Laparoscopic Heller Cardiomyotomy with Dor Fundoplication versus Nissen Fundoplication in the Management of Type II Achalasia: A Prospective Randomized Study

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Background: Surgery is considered the treatment of choice for esophageal achalasia as it achieves better and longer-lasting symptomatic relief. Laparoscopic Heller cardiomyotomy is the standard procedure with partial or complete fundoplication as an anti-reflux measure.

Aim of the work: To compare results between Dor and Nissen fundoplication after laparoscopic Heller cardiomyotomy in type II achalasia regarding postoperative GERD and dysphagia.

Patients and methods: This prospective randomized study was conducted on (40) patients who presented to the outpatient clinics suffering from chronic dysphagia from May 2017 to May 2019 with minimal follow for 12 months. Group A (20) patients underwent laparoscopic Heller cardiomayotomy with Dor fundoplication and group B (20) patients underwent laparoscopic Heller cardiomayotomy with Nissen fundoplication.

Results: Regarding dysphagia and gastroesophageal reflux no significant differences were noted postoperatively between Dor fundoplication and Nissen fundoplication with Heller cardio-myotomy. At the end of follow-up, dysphagia occurred in 10% and 20% of patients belonging to the Dor and Nissen groups respectively (p=0.517), while reflux occurred in 10 % of patients with Dor fundoplication, with no cases of reflux after the Nissen fundoplication (p=0.163).

Conclusion: Dor and Nissen fundoplication after heller cardiomyotomy showed good control of postoperative reflux with non-significant dysphagia if done properly. The choice of associated anti-reflux procedure is up to the surgeon's preference and experience.

Key words: Achalasia, dysphagia, fundoplication, Heller myotomy, Nissen-Dor comparison.

Introduction

Achalasia is a rare traditionally reported incidence of 1 per 100,000 individuals.[1] However, the latest data have shown an incidence at least two to three times greater than previous studies.[2] The incidence increases with age and has an equal distribution across gender and race.[1,3,4]

Achalasia is a primary esophageal motor disorder of unknown etiology characterized manometrically by insufficient relaxation of the lower esophageal sphincter (LES) and loss of esophageal peristalsis, radiographically by abnomal peristalsis, esophageal dilation, with minimal LES opening, "bird-beak" appearance, poor emptying of barium, and endoscopically by dilated esophagus with retained saliva, liquid, and undigested food particles in the absence of mucosal structuring or tumor.[5]

With esophageal high-resolution manometry (HRM), achalasia spectrum disorders have been categorized into clinically relevant subtypes based on esophageal body motor patterns.[3,6,7]

According to the Chicago Classification of patterns of esophageal pressurization on HRM, achalasia is subtyped into the following: Type I (classic achalasia), Type II (pan-esophageal pressurization), Type III (spastic achalasia).[3] In particular, type II (pan esophageal compartmentalization of intra bolus pressure ≥30 mmHg in ≥20 % test swallows) is associated with a significantly better treatment response compared to type I or III, while type III (preserved but premature esophageal body peristalsis in ≥20 % test swallows) is associated with worse outcomes and can be the most challenging to manage.[6]

Since a floppy total fundoplication effective in cases of weak esophageal peristalsis,[8] some authors initially tried to apply total fundoplication after laparoscopic Heller cardiomyotomy (LHM).[9,10] However, because of the lack of peristalsis in achalasia patients, others argued that a 360 fundoplication would increase the outflow resistance, impeding esophageal emptying and causing persistent or recurrent dysphagia,[11,12] and pointed out that a partial fundoplication compares favorably with a total fundoplication for GERD control while causing less postoperative dysphagia.[13]

GERD is an important outcome parameter to

consider after myotomy as the incidence of GERD symptoms and objective measurements of acid exposure by 24-h pH monitoring are higher without fundoplication.[14,15,16]

Patients and methods

Forty patients were enrolled in a prospective randomized study on patients who presented to outpatient upper GIT surgery clinics suffering from chronic dysphagia in the period from May 2017 to May 2019 to compare the results of partial and total fundoplication plus LHM in patients suffering from type II achalasia.

A comprehensive assessment program was carefully structured so that a disciplined routine was followed in each patient. All patients were pre-operatively and post-operatively evaluated. Ethical approval was taken from Ain Shams University ethical committee and written consent was taken from every patient after explanation of all details of the operation, advantages, disadvantages, realistic expectations, and with the possibility of conversion to open surgery and all the possible intra-operative, early, and late postoperative complications. Surgeries were done by the same surgical team throughout the study. All patients were randomized according to the closed envelope method.

Inclusion criteria: Included all adult patients with suspected type II achalasia who didn't have evidence of mechanical obstruction on endoscopy with or without previous failed trials of dilatation. **Exclusion criteria:** Patients who were unfit for general anesthesia, previous major upper abdominal surgeries or midline exploratory surgeries, and pregnant females. Patients with esophageal strictures, diffuse ulceration, and with dysphagia related to causes other than achalasia were also excluded.

Patients were assessed clinically via history and examination for 1) Dysphagia for solids and liquids. 2) Regurgitation of undigested food. 3) Respiratory complications (nocturnal cough and aspiration). 4) Chest pain, heartburn. 5) Weight loss. Investigations were done for all patients including 1-Upper GI endoscopy: Comments on esophageal peristalsis and LES. 2-Barium study: Showed smooth tapering of the lower esophagus leading to the closed LES Resembling a "bird's beak." 3-Oesophageal manometry (HRM): used for evaluation of esophageal peristalsis, lower esophageal sphincter pressure, and confirmed type II achalasia.

Operative steps

Patients were placed supine, under general anesthesia, with a split leg and reverse Trendelenburg position. Inflation of the abdomen was done with Veress needle from Palmer's point. Four operative ports (two of them 10 mm and the others were 5mm) were placed under direct vision. The liver retractor was placed through an epigastric port (S-shaped). Dissection started through pars flaccida using ligasure scalpel, followed by dividing the phrenoesophageal ligament and peritoneum overlying the abdominal esophagus all-around preserving both vagi nerves. Division of the short gastric vessels, starting at the inferior pole of the spleen to the exposed left crus of the diaphragm was done. The fundus was mobilized by dividing the short gastric vessels and all fundal attachments, then mobilization of the distal part of the mediastinal esophagus was performed.

After excision of fat at the gastroesophageal junction, myotomy was performed for 7 cm on the anterior esophageal wall and 2-3 cm onto the stomach wall using blunt dissection, hook, or curved ligasure energy device (Medtronic, USA) **(Fig. 1).** The longitudinal muscles were divided first then the circular one until bulging of the mucosa occurred. Assessment of mucosal integrity was done using methylene blue. The gastroesophageal hiatus was closed posteriorly with two interrupted ethibond 2-0 sutures after application of bougie (36Fr).

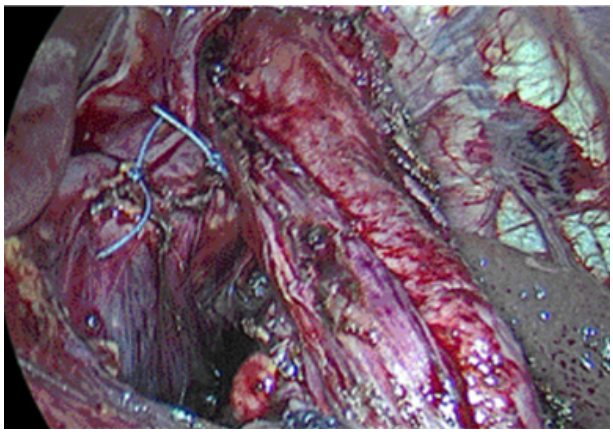

Fig 1: cardiomyotomy and hiatal closure.

In Dor fundoplication, the greater curve of the fundus of the stomach was grasped anteriorly and sutured to the left edge of esophageal myotomy and then to the right edge with three interrupted stitches on each side **(Fig. 2).** In Floppy Nissen fundoplication, the posterior fundus was passed behind the esophagus from left to right to complete a 360-degree full wrap. Two seromuscular sutures were placed from left to right starting from up downward suturing the fundus to itself to cover the whole myotomy length **(Fig. 3).** After finishing the anti-reflux procedure, a stitch was taken between the wrap and right crus to avoid tension and prevent migration of the wrap. The area was inspected for bleeding. Hemostasis was achieved then the insertion of intra-abdominal drain to the left side of the fundus was done and

the liver retractor was removed. The port sites were then closed.

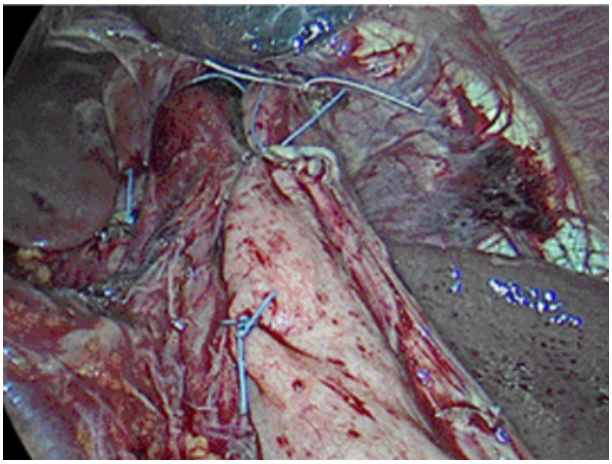

Fig 2: Creation of Dor flap.

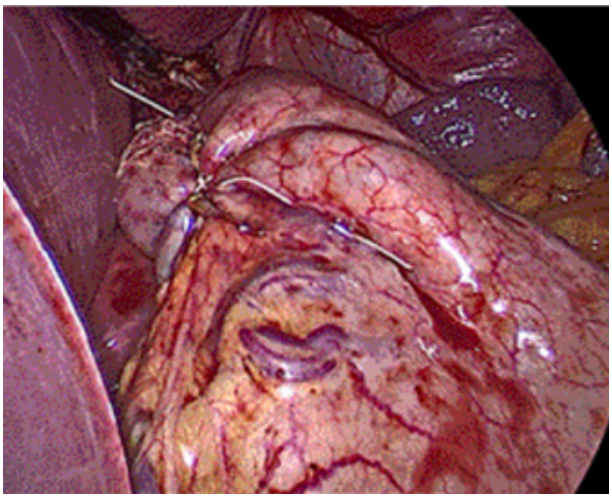

Fig 3: Creation of Nissen flap.

Outcome measures

Clinical evaluation was carried out at baseline and 1,3,6,9,12 months after the surgery (pre-post), using a modified DeMeester symptom scoring system **(Table 1)** in which each patient was evaluated according to the presence of three symptoms: dysphagia, regurgitation, and heartburn. For each symptom, a score from 0 to 3 was attributed, depending on its severity. Then, for each patient, a clinical global score equal to the sum of its symptoms scores was finally assessed, and the reduction of each symptom severity after the surgery was then investigated. Patients were assessed for dysphagia and reflux between both types of operations. A comparison was done preoperative and 12 months postoperative regarding the following parameters: DeMeester score and LES pressure by manometry. The follow-up was done at our outpatient clinic for surgery and at the endoscopy unit.

Statistical analysis

Data were collected tabulated and statically analyzed. Analysis of data was done using the SPSS (Statistical program for social science version 26) as follows: Descriptive statistics (Mean, standard deviation, range) was done for patient characteristics and continuous variables. Quantitative data were tested for normality with t-test-independent. For qualitative data the chi square test was used. P-value ≤ 0.05 was considered significant.

Results

Preoperative, intraoperative, and postoperative parameters were performed systematically in all patients. The upper GIT endoscopy ruled out any malignancy in all patients. The upper gastrointestinal barium swallow revealed esophageal achalasia in all patients. High-resolution manometry (HRM) ascertained type II achalasia. Clinical follow-up was done in the surgery outpatient clinic and the instrumental follow-up was done at the endoscopy unit for all patients. Statistical analysis for investigation of difference in esophageal manometry variation between the two groups was done.

Preoperative data

Statistical analysis was performed on the final study sample of 40 patients, 19 men (47.5%), and 21women (52.5%). Baseline characteristics were reported in **(Table 2)**.

Intraoperative data (Table 3)

All operations were performed laparoscopically without conversion to laparotomy. The average duration of the intervention was (91.3±14 minutes) in group A versus

(101.8±15.6 minutes) in group B, with a significant P value (0.032), which might be due to careful dissection of the gastric fundus in Nissen fundoplication. Blood loss was negligible, and transfusions were not needed in both groups, estimated (64.3±18.7 ml) in group A, versus (77.3±17.2 ml) in group B with a significant p-value (0.028), might also be due to more dissection in the Nissen group. No patient died during the procedure whereas there was one case of micro-perforation in A group, the diagnosis was made intraoperative, and it was managed with an intraoperative suture of the perforation without sequelae on the outcome of the treatment or the study.

Postoperative data

The average hospitalization for group A was (2.6±0.7) days, while in group B it was (2.9±0.7) days with a non-significant p-value (0.275). There

were no major postoperative complications. Patients return to work in group A within (10.5±2.3) days, while in group B (10.6±2.9) days with a non-significant p-value (0.902). **(Table 4).**

Follow-up

The follow-up for all patients was 12 months. one month, 3,6, and 12 months postoperative. The upper gastrointestinal barium swallow after 6 months showed a reduction in the average esophageal diameter of about 2 cm in both groups and a smoother passage of barium from the esophagus into the stomach. **Tables 4** reported, for each group estimated mean scores of symptoms severity after surgery along with standard errors and the differences between LES pressure done postoperatively.

Compared results in the same group pre and postoperative showed significant improvement in DeMeester score for dysphagia, heartburn, regurgitation, and global score. **(Table 5).**

postoperative compared results between both groups regarding dysphagia, heartburn and regurgitation scores were non-significant, however, DeMeester's score for global severity was significant.

Postoperative DeMeester dysphagia score for group A (1.45±0.51), while group B (1.75±0.6) with p-value (0.561). DeMeester score Heart burn for group A (0.6±0.6), while in group B (0.7±0.7) with p-value (0.457). DeMeester score Regurgitation for group A (0.6±0.6), while in group B (0.8±0.6) p-value (0.414). Postoperative DeMeester Global score for group A (2.65±0.81), while in group B (3 ±1.05) with p-value (0.05). Postoperative average measurements of LES pressure in group A were (12.05±0.69) while in group B was (16±1.78) with a significant p-value (<0.001).

(Table 6) Comparing postoperative dysphagia and reflux, there were (2) patients (10%) with mild dysphagia early after Dor fundoplication improved on follow up. Also, there were (4) patients (20%) with dysphagia after Nissen fundoplication (2) of them improved on follow-up, (2) needed trial of endoscopic dilatation. Considering reflux there were no patients with reflux after Nissen fundoplication but there were (2) patients (10%) suffering mild regurgitation and reflux after Dor fundoplication, they needed medical treatment (Proton pump inhibitors) and were satisfied with their symptoms. **(Fig. 4).**

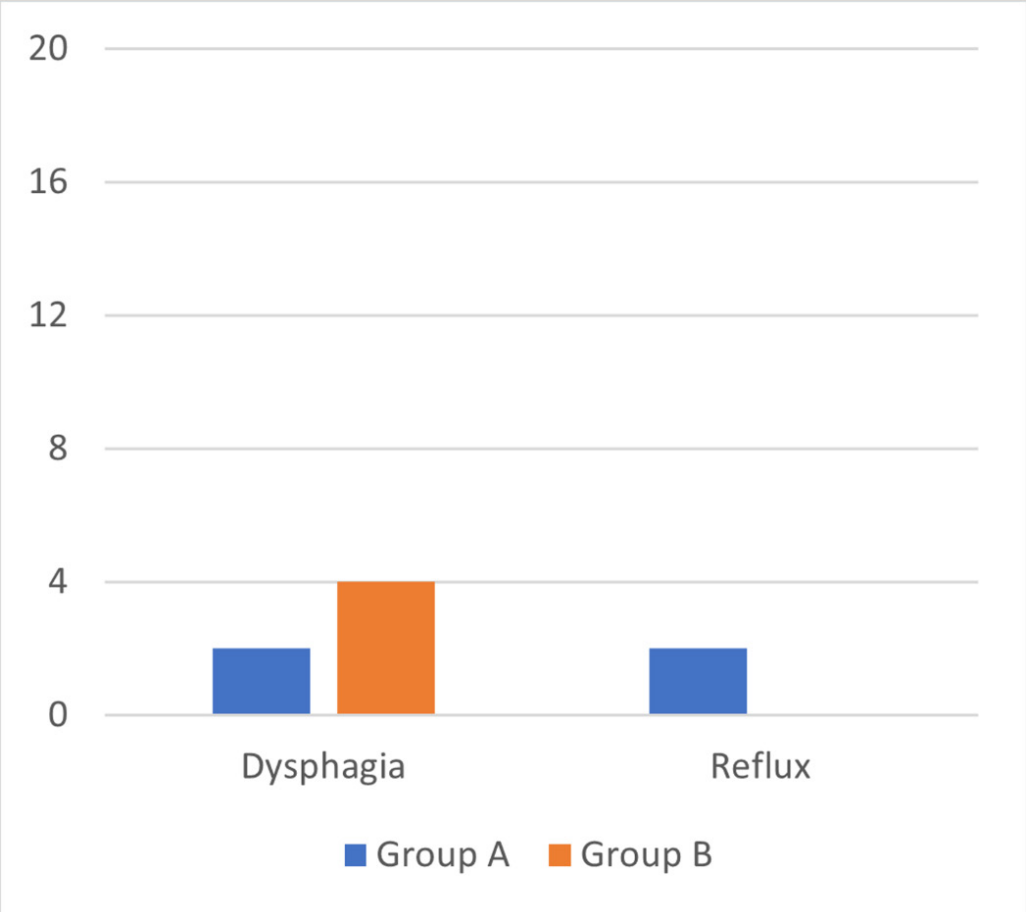

Fig 4: Results of postoperative dysphagia and reflux in both groups.

Table 1: Modified DeMeester score

Dysphagia	0	None
	1	Occasional transient episodes
	2	Require liquids to clear
	3	Impaction requiring medical attention
Heartburn	0	None
	1	Occasional brief episodes
	2	Frequent episodes requiring medical treatment
	3	Interference with daily activities
Regurgitation	0	None
	1	Occasional episodes
	2	Predictable by posture
	3	Interference with daily activities

Table 2: Patients' demography and preoperative data

		Group A=20	Group B=20	P-value	Significance
Age		46.9±7.0	44.25 ±7.85	0.268	NS
sex	Male	11 (55.0%)	8 (40.0%)	0.342	NS
	Female	9 (45.0%)	12 (60.0%)		
BMI		28.0±2.5	30.8±3.1	0.06	NS
Symptoms duration (years)		2.42±1.27	1.93±0.57	0.116	NS
Weight loss (yes)		8 (40.0%)	7 (35.0%)	0.744	NS
Thoracic pain (yes)		5 (25.0%)	6 (30.0%)	0.723	NS
Esophageal diameter (cm)		4.53±0.69	4.83±0.59	0.150	NS
Endoscopic dilatation (yes)		7(35.0%)	6(30.0%)	0.718	NS
Trials of dilatation	once	4 (43.9%)	3(50.0%)	0.363	NS
	Twice	3 (57.1%)	3 (50.0%)		
LES pressure (mmHg)		34.9±2.7	34.9±2.6	0.953	NS
DeMeester score	Dysphagia	2.6±0.5	2.7±0.47	0.541	NS
	Heartburn	1.4±0.6	1.6±0.6	0.190	NS
	Regurgitation	1.5±0.9	1.6±0.9	0.732	NS
	Global score	5.4±1.31	5.8±1.36	0.372	NS

Table 3: Operative data

	Group A	Group B	P-value	Significance
Operative time (min.)	91.3±14.0	101.8±15.6	0.032	S
Bleeding (ml)	64.3±18.7	77.3±17.2	0.028	S
complications	1 (5%)	0 (0%)	1.000	NS

Table 4: Postoperative data, compared results between both groups

		Group A	Group B	P-value	Significance
DeMeester score	Dysphagia	1.45±0.51	1.75±0.6	0.561	NS
	Heart burn	0.6±0.6	0.7±0.7	0.457	NS
	Regurgitation	0.6±0.6	0.6±0.8	0.414	NS
	Global score	2.65±0.81	3 ±1.05	0.05	S
LES pressure (mmHg)		12.05±0.69	16±1.78	<0.001	S
Hospital stays (days)		2.6±0.7	2.9±0.7	0.275	NS
Return to work (days)		10.5±2.3	10.6±2.8	0.902	NS

Table 5: Pre-and postoperative results in the same group

		Pre		Post		Paired t-test	
		Mean	SD	Mean	SD	p-value	sig.
Group A	DeMeester score Dysphagia	2.6	0.5	1.45	0.51	<0.001	S
	DeMeester score Heart burn	1.4	0.6	0.6	0.6	<0.001	S
	DeMeester score Regurgitation	1.5	0.9	0.6	0.6	<0.001	S
	DeMeester score Global score	5.4	1.31	2.65	0.81	<0.001	S
Group B	DeMeester score Dysphagia	2.7	0.47	1.75	0.6	0.001	S
	DeMeester score Heart burn	1.6	0.6	0.7	0.7	<0.001	S
	DeMeester score Regurgitation	1.6	0.9	0.8	0.6	<0.001	S
	DeMeester score Global score	5.8	1.36	3	1.05	<0.001	S

Table 6: Comparison between postoperative dysphagia and reflux between both groups

	Group A (20)	Group (B)	P-value	Significance
Dysphagia	2 (10%)	4 (20%)	0.517	NS
Reflux	2(10%)	0%	0.163	NS

Discussion

The treatment of esophageal achalasia is mainly surgical, and it focuses on decreasing the outflow resistance of the gastroesophageal junction caused by the dysfunctional LES. LHM has been the gold standard therapy for most esophageal achalasia patients.[17,18] SAGES guidelines describe it as a safe and low-risk treatment method for resolving symptoms and improving quality of life.[30] This statement is based on strong evidence showing excellent and durable results.[19] The evolution of achalasia treatment clearly shows that fundoplication is required to prevent postoperative GERD.[20,21]

Until the 1960s, the focus of treatment was on the relief of dysphagia by myotomy, and no consideration was given to the possibility of post-myotomy reflux. In 1956, Nissen popularized a 360-degree fundoplication to control gastroesophageal reflux, and this inspired Dor to propose a 180-degree anterior fundoplication in 1962 that could be added to the myotomy[22]

Determining whether to perform a total or partial fundoplication was not clear from the start. It has been shown that a laparoscopic total (360°) fundoplication is the procedure of choice in patients with gastroesophageal reflux disease. When compared to a partial fundoplication, a total fundoplication determines a better control of reflux without a higher incidence of postoperative dysphagia, even when esophageal peristalsis is weak.[8]

In esophageal achalasia, however, the pump action of the esophageal body is completely missed, as there is no peristalsis. Therefore, a total fundoplication might determine too much of resistance at the level of the gastroesophageal junction, impeding the emptying of food from the esophagus into the stomach by gravity and eventually causing persistent or recurrent dysphagia. Albeit some groups still claim good results adding a total fundoplication after a myotomy,[23,24] others have abandoned this procedure and switched to a partial fundoplication. This switch was based on the results of long-term studies that showed that esophageal decompensation and recurrence of symptoms eventually occur in most patients.[25]

Topart et al., in a 10-year follow-up evaluation of patients after LHM with total fundoplication, showed that 82% of the patients had a recurrence of symptoms.[26] In contrast, Rossetti et al., described excellent outcomes regarding dysphagia symptoms relief in more than 90% of patients, showing no pathologic GER at a mean follow-up of 83 months.[24] In 2008, Rebecchi and colleagues published data from their prospective randomized trial comparing the outcome of an LHM with a Dor or Nissen fundoplication. They found that at a 5-year follow-up the postoperative pathologic GER ratio was similar in both groups. However, patients after total fundoplication had an increased dysphagia rate when compared to those after Dor (15% vs 2.8%).[13]

Di Martino et al. showed that Nissen fundoplication presents with the better antireflux result as proved

objectively based on pH studies without significant difference in clinical outcome when compared to the Dor technique.[27] Duranceau and colleagues initially reported excellent results with a Heller myotomy (HM) and total fundoplication.[28] Ten years later, however, they noted that symptoms had recurred in 14 of 17 patients (82%), five of whom required a second operation.[26] They felt that a total fundoplication determines over time a progressive increase in esophageal retention with poor emptying and recurrence of symptoms. They were able to avoid this problem by performing a partial fundoplication.[26] A study was done to compare the outcomes of 34 patients submitted to an HM and different types of fundoplication (Belsey, gastroplasty + partial wrap, gastroplasty + total wrap, and Nissen). Not surprisingly, better postoperative GERD control was obtained with partial fundoplication, whereas postoperative dysphagia was more of an issue after total fundoplication at a follow-up period that varied between 5–10 years.[29]

Our study revealed that there were 4 (20%) patients with dysphagia after Nissen fundoplication (2) of them improved on follow up while the (2) others needed further endoscopic dilatation and 2 patients (10%) with dysphagia after Dor fundoplication both improved during follow up with no significant difference between both groups. Finally, while accepting, a greater tendency of Dor fundoplication to develop postoperative GERD, we point out that it is negligible, and we add that this complication can be treated with good patient compliance with medical therapy (Proton pump inhibitors), instead of the occurrence of dysphagia generally requires an endoscopic treatment or even a re-do surgery.

Therefore, today a 360 fundoplication is discouraged for patients with esophageal achalasia after LHM because it may be associated with higher postoperative dysphagia rates if not done properly.[3,30] As stated by the 2018 International Society for Diseases of the Esophagus guidelines,3 an LHM with partial wrap (Either anterior or posterior) should be the chosen technique for patients with achalasia, as it achieves the main goal of relieving dysphagia while preventing GERD in most of the patients.

Conclusion

Dor fundoplication (Partial anterior wrap) is a good, adequate, and safer anti reflux procedure after Heller cardiomyotomy, like the fact that GER which is the most probable complication may be treated medically with good patient compliance. Also, if laparoscopic Nissen fundoplication is done properly after Heller cardiomyotomy, the incidence of dysphagia may be non-significant with a good reflux control. The choice of associated anti-reflux procedure after Heller cardiomyotomy is up to the surgeon preference and experience.

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