

Laparoscopic Anterior Partial Fundoplication is Comparable With Nissen Fundoplication for Gastroesophageal Reflux Disease

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Background: Laparoscopic Nissen fundoplication (LNF) has been the gold standard for gastroesophageal reflux disease (GERD), but the side effects of dysphagia and bloating have lead to interest in partial fundoplication as an alternative.

Aim: To compare the symptomatic and objective parameters after LNF and laparoscopic anterior partial fundoplication (LAPF) in patients with GERD.

Patients and Methods: The study was conducted in the Division of Minimal Access Surgery, Maulana Azad Medical College from June 2008 to October 2016. Patients with GERD with high score on 24-hour pH monitoring were selected for surgery (LAPF) and were compared with our historical control of 25 patients who underwent LNF. The preoperative and postoperative symptom score and objective parameters were analyzed.

Results: Of 50 GERD patients, 20 patients underwent surgery (LAPF) and these were compared with 25 patients who underwent LNF. Demester score, modified Visick grade decreased from 4.12, 3.23 in LNF; 4.35, 3.35 in LAPF to 0, 1 in both groups. There was significant and similar increase in lower esophageal sphincter (LES) length, intra-abdominal LES length, LES pressure. The 24-h pH decreased from 10.18% and 8.08% to 0.85% and 1.09% in LNF and LAPF, respectively. At 1 year and 5 years of follow-up, symptom scores, manometric analysis, and pH metry evaluation remained to be improved in both the groups.

Conclusions: LAPF is as effective as LNF for GERD, with less dysphagia.

Key Words: laparoscopic anterior partial fundoplication, gastroesophageal reflux disease, Nissens fundoplication

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The incidence of gastroesophageal reflux disease (GERD) is steadily on the rise. Medical management of GERD is prolonged, requires more compliance and has higher cost and failure rate,¹ especially in patients with severe reflux.² Surgery is shown to be beneficial to medical treatment in

long-term control of symptoms, prevention as well as regression of Barrett metaplasia and subsequently, prevention of high-grade dysplasia and adenocarcinoma.^{3–5}

Open Nissen fundoplication has been the gold standard, but laparoscopic Nissen fundoplication (LNF) has shown lower morbidity, shorter stay, and better patient satisfaction.^{6,7} New symptoms like gas bloat, dysphagia, and inability to belch, have been reported after LNF, which probably result from hypercompetent lower esophageal sphincter (LES).^{8,9} Partial fundoplication has the potential to produce a more physiological gastroesophageal junction with fewer side effects.^{10–13} Posterior (Toupet) fundoplication is a well-accepted procedure with significant improvement in symptomatic and objective parameters,^{14–16} but there are not many studies evaluating the objective parameters and postoperative outcomes of laparoscopic anterior partial fundoplication (LAPF).¹⁷ The present study is a prospective study comparing the preoperative and postoperative parameters after LNF and LAPF in patients with GERD.

PATIENTS AND METHODS

The study was conducted in the Division of Minimal Access Surgery, Maulana Azad Medical College, New Delhi between June 2008 to October 2016, after taking approval from Institutional Review Board. A total of 50 patients, having heartburn and reflux, with esophagitis on endoscopy and already received at least 8 weeks of acid suppression therapy were included in the study. Patients with comorbidities, morbid obesity, gallstones, shortened esophagus, or aperistaltic esophageal segment were not included. All the patients were scored according to severity of heartburn and reflux using Demester score (DS) and modified Visick grade (MVG). Esophagoduodenoscopy and biopsy was performed to classify patients according to Savary-Miller grading. Esophageal manometry was done in all the patients in endoscopy laboratory on MK2 Gastrointestinal motility apparatus using Griffon Manometry program. The length of LES, length of intra-abdominal part of LES, LES pressure, and esophageal motility were recorded. All patients underwent 24-hour pH monitoring using Gastrograph Mark IV pH meter and analyzed using Winreflux program. The percentage of total time that the pH was <4 was calculated, if that time was >4% it was taken as positive pH monitoring.

A total of 20 patients were positive on pH monitoring and were selected for surgery. Barium swallow was done in these patients to rule out short esophagus or motility disorder. Investigations for anesthesia fitness were done. These

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The authors declare no conflicts of interest.

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patients underwent LAPF (group A) and were compared with our previously operated 25 LNF patients (group B).

Informed Consent

Consent was obtained from all the patients for surgery and use of their medical information for research purposes, without revealing any specific information of the patient.

Operative Techniques

All patients were operated under general anesthesia, supine position with reverse Trendelenburg, legs abducted, and surgeon standing in between legs. Nasogastric tube (16 fg) was placed. The camera port (10 mm) was inserted via open technique at the umbilicus or 2 cm cranial and to left of it according to the patient's body habitus. Right (5 mm) and left (12 mm) midclavicular ports as working ports for surgeon, subxiphoid (5 mm), and left anterior axillary (5 mm) ports for retraction of liver and stomach, respectively, were inserted (Fig. 1). Dissection was started from the gastrohepatic omentum, saving the hepatic branch of vagus nerve in all cases as a matter of principle. The dissection was started on the right crus and then extended to the left side with clear definition of both crurae. Circumferential mobilization of esophagus was done by dissecting the phrenogastric and phrenoesophageal attachments off the crura. Posterior vagus was identified and taken along with the esophagus while retracting with a flat penrose or a corrugated drain. Hiatus was repaired with 2 or 3 interrupted 1-0 silk sutures using intracorporeal knotting technique (Fig. 2). Division of short gastric vessels was not required in any case.

In patients undergoing LAPF, first suture was taken between anterior aspect of fundus and left crus to accentuate the angle of His. The fundus was brought on anterior aspect of LES and was sutured to the left crus, anterior part of hiatal opening, esophagus, and right crus using 6 to 9 sutures, thus completing 180-degree anterior wrap (Figs. 3, 4).

In patients undergoing LNF, the fundus of stomach was brought from behind the esophagus and sutured to the fundus anterior to gastroesophageal junction without twisting, with 2 or 3 interrupted 2-0 silk sutures creating a tension-free floppy of 2 to 3 cm wrap. The lowest suture while making the wrap included the anterior wall of the esophagus in the bite. The wrap was fixed to the crurae in all patients with a single 2-0 silk suture. Short gastric vessels were divided in a few patients undergoing LNF if tension

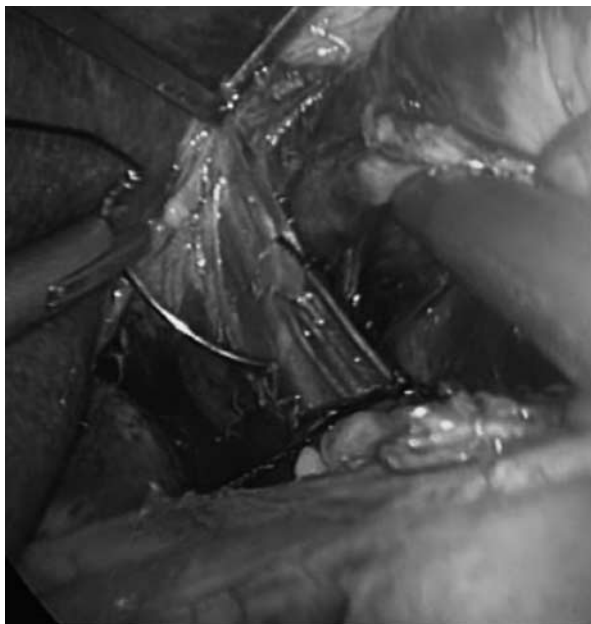


FIGURE 2. Hiatal repair after dissecting crura.

was seen making the wrap. No esophageal dilator was used while making the wrap.

A 24 fg drain was kept in all cases as a protocol.

Postoperative Period

Nasogastric tube was taken out on the 1st postoperative day. Drain was removed at 48 hours and patients were discharged on the 3rd day. They were given liquids on 1st day, semisolids of very low consistency from day 2 to day 7 and were gradually brought to normal diet over 3 to 4 weeks. Symptomatic evaluation was done using DS and MVG at 1, 3, and 6 weeks and objective parameters were evaluated using manometry and 24-hour pH monitoring at 6 weeks after surgery. All patients were evaluated for recovery time, patient acceptability, and complication if any. At a follow-up of 1 and 5 years, symptom scores and objective parameters were analyzed on outpatient basis.

Statistical Analysis

Mean values of preoperative and postoperative DS, MVG, LES length, intra-abdominal LES length, LES pressure, percentage time pH < 4 were calculated and compared between groups A and B. The preoperative and postoperative mean values for all the parameters were compared separately in each group using Wilcoxon signed rank test (nonparametric). The postoperative values of group A were compared with those of group B.

RESULTS

Preoperative Parameters

Groups A and B were comparable in terms of age and mean duration of preoperative medical management with proton pump inhibitors; however, there was a difference in sex distribution (Table 1). Both groups had similar symptoms as the preoperative DS and MVG showed no statistical difference. Endoscopy in both groups showed grades



FIGURE 1. Port position.



FIGURE 3. Suturing fundus anteriorly.

2 or 3 esophagitis, whereas the biopsy revealed mild to severe esophagitis. Barium swallow was comparable and no patient had shortened esophagus or aperistaltic segment. Manometry revealed shortened length of LES, intra-abdominal LES, and low LES pressure at respiratory inversion point in all the patients in groups A and B. The percentage of time the pH was <4, was quite high as seen in 24-hour pH monitoring. All these objective parameters were not statistically different.

Intraoperative Details

All the patients were operated by the first author. The mean duration of surgery was 99 minutes in LNF and 108 minutes in LAPF which was not statistically different



FIGURE 4. Completed 180-degree wrap.

TABLE 1. Comparison of Preoperative Parameters in Groups A and B

	LAPF (Group A)	LNF (Group B)	P
No. patients	20	25	
Age (y)	27.5 (22-58)	37.38 (20-50)	> 0.1
Sex (female/male)	6/14	12/13	> 0.1
Duration of medical treatment (wk)	21 (8-48)	21.17 (8-48)	> 0.1
DS	4.35	4.12	> 0.1
MVG	3.35	3.23	> 0.1
Endoscopy (Savary-Miller grade)	Grade 2/3	Grade 2/3	
Biopsy	Mild to severe esophagitis	Mild to severe esophagitis	
Reflux on imaging [n (%)]	11 (55)	17 (68)	> 0.1

DS indicates Demester score; LAPF, Laparoscopic Anterior Partial Fundoplication; LNF, Laparoscopic Nissen Fundoplication; MVG, modified Visick grade.

(Table 2). Hepatic branches of vagus were preserved in both groups. Hiatal repair was done with 2 to 3 sutures. Division of short gastric vessels was done in 2 patients in LNF group. The floppy wrap in LNF required 2-4 sutures, whereas LAPF required 6 to 9 sutures to fix the fundus over anterior 180 degrees. Two patients in LNF had pneumothorax and were managed successfully with chest tube.

Postoperative Period

Both groups were similar in terms of postoperative pain, drain output (LNF, 12 mL; LAPF, 20 mL), time of starting of liquids orally (postoperative day 1), semisolids (postoperative day 2), and time of discharge (day 3). There was no complication in the early postoperative period.

Follow-up

Symptomatic scoring was done at 1, 3, and 6 weeks in outpatient department and DS and MVG were documented. All patients in LNF and LAPF had DS = 0 and MVG = 1 at 1, 3, and 6 weeks. There was statistically significant improvement in symptoms in both groups after surgery which was comparable as evaluated by comparing the preoperative and postoperative values (Table 3). Objective parameters were evaluated at 6 weeks by doing

TABLE 2. Comparison of Intraoperative Parameters in Groups A and B

	LAPF (Group A)	LNF (Group B)
Duration (min)	108 (90-125)	99 (80-140)
Hiatal repair		
Using 2 sutures	15	15
Using 3 sutures	5	10
Division of short gastric vessels	0	2
No. sutures for wrap	6-9	2-4
Blood loss (mL)	20 (10-30)	11.5 (10-20)

LAPF indicates laparoscopic anterior partial fundoplication; LNF, laparoscopic Nissen fundoplication.

TABLE 3. Comparison of Preoperative and Postoperative Parameters in Groups A and B

Parameters	Group A/B	Preop	Postop	P (Preop vs. Postop)	P (Group A vs. B)
DS	A	4.35	0	< 0.001	> 0.1
	B	4.12	0	< 0.001	
MVG	A	3.35	1	< 0.001	> 0.1
	B	3.23	1	< 0.001	
LES length (cm)	A	1.7 (1.75-2.5)	3.65 (3-4)	< 0.001	> 0.1
	B	2.08 (1-2.5)	3.36 (2.5-4)	< 0.001	
Intra-abdominal length (cm)	A	1.0 (0.75-1.5)	2.05 (2-3)	< 0.001	> 0.1
	B	0.85 (0.5-1.5)	2.13 (2-3)	< 0.001	
LES pressure (cm of water)	A	6.75 (5-9)	27.6 (18-30)	< 0.001	> 0.1
	B	7.82 (4-10)	22 (16-32)	< 0.001	
Esophageal dysmotility	A	5	5	< 0.001	> 0.1
	B	9	9	< 0.001	
% time pH < 4	A	8.08	1.09	< 0.001	> 0.1
	B	10.18	0.85	< 0.001	
Acceptability of surgery (%)	A		90		> 0.1
	B		88		
QOL (VAS)	A	2.95	7.35		> 0.1
	B	2.53	7.52		
Complications	A		1-epigastric burning 5-dysphagia		
	B		1-epigastric fullness		

DS indicates Demester score; LES, lower esophageal sphincter; MVG, modified Visick grade; Preop, preoperative; Postop, postoperative; QOL, quality of life; VAS, visual analog scale.

manometry and 24-hour pH monitoring. The mean length of LES, intra-abdominal part of LES, and LES pressure showed an increase of 1.95, 1.05, 20.85 cm of water in LAPF and 1.28, 1.28, 14.18 cm of water in LNF respectively (as above). The mean preoperative and postoperative values were compared in each group separately using Wilcoxon signed rank test and were found to be very highly significant ($P < 0.001$). The difference between the preoperative and postoperative values in groups A and group B, was compared using unpaired t test and were not significant. A 24-hour pH monitoring after 6 weeks of surgery showed a mean of 1.09% in LAPF and 0.85% in LNF which were very highly statistically different from their respective preoperative values. However, the difference between the improvement seen in groups A and B (comparing preoperative and postoperative value using unpaired t test) was not statistically significant. Time of recovery and return to work was 10.5 days in group A and 12.6 days in group B which was similar. In group A, 1 patient had heartburn 16 weeks after surgery which improved with medications. Endoscopy, manometry, and pH monitoring were done which showed normal results. In total, 5 of 25 patients in group B had dysphagia to solids. A total of 3 patients were relieved after 3 weeks of liquid and very low consistency semisolid diet, whereas other 2 required 4 weeks. One patient had epigastric fullness and was successfully managed with Mozapride. All patients were followed after 1 year and 5 years of surgery on phone and hospital visits. They were found to remain symptom free as per DS and MVG in both the groups. Manometry and pH metry could be done in 16 group A patients and 20 group B patients, which confirmed persistence of objective improvement in both the groups. Quality of life index (using visual analog scale) improved in both the groups. The acceptability of surgery was 18/20 (90%) in group A and 22/25 (88%) in group B which was not different.

DISCUSSION

The Dor (anterior 180 degrees) repair remains widely used as the most common antireflux adjunct after Heller myotomy for achalasia or distal diverticula.¹⁸ Its use in GERD was started to overcome dysphagia seen in LNF.¹⁸ The other variants of anterior partial fundoplication, Thal fundoplication (anterior 270 degrees), Watson 120 degrees, and Watson 90-degree anterior wrap are described with encouraging results.^{12,13}

In the present study, the age distribution was similar in groups A and B but lower than in other studies, which may be due to younger age group presenting more and changing lifestyle of new generation in our country.^{19,20} The duration of medical treatment before surgery, Savary-Miller grading on endoscopy was comparable within the groups and with most of other studies; however, more of our patients had severe esophagitis on biopsy, which may be due to late presentation of patients in our country.^{19,21,22} Barium swallow was done to diagnose short esophagus, incident peptic esophageal stricture, hiatal hernia, and aperistaltic segment. It showed reflux in 55% in group A and 68% in group B, and no other disorder in any group, which was comparable. However, these findings have not been well documented in other studies.

Although performing LNF, short gastric vessels were preserved in most of the cases, hiatal repair was done using 2 to 3 sutures and a floppy 360-degree fundal wrap was made in a way similar to other studies. The hepatic branch of anterior vagus and posterior vagus were identified and preserved in both LNF and LAPF. In LAPF hiatal repair was followed by reconstruction of angle of His and suturing the fundus to anterior 180 degrees was done which was similar to most of the other studies.²³ Short gastric vessels were preserved in all cases in LAPF. The duration of surgery was a bit more in LAPF as it requires more number of intracorporeal sutures. Two patients

had pneumothorax in LNF. There was no intraoperative complication in LAPF. No case was converted to open in any of the groups.

The protocol followed in the postoperative period was same as that seen in other studies. There was no complication seen in the early postoperative period. The recovery time of 10 to 12 days and gradually building to normal diet over 3 to 4 weeks was observed in other studies also.²¹

The DS and MVG reduced significantly and similarly after both LNF and LAPF, but on comparison with other studies our results in LAPF seem to be better, which may be due to small sample size and short follow-up.^{12,24–27} A long-term follow-up is thus required. The preoperative LES length, intra-abdominal part of LES, and LES pressure were low in all our patients considered for surgery. These manometric findings help to understand the pathophysiology of GERD and the basis of various types of funduplications as the management of GERD. The postoperative increase seen in these parameters prevents reflux and corroborates well with symptomatic improvement. The increase was similar in groups A and B, and comparable with that in the studies which have mentioned manometric findings.^{19,21,28,29} The 24-hour pH monitoring helps to identify patients who will be benefited from surgery and patients having pH < 4 for >4% of time in 24 hours, were considered for operative treatment. The preoperative and postoperative values showed significant reduction after both LNF and LAPF which was comparable with the best results in the studies in literature.^{21,29–31} The good results in our study may be due to the meticulous technique, great care taken, and surgeon's experience in intracorporeal knotting.

The rate of dysphagia in group B, that is, 20% (5/25) and epigastric fullness, that is, 4% (1/25) is similar to that seen in other studies.^{25–27} These complications were not observed in any of the patients in group A. In other studies, the incidence of epigastric fullness, gas bloat, and dysphagia is seen to be less in LAPF as compared with LNF which can be explained by significantly higher intragastric pressure in LNF, as seen on manometry in follow-up period.^{10,11,13,32,33} In group B, 1 patient showed epigastric burning at 16 weeks which matches with the data from other studies.^{34,35} As in others, the improvement in quality of life and acceptability of surgery was observed in both the groups in our study.^{10,24,36–38} According to other studies, patient satisfaction, gastrointestinal quality of life index, symptomatic improvement as well as operative time, postoperative objective parameters like LES pressure, acid exposure, and endoscopic findings are similar in LNF and LAPF.^{39–42} Persistence of low symptom scores and better objective parameters in group A point toward the efficacy of LAPF. However, a larger group of study with long-term follow-up is required to establish these results as the increased incidence of recurrence after LAPF is the main concern.^{11,33,43}

CONCLUSIONS

LAPF is as effective as LNF for GERD as shown by symptom scoring system and objective characteristics of LES and pH, evaluated by manometry and 24-hour pH monitoring. Dysphagia, which is frequently seen after LNF, is not seen after LAPF but the latter is a more demanding procedure with higher chance of recurrence.

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