performed in every patient preoperatively to detect the presence or absence of esophagitis and grade it (Table 2), esophageal sphincter appearance and Barret esophagus, Hiatus hernia, Any stricture, etc.

Table 2: Los Angeles classification of endoscopic grades of esophagitis.

Grade	Endoscopic description
A	One or more mucosal break <5 mm that does not extend between the tops of two mucosal folds
B	One or more mucosal break ≥5 mm that does not extend between the tops of two mucosal folds
C	One or more mucosal break that is continuous between the tops of two or more mucosal folds but that involves <75% of the circumference
D	One or more mucosal break that involves ≥75% of the esophageal circumference

Esophageal manometry was performed in each patient to rule out any motility disorder, assess the peristaltic integrity of esophageal body and measure pressure of lower esophageal sphincter at respiratory inversion point. Pressure ≤ 6mm Hg was taken as low and > 6 taken as normal. 24 hour ambulatory pH monitoring was performed using wireless pH probe, to document the acidic reflux and results were interpreted using DeMeester score (Table 3). The presence of either a DeMeester score > 14.7 or % acid exposure time > 4.2 or both were taken as objective evidence of GERD.

Table 3: DeMeester score is calculated using following parameters of 24 hour pH monitoring.

Parameter
The percent of total time pH less than 4
Percent upright time pH less than 4
Percent supine time pH less than 4
Number of reflux events
Number of reflux events longer than 5 minutes
The longest reflux event

Operative techniques

Patient positioning and equipment

The surgeon stands between the patient's abducted legs facing directly forward with operating table maintained in a steep head-up position. Video monitor was positioned at the head end of the table. Different laparoscopic instruments were used as per the need.

Abdominal access and port placement

Closed technique using Veress needle was used to access the peritoneal cavity. Total of five ports were used 10mm for laparoscope, 10mm for surgeon's right hand, 5 mm port for surgeon's left hand, another 5 mm port for liver retractor and 5mm port for assistant.

Initial dissection

The gastrohepatic omentum is divided, beginning just superior to the hepatic branch of the vagus nerve. The phrenoesophageal membrane is divided in a transverse direction, with care taken to divide only the most anterior portion to prevent injury to the underlying esophagus and anterior vagus nerve. The gastrophrenic ligament is divided to mobilize the gastric cardia.

A meticulous dissection is then undertaken around the esophageal hiatus. During the hiatal dissection, the assistant grasps the epiphrenic fat pad and retracts inferiorly to place tension on the distal esophagus and a blunt-tipped instrument is passed just medial to the right crus of the diaphragm to establish a plane between the esophagus and the right crus. The surgeon's left-hand instrument pushes the crus to the patient's right while the right-hand instrument gradually and gently sweeps the esophagus and periesophageal tissue to the left to bluntly mobilize the distal esophagus. The posterior vagus nerve is swept along with the esophagus to the left. This mobilization continues in an orad direction and once the right side of the esophagus has been mobilized, the surgeon's right-hand instrument sweeps anterior to the esophagus and elevates the anterior crural arch while gently pushing the esophagus posteriorly with the blunt side of the left-hand instrument. The posterior-medial aspect of the left crus is visualized, and all of the periesophageal tissue is swept posteriorly to develop the plane to the left of the esophagus. The initial dissection of the mediastinum is therefore completed, freeing the esophagus from the pleura, aorta, and lateral crural attachments. The anterior and posterior vagus nerves are clearly identified and maintained alongside the esophagus to avoid injury.

The gastric fundus is then mobilized. All structures tethering the fundus, including the short gastric vessels, posterior gastric vessels, and gastrosplenic and gastropancreatic ligaments, are divided up to the angle of His.

After complete fundic mobilization, the medial border of the left crus of the diaphragm is dissected back to its junction with the right crus, joining the plane previously begun from the right side. A large window is thereby created posterior to the esophagus and proximal stomach and anterior to both crura. We use the gastroesophageal fat pad or fundus for inferior traction. A grasper is placed through the retroesophageal window from right to left, which grasps the apex of the fundus and pulls it back through the window to the right side of the esophagus. To test for twist or entrapment of the wrapped fundus in the posterior window, the "shoeshine" maneuver is

performed. Before closing the crura and constructing the fundoplication, 3 cm intraabdominal length of esophagus is ensured.

Crural closure

The crura are closed by interrupted sutures (2-0), beginning posteriorly near the crural junction and then proceeding anteriorly toward the esophagus, until they lightly touch the empty esophagus.

Fundoplication

We serially pass 50F and 60F esophageal bougies and suture the fundoplication with a 50F to 60F bougie in place. The two sides of the fundus are then abutted around the distal esophagus to ascertain whether a tension-free wrap may be achieved. The lateral edge of the fundus to the left of the esophagus is then sutured to the leading edge of the wrapped fundus to the right of the esophagus. Three 2-0 gauge interrupted, silk, sutures are used, taking deep seromuscular suture bites in the fundus from the left to the right of the esophagus such that the suture line is placed to the right of the anterior midline of the esophageal wall.

At least two of these sutures incorporate anterior muscularis of the esophagus to the right of the anterior vagus nerve. The first suture opposes fundus to fundus, without incorporating the esophageal wall. After this first suture is tied, the location and orientation of the wrap are checked and the fundoplication may be slid up or down the esophagus and positioned just proximal to the gastroesophageal junction. The sutures are tied, the bougie is then removed, and the wrap is checked for degree of laxity by passing a 5-mm diameter instrument between the left side of the wrap and the esophagus. The length of the fundoplication is ensured to be ≤ 2 cm and that it is situated around the esophagus rather than inferiorly on the proximal stomach. After ensuring complete haemostasis, trocars are removed pneumoperitoneum deflated, and port sites are closed back.

The patient was allowed sips of water 12 hours after the operation, clear liquids the following morning, and then a soft diet for lunch the same day in the afternoon. If the meal was tolerated, the patient was discharged the next morning and advised to be on soft diet for the first 2 to 4 weeks. The follow up was done after two weeks of surgery and symptom scoring using GERD questionnaire was performed and any complaints and complications were noted and treated.

All patients were seen again at three months and were asked for overall satisfaction (Table 4) after surgery, and selected patients underwent EGD at this time.

Table 4: Grading of overall patient satisfaction.

Grade	Description
Excellent	Completely recovered, no side effects, no residual symptoms.
Good	Major improvement with minor tolerable side effects (mild difficulty in belching, mild temporary dysphagia)
Fair	Major improvement, but still some significant symptoms(mild heartburn) or side effects (significant but improving dysphagia or gas bloat syndrome or flatulence)
Poor	Minor or no improvement or even worsening (persistent reflux or regurgitation, new onset new dysphagia which doesn't improve or persistent gas bloat syndrome)

RESULTS

The median age of patients in our study was 38 years (range 24-56). Most patients were from the age group of 31-40 yrs. Overall 18 patients were male and 18 were female. Most common symptoms were heartburn and regurgitation which were present in every patient. Dysphagia was present in 5 patients, which was grade 1 in 4 patients and grade 2 in 1 patient. While all patients had typical symptoms, extraesophageal symptoms were present in 4 patients (cough in 2 patients and dental erosions in 2). Score of ≥8 was taken as cut off for the diagnosis of GERD and all the patients in the study had scores ≥8. Score range was 8-16 and most patients had scores ≥ 8 and ≤ 12 (83.3%). Median symptom score was 10 and mean was 10.7.

Barium studies of patients showed all patients have a normal gross esophageal anatomy and none had any motility disorder. Hiatus hernia was documented in 7 patients, all of whom had sliding (type 1) hernia ≤ 3 cm in length (Table 5).

Table 5: Results of Barium study.

Barium Esophagram	Present (No.)	Absent (No.)	Total no. of patients
Normal Gross anatomy	36	0	36
Motility disorder	0	36	36
Stricture	0	36	36
Reflux	6	30	36
Hiatus hernia	7	29	36

Esophagitis was demonstrated in 13 patients which was grade-1 in 2 patients, grade-2 in 8 patients and grade-3 in rest 3 patients (Table 6). Manometry of patients showed normal peristaltic integrity in all the patients and no

evidence of any motility disorder in any patient, however low LES pressure defined as pressure ≤6mm Hg at respiratory inversion point, was present in 20 patients (55.5%) (Table 7).

Table 6: Results of EGD (n=36).

	Present	Absent
Esophagitis	13	23
Stricture	0	36
Hiatus Hernia	7	29
Lax LES	7	29

Table 7: Manometric findings (n=36).

Parameter	Yes (In No.s)	No (In No.s)
Normal peristaltic Integrity	36	0
Motility Disorder	0	36
LES Pressure ≤6 mm Hg	20	16

All patients had abnormal results on 24 hour ambulatory pH metry. Acid reflux was documented in each patient. A DeMeester score ≥ 14.7 was seen in 31 patients (86.11%) and % Acid exposure >4.2 was seen in 35 patients (97%). All patients having DeMeester score < 14.7 and had % Acid exposure >4.2.

Only one patient had intraoperative complication. During dissection of left crus of diaphragm there was breach in the left pleura and patient developed pneumothorax and procedure was converted to open .A chest tube was placed, patient stayed in the hospital for ten days, however, he recovered completely.

Most patients were discharged early from hospital in satisfactory condition. Mean hospital stay was 3 days. Most patients (28; 77.7%) were discharged on second or third postoperative day.

Postoperative complications were reported by 4 out of 36 (11.11%) patients. One patient complained of diarrhea and flatulence in first week which significantly decreased in intensity and frequency over following weeks. Both dysphagia and gas bloat syndrome were reported by 2 patients in immediate postoperative period. One patients dysphagia completely subsided by the end of 3 months while other patients dysphagia had significantly improved by 3 months. Gas bloat syndrome in both patients had reduced from moderate to mild by the end of 3 postoperative months and was no more bothersome. Postoperative symptom score in majority (78%) of patients was either 0 or 1.

At 3 months, EGD was performed in 4 patients who developed postoperative complications, one of whom had preoperatively diagnosed esophagitis, and also in 12 other patients who also had preoperatively diagnosed esophagitis as mentioned above. All other patients had a normal study and esophagitis had healed in ones with preoperative evidence of same.

On the same follow up at three months, 24 hour ambulatory pH monitoring was performed in 26 out of 36 patients, who agreed to undergo the test, including all the 13 patients who had preoperatively diagnosed esophagitis and all 4 patients who developed postoperative complications. pH metry results showed DeMeester score <14.7 and % acid exposure time < 4.2 in every patient tested and hence were normal in all these patients as compared to preoperative results.

Patient satisfaction was assessed using grading scale as shown in Table 4 (materials and methods section). All patients were satisfied with the results of surgery. 83% graded their satisfaction as "excellent" (highest grade) and remaining 17% graded it as "good" (2nd highest grade).

DISCUSSION

GERD is one of commonest upper gastrointestinal disorders which accounts for most outpatient visits to hospitals all over the world. Antisecretory therapy based on PPIs being only few decades old has raised questions about their long term safety as sides effects like calcium malabsorption, osteoporosis, risk of pneumonia and clostridium difficile infection and interstitial nephritis have been reported. Currently Laparoscopic Nissen fundoplication is the gold standard of surgical management of GERD and its role is well established.

Reports of the association between GERD symptoms and gender have yielded conflicting results, with some suggesting the prevalence is greater in men, some suggesting it is greater in women and others reporting no difference by gender.[19-25] In our study we observed 1:1 male female ratio in the 36 patients selected for surgery. The median age of patients was 38 years (range 24-56). Gotley, Smithers, Rhodes, et al, in their study of Laparoscopic Nissen fundoplication in 200 consecutive cases, reported the median age of patients to be 49 years (range 4-77 yrs.). [26]

Most common symptoms seen in the patients were typical GERD symptoms (heartburn and regurgitation) which were present in every patient. Dysphagia was present in 5 patients. While all patients had typical symptoms, extraesophageal symptoms were present in 4 patients (11%). GERDQ, score of ≥8 was taken as cut off for the diagnosis of GERD and patients in the study had scores ≥8. Gotley, Smithers, Rhodes, et al observed similar results regarding the preoperative symptoms of GERD although they used a different score but it was based similarly on typical symptoms of GERD.[26] Typical symptoms are a more reliable and precise guide to the presence of disease, and consequently their improvement

better reflects the effectiveness of therapy, hence we decided to choose GERDQ for clinical symptom scoring.[27]

In our series of patients, all had a normal gross esophageal anatomy and none had any motility disorder on Barium esophagram. Stricture wasn't noted in any patient, although reflux was demonstrated in 6 patients (16%) and hiatus hernia was documented in 7 patients (19.4%), all of whom had sliding (type 1) hernia. Similar results in barium esophagraphy were reported by Peters, DeMeester, Crookes, et al in their study on laparoscopic Nissen fundoplication in treatment of 100 patients with typical symptoms.[27] However they noticed a high, approx. 80% incidence of hiatus hernia in their patients but percentage of patients having hernias ≤3 cm were same as observed in our series of patients.

All our patients underwent EGD. Esophagitis was demonstrated in 13 (36%) patients. Hiatus hernia was noticed in the same 7 patients who also had barium esophagraphic evidence of the same. Gotley, Smithers, Rhodes, et al found grade 2-3 esophagitis in 56% patients in their series of 200 patients preoperatively.[26]

Manometry was performed using conventional stationary manometry. All of our patients had normal peristaltic integrity and no evidence of any motility disorder, however low LES pressure defined as pressure ≤6 mm Hg at respiratory inversion point, was present in 20 patients (55.5%) which correlates with the results seen by Peters, DeMeester, Crookes, et al in their study.[27]

Next 24 hour ambulatory pH monitoring, using wireless pH probe was performed in all our patients. All patients had abnormal results on 24 hour ambulatory pH metry which was defined as DeMeester score ≥ 14.7 or % Acid exposure time >4.2 or both. Acid reflux was documented in each patient. DeMeester score ≥ 14.7 was seen in 31 patients (86.11%) and % Acid exposure >4.2 was seen in 35 patients (97%).

Our operative technique was standard and incorporated the standardized approach laid down by DeMeester and his group which includes preservation of hepatic branch of anterior vagus nerve, division of short gastric vessels, adequate mobilization of fundus to allow construction of tension free wrap, posterior crural closure in all cases and limiting the length of wrap to ≤2 cm.[28] However we included posterior vagus nerve in the fundoplication rather than excluding it, as is done in the open procedure; extending the scope of the dissection posterior to the gastroesophageal junction and the degree of fundic mobilization; and paying attention to the geometry of the fundoplication such that the anterior and posterior fundic lips were folded around the esophagus to meet at the 9 O'clock position.[27]

Only one of our patients (2.77%) had intraoperative complication. Due to inadvertent injury to left lung pleura, patient developed pneumothorax and procedure was converted to open and chest tube was also placed in left pleural cavity at the end of procedure. Gotley, Smithers, Rhodes, et al in their series encountered pneumothorax in two patients (1%) and esophageal perforation during bougie insertion in one patient (0.5%) intraoperatively.[26]

In our study mean hospital stay was 3 days (range 2-10 days). Majority of patients (77.7%) were discharged on second or third postoperative day. Both Gotley and his group and Peters, DeMeester, Crookes, et al reported similar data regarding the hospital stay in their patients.[26,27]

Postoperative complications like wrap migration, bolus obstruction, respiratory failure, recurrent reflux, dysphagia, pneumonia, ulnar nerve paresis, mediastinitis, and pulmonary embolism were observed by Gotley and his group in 12% of their patients. In our series postoperative complications were reported by 4 out of 36 (11.11%) patients.[26] Although postoperative complications occurred in few patients but they significantly improved with time and no patient needed a revision surgery for the complications. Most common complication in our patients was dysphagia and even in our short follow up it improved significantly.

We followed the patients for the first time at two weeks and assessed improvement in symptoms using the same symptom score which was used preoperatively. Postoperative symptom score in majority (78%) of patients was either 0 or 1. Range of postoperative scores was 0 to 3. Resolution of GERD symptoms was seen in all patients. Ninety- six percent patient's symptoms were relieved after laparoscopic Nissen fundoplication as reported by Peters, DeMeester, Crookes, et al and median symptom scores fell to zero in their series of 200 patients, after operation as reported by Gotley, Smithers, Rhodes et al.[26,27]

At 3 months, patients were again called for follow up and EGD was performed in selected patients as discussed in result section. All patients had a normal study and esophagitis had healed in ones with preoperative evidence of same. On the same follow up at three months, we performed 24 hour ambulatory pH monitoring in 26 out of 36 patients, who agreed to undergo the test. pH metry results showed DeMeester score <14.7 and % acid exposure time < 4.2 in every patient tested and hence were normal in all these patients as compared to preoperative results. Similar postoperative results were reported by Peters, DeMeester, and Crookes, et al.[27]

On the same follow up all patients were satisfied with the results of surgery. 83% graded their satisfaction as "excellent" (highest grade) and remaining 17% graded it as "good" (2nd highest grade) whereas none had any residual symptoms or significant side effects of operation. Similar satisfaction rates were reported by Peters,

DeMeester, Crookes, et al and Gotley, Smithers, Rhodes et al in their patients.[26,27]

CONCLUSION

Laparoscopic Nissen fundoplication is a safe and effective treatment for GERD. It has low rate of complications, acceptable hospital stay and curative potential, and achieves a high level patient satisfaction as demonstrated by our study. However, because of small number of patients, the study needs to be carried out further for definitive recommendations.

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