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• *BRIEF REPORTS* •

Laparoscopic Heller myotomy with or without partial fundoplication: A matter of debate

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Abstract

AIM: To present our experience of laparoscopic Heller stretching myotomy followed by His angle reconstruction as surgical approach to esophageal achalasia.

METHODS: Thirty-two patients underwent laparoscopic Heller myotomy; an anterior partial fundoplication in 17, and angle of His reconstruction in 15 cases represented the antireflux procedure of choice.

RESULTS: There were no morbidity and mortality recorded in both anterior funduplication and angle of His reconstruction groups. No differences were detected in terms of recurrent dysphagia, p.o. reflux or medical therapy.

CONCLUSION: To reduce the incidence of recurrent achalasia after laparoscopic Heller myotomy, we believe that His' angle reconstruction is a safe and effective alternative to the anterior fundoplication.

Key words: Achalasia; Gastroesophageal reflux; Laparoscopic Heller myotomy

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INTRODUCTION

Achalasia is a rare esophageal disease characterized by incomplete and uncoordinated relaxation of the lower esophageal sphincter associated with aperistaltic esophagus.[1,2] This condition causes typical symptoms of dysphagia and regurgitation, heartburn, postprandial chest pain, malnutrition and aspiration, all leading to a poor quality of life.[3] Treatment is directed to reduce the resting pressure of the lower esophageal sphincter which can be achieved in different ways: 1 pharmacologically, with the use of calcium channel blockers; 2 endoscopically, by means of balloon dilatation or botulinum toxin injection; 3 surgically, performing an esophageal myotomy[4].

Extramucosal myotomy was first described by Heller in 1913, who performed two complete myotomies on opposite sides of the esophagus with an open access. Later in 1923, Zaaijer restricted this procedure to a single anterior myotomy. However, surgical section of the muscular layers of the lower esophageal sphincter normally exposes the esophageal mucosa to gastroesophageal reflux, thus requiring an antireflux procedure[5].

Since 1991, thoracoscopic and laparoscopic approaches to Heller myotomy have shown equal efficacy compared to open procedure, eventually making the laparoscopic Heller myotomy followed by an antireflux procedure, the treatment of choice for achalasia.[6] Since several authors have eventually reported some lack of success of this procedure in terms of recurrent achalasia[7,8], which required additional endoscopic or surgical maneuvers, the selective application of different antireflux procedures started to be put in place[9-13].

Aim of this study is to present our experience of laparoscopic Heller stretching myotomy followed by His angle reconstruction, as surgical approach to esophageal achalasia.

MATERIALS AND METHODS

After a cumulative experience of more than 75 patients treated over a 20-year period with either open Heller-Nissen or Heller-Beltsey fundoplication MKIV and a previous series of 16 cases treated with thoracoscopic Heller Myotomy,[14] a total of 32 patients between 1997 and 2004 underwent Laparoscopic Heller Myotomy at the Department of Surgery "P. Valdoni" of the University of Rome "La Sapienza". In 17 patients an anterior partial fundoplication was associated to the myotomy (Heller - Dor, HD), whereas in 15 cases the angle of His reconstruction (Heller - His, HH) was the chosen antireflux procedure.

Pre-operative work-up consisted of patient's clinical history, barium swallow, upper GI endoscopy, and esophageal Ph-manometry. There were 16 males and 16 females with a mean age of 42.0 (range 14-77) and the mean symptoms -duration was 73.4 mo. The disease was graded according

to esophageal diameter: stage I (<4 cm): 1 patient, stage II (4-6 cm): 22 patients, stage III (>6 cm) : 9 patients; median LES pressure was 32.8 mmHg (mean 32.8±5.9 mmHg). Esophageal peristalsis was absent in all patients. None of them had undergone previous abdominal surgery.

Surgical technique: five trocars are required as previously described.[14] After incision of the phrenoesophageal ligament, the dissection is performed selectively over the anterior aspect of the esophagus and the superior part of the diaphragmatic crura. The anterior vagus nerve is identified and its branches preserved. The short gastric vessels are not divided and the esophagus is not encircled, in order to preserve the anatomical attachments of the cardia. The esophageal dissection is prolonged into the mediastinum, 6-8 cm above the gastroesophageal junction (GEJ). The esophagomyotomy is then extended proximally to the GEJ for about 6 cm and distally for 2 cm below the cardia on the gastric wall. We found advantageous and safe performing the myotomy by stretching and tearing the circular muscle fibers with two laparoscopic graspers directed in opposite direction. Once the submucosal plane is reached, the muscular layer is separated bluntly from the submucosa and the stretching myotomy is easily extended proximally and distally. Bleeding from the esophageal musculature is minimal and no attempt is made to diathermy the bleeding. All surgical maneuvers are performed, with the esophagoscope placed in the esophagus, in order to assess the completeness of the myotomy and ensure mucosal integrity.

After completion of the myotomy once the partial anterior fundoplication has been performed, the anterior wall of the gastric fundus is sutured first to the left, then to the right muscular edges of the myotomy with three interrupted stitches for each side in H-D series (17 cases). The proximal suture of the right side also includes the superior part of the right crus. In 15 patients, we only reconstruct the angle of His, (H-H) tying two or three interrupted stitches between the gastric fundus and the left wall of the esophagus.

A barium swallow is routinely performed post-operatively on D1 to confirm mucosal integrity before starting oral fluid intake. Patients were discharged as soon as comfortable and when a soft diet was tolerated, usually on D2 or 3.

Patients were evaluated clinically at 1, 6, 12 mo after surgery, in order to assess recurrent achalasia or heartburn. This was achieved by handing out a standard validated questionnaire. Endoscopy and esophageal pH-manometry were carried out when indicated. All the patients received Proton-Pump-Inhibitors (PPI) medication in the perioperative period and for the first months after surgery.

Statistical analysis

SPSS statistical package was used to generate frequency distribution for demographic variables. The Fisher- exact test for comparison of patient subgroups for categorical variable was used. Results are expressed as mean±SD and median. Differences were considered significant at $P<0.05$.

RESULTS

Among HD patients there was 1 esophageal perforation identified at the time of surgery by intraoperative endoscopy and repaired laparoscopically with the anterior partial fundoplication protecting the suture. Mean operative time was 150 min (range 60-192 min). Mean blood -loss was less than 50 mL. No p.o. morbidity and mortality were recorded. Post-operative mean hospital stay was 2.0±1.0 d. Occasional dysphagia and regurgitation were reported in 1 patient. Post-operative heartburn occurred in 1 patient, who was successfully treated with medical therapy. Barium swallow examination showed a decrease in mean esophageal diameter from 54.5±5.7 to 27.1±3.3 mm ($P = 0.0001$).

Among HH patients no esophageal perforation were identified at the time of surgery. Mean operative time was 130 min (range 60-145 min) and mean blood -loss was less than 50 mL. Neither p.o. morbidity nor mortality was recorded. Post-operative hospital stay was 2.0±1.0 d. No p.o. dysphagia has been noticed. Post-operative occasional heartburn occurred in 3 cases, although only 1 required medical treatment.

Barium swallow examination showed a decrease in mean esophageal diameter from 55.3±5.1 to 28.5±2.9 mm ($P = 0.0001$).

When comparing p.o. dysphagia rates between HD *vs* HH group, no significant differences ($P = 1.0$) (Table 1) were found.

Post-operative gastroesophageal reflux following HD and HH occurred in 1 and 3 patients respectively, $P = 0.30$ (Table 2), only one patient submitted to HH operation required continuous medical treatment $P = 0.45$ (Table 3).

Table 1 Dysphagia after Heller-Dor *vs* Heller-His operation

	Dysphagia Yes patients (*n*)	%	No patients (*n*)	%	Total patients (*n*)
Heller-Dor	1	5.9	16	94.1	17
Heller-His			15	100	15
					32

$P = 1.0$.

Table 2 Gastroesophageal reflux Heller-Dor *vs* Heller-His operation

	Reflux Yes patients (*n*)	%	No patients (*n*)	%	Total patients (*n*)
Heller-Dor	1	5.9	16	94.1	17
Heller-His	3	20	12	80	15
					32

$P = 0.30$.

Table 3 Chronic PPI Therapy after Heller-Dor *vs* Heller-His operation

	PPI Medical Yes patients (*n*)	Therapy %	No patients (*n*)	%	Total patients (*n*)
Heller-Dor			17	100	17
Heller-His	1	6.6	14	93.4	15
					32

$P = 0.45$.

DISCUSSION

Heller myotomy is the most effective treatment of dysphagia due to achalasia, and the laparoscopic approach allows extending the myotomy well below the GEJ. Some aspects of this procedure, however, have yet to be defined. Firstly, there is no agreement about how much the myotomy should be extended in order to be effective. Secondly, it is still not clear to what extent the myotomy causes gastroesophageal reflux. Another unresolved issue is the need to add an antireflux procedure to the myotomy and what type of procedure should be performed. Finally, there is still debate about the incidence of recurrent achalasia following the antireflux procedure, and what are the reasons for this. Topart, in 1992, reported an incidence of 30% of redo-surgery for recurrent dysphagia following Heller myotomy associated with Nissen fundoplication[12].

Oelschlager *et al*[8] recently reported recurrence of dysphagia up to 17.3% in patients treated with myotomies extended for 1.5 cm or less below the GEJ, and only of 3.4% when extended for 3 cm below this mark.

Shiino *et al* reported severe dysphagia after myotomy in 16% of patients, requiring either surgical or endoscopic treatment. The myotomy was extended for 2 cm below the GEJ and an antireflux procedure was performed[15]. Zaninotto *et al* reported an incidence of recurrent dysphagia of 8.8% after laparoscopic Heller myotomy followed by anterior partial fundoplication (Dor). According to the authors, this was due to either an incomplete section of the muscle fibers or to the fibrotic scar of the myotomy edges[13]. The hypothesis that scarring between the fundoplication and esophageal mucosa in the anterior wrap may account for the poorer result after Dor procedure is also argued by Lyass[11].

Oelschlager compared Dor *vs* Toupet fundoplication following Heller myotomy reporting an incidence of recurrent achalasia of 17.3% and 3.4%, respectively ($P = 0.001$).[8] This could be due to the fact, that covering the myotomy site with the Dor fundoplication could lead to adhesions formation between the two surfaces and provoke recurrent achalasia;[13] the Toupet fundoplication keeps the myotomy edges apart by keeping fixed the fundus to each side thus reducing the risk of fibrosis.[8] Toupet fundoplication also requires dissection of the posterior esophageal attachments and the section of some of the short gastric vessels, which could reduce the GEJ competence with subsequent p.o. reflux. However, there are cases in which a partial fundoplication may be beneficial. In patients with hiatal hernia, fundoplication may prevent stomach herniation. When an unnoticed mucosal perforation occurs during myotomy, a partial fundoplication may be used to cover the repair.[6] Clearly neither of the two approaches (Toupet or Dor fundoplication) resulted in a completely competent cardia and normal acid exposure[5,8,11].

On the other hand Raiss reported a 2% incidence of recurrent achalasia after laparotomic Heller myotomy without fundoplication.[16] Lyass, in a review of literature from 1991 to 2001, analyzed persistent dysphagia and p.o. gastroesophageal reflux after laparoscopic Heller myotomy associated or not to antireflux procedures.[11] In this paper, an incidence of abnormal esophageal pH-manometry is reported in 35-36% of patients who underwent trans-abdominal open Heller myotomy without fundoplication and 10-16% of patients who had a partial fundoplication. In the presented laparoscopic series, the rate of abnormal pH-manometry findings in the antireflux *vs* no antireflux procedures groups were 10% and 7.9%, respectively.[11] This may be explained by the different technical aspects of the procedures. The extent of esophageal dissection performed in open surgery may be more disruptive. The angle of His, a natural barrier to reflux, is often destroyed by the extensive dissection performed in open surgery. The laparoscopic approach is less traumatic to this area and more often preserves this angle. Also, the length of the myotomy may be shorter, especially on the gastric side.[11] Bloomston *et al* compared the results of laparoscopic Heller myotomy with or without concomitant fundoplication (Dor). The dysphagia rate was of 14% among patients who underwent myotomy alone compared to 26% of patients received concomitant Dor fundoplication. The incidence of anti-acid treatment required post-operatively in the two groups were 13% *vs* 10%, respectively (data non statiscally significant)[1,11] Diener *et al* and Douard reported 10% incidence of p.o. dysphagia[17,18], and Ackroyd *et al*[3] 13%. The incidence of p.o. dysphagia reported in literature varies between 17.3% and 30% after short myotomy compared to 3.4-16% after long myotomy[15,19,20]. Kumar *et al* reported a 6% incidence of endoscopic proved esophagitis after laparoscopic cardiomyotomy using the Dundee technique which limits the mobilization to the anterior wall of the abdominal and thoracic esophagus, stating that the routine addition of an anti-reflux operation is not justified in patients undergoing laparoscopic cardiomyotomy, provided that the lateral and posterior attachment of the esophagus are kept intact[21].

In striving to reduce the incidence of recurrent achalasia after Heller myotomy, we decided not to perform any type fundoplication over the raw mucosal surface. Furthermore, we did not dissect the posterior aspect of the esophagus as the Toupet fundoplication requires, in order to reduce the surgical modifications of the posterior elements of fixation of the GEJ. To control the gastroesophageal reflux, we decided to reconstruct the angle of His forcing the gastroesophageal gas valve mechanism described by Hill.[22] Our technique requires the suture of the right side of the gastric dome to the adjacent left side of the esophageal myotomy with three interrupted, non absorbable stitches. In our series, we performed a 2 cm extended myotomy on the gastric side and we recorded only 1 case of p.o. occasional dysphagia (1/32) 3.1%, which was in the HD group (1/17, 5.8%). No recurrence of dysphagia was recorded among HH patients. Among the 3 patients who experience occasional episodes of p.o. heartburn, only 1 required medical therapy (PPI) to control the reflux. The association of a Dor antireflux procedure was necessarily performed in a case where a mucosal perforation was noticed at the time of surgery, whereas a different antireflux procedure could be chosen if the mucosal layer resulted intact after completion of the myotomy.[11,20] Decker reported 17% p.o. dysphagia after myotomy and partial posterior or anterior fundoplication and 7% of mucosal perforation[2]. Luketich and co-workers reported an overall incidence of 9.6% of intraoperative mucosal perforation

despite the use epinephrine injection to lift up the muscular layers and recurrent dysphagia rate of 12.9%, with 4.8% of redo myotomy[7].

Mucosal tear rates vary from author to author: Luketich[7] reported a rate of 9.6%, Bloomston[1] of 6%, Decker[2] 5.4%, Donahue[20] 13.5%, Diener[18] 5%, Ackroyd[3] 12%, Raiss[16] 4%. In our personal experience, intra-operative mucosal perforation decreased from 12.5% (thoracoscopic approach) to 5.9% (laparoscopic approach)[14]. In the present series mucosal tearing occurred in 3.1%. Even if the laparoscopic approach offers better exposure of the GEJ injuries to the mucosa still occur especially when extending the myotomy on the gastric side, where the plane between the submucosa and the muscle layer is less evident and bleeding is more profuse[13]. In order to reduce incidence of mucosal perforation we performed the myotomy by stretching and tearing the circular muscle fibers with two laparoscopic graspers directed in opposite directions, with no attempt to diathermy small bleeding or to perform the myotomy with monopolar hook or ultrasonic shears. Diathermy and division of circular muscle fibers with these instruments may increase the risk of intra-operative or delayed mucosal perforation. Since the use of this stretching technique, the incidence of mucosal perforation has decreased from 12.5% to 3.1% (1/32). Although mucosal tearing could not be completely abolished after stretching myotomy, 3.1% rate appears to be one of the lowest reported, even less than the one reported after open Heller procedure.[16] Further improvement could be achieved in the future using robot-assisted laparoscopic cardiomyotomy as suggested by Shah *et al*, with the possibility of scaling down of movements allowing to be carry out the myotomy with greater precision, eliminating the surgeon's natural tremor too.

In conclusion, recurrent achalasia seems to be the major problem after laparoscopic Heller myotomy. In striving to reduce the incidence of this complication, we decided not to perform any type of fundoplication, in order to avoid adhesions formation and scarring between the row mucosal surface of the esophagus and the overlapped gastric wall.

Our antireflux procedure consisted in suturing the right side of the gastric fundus to the left side of the esophageal myotomy, stressing the His' angle flap valve. In this subgroup, no cases of recurrent achalasia were recorded, although when comparing the HH and HD groups no significant differences could be detected in respect to this issue. Before deciding not to perform an anterior fundoplication it is essential to rule out esophageal mucosa perforation at the time of surgery. In our experience, laparoscopic stretching myotomy is associated with a total incidence of mucosal perforation of 3.1% compared to 13.5-4% reported in literature.

REFERENCES

1 **Bloomston M,** Rosemurgy AS. Selective application of fundoplication during laparoscopic heller myotomy ensures favorable outcomes. *Surg Laparosc Endosc Percutan Tech* 2002; **12**: 309-315

2 **Decker G,** Borie F, Bouamrirene D, Veyrac M, Guillon F, Fingerhut A, Millat B. Gastrointestinal quality of life before and after laparoscopic heller myotomy with partial posterior fundoplication. *Ann Surg* 2002; **236**: 750-758; discussion 758

3 **Ackroyd R,** Watson DI, Devitt PG, Jamieson GG. Laparoscopic cardiomyotomy and anterior partial fundoplication for achalasia. *Surg Endosc* 2001; **15**: 683-686

4 **Patti MG,** Fisichella PM, Perretta S, Galvani C, Gorodner MV, Robinson T, Way LW. Impact of minimally invasive surgery on the treatment of esophageal achalasia: a decade of change. *J Am Coll Surg* 2003; **196**: 698-703; discussion 703-705

5 **Richards WO,** Clements RH, Wang PC, Lind CD, Mertz H, Ladipo JK, Holzman MD, Sharp KW. Prevalence of gastroesophageal reflux after laparoscopic Heller myotomy. *Surg Endosc* 1999; **13**: 1010-1014

6 **Shimi S,** Nathanson LK, Cuschieri A. Laparoscopic cardiomyotomy for achalasia. *J R Coll Surg Edinb* 1991; **36**: 152-154

7 **Luketich JD,** Fernando HC, Christie NA, Buenaventura PO, Keenan RJ, Ikramuddin S, Schauer PR. Outcomes after minimally invasive esophagomyotomy. *Ann Thorac Surg* 2001; **72**: 1909-1912; discussion 1912-1913

8 **Oelschlager BK,** Chang L, Pellegrini CA. Improved outcome after extended gastric myotomy for achalasia. *Arch Surg* 2003; **138**: 490-495; discussion 495-497

9 **Chipponi J.** Should fundoplication be added to Heller's myotomy? *Ann Chir* 2002; **127**: 743-744

10 **Hagedorn C,** Jonson C, Lonroth H, Ruth M, Thune A, Lundell L. Efficacy of an anterior as compared with a posterior laparoscopic partial fundoplication: results of a randomized, controlled clinical trial. *Ann Surg* 2003; **238**: 189-196

11 **Lyass S,** Thoman D, Steiner JP, Phillips E. Current status of an antireflux procedure in laparoscopic Heller myotomy. *Surg Endosc* 2003; **17**: 554-558

12 **Topart P,** Deschamps C, Taillefer R, Duranceau A. Long-term effect of total fundoplication on the myotomized esophagus. *Ann Thorac Surg* 1992; **54**: 1046-1051; discussion 1051-1052

13 **Zaninotto G,** Costantini M, Portale G, Battaglia G, Molena D, Carta A, Costantino M, Nicoletti L, Ancona E. Etiology, diagnosis, and treatment of failures after laparoscopic Heller myotomy for achalasia. *Ann Surg* 2002; **235**: 186-192

14 **Ramacciato G,** Mercantini P, Amodio PM, Corigliano N, Barreca M, Stipa F, Ziparo V. The laparoscopic approach with antireflux surgery is superior to the thoracoscopic approach for the treatment of esophageal achalasia. Experience of a single surgical unit. *Surg Endosc* 2002; **16**: 1431-1437

15 **Shiino Y,** Awad ZT, Haynatzki GR, Davis RE, Hinder RA, Filipi CJ. Postmyotomy dysphagia after laparoscopic surgery for achalasia. *World J Gastroenterol* 2003; **9**: 1129-1131

16 **Raiss M,** Hrora A, Menfaa M, Al Baroudi S, Ahallat M, Hosni K, Halhal A, Tounsi A. Heller's myotomy without fundoplication: a series of 123 patients. *Ann Chir* 2002; **127**: 771-775

17 **Douard R,** Gaudric M, Chaussade S, Couturier D, Houssin D, Dousset B. Functional results after laparoscopic Heller myotomy for achalasia: A comparative study to open surgery. *Surgery* 2004; **136**: 16-24

18 **Diener U,** Patti MG, Molena D, Tamburini A, Fisichella PM, Whang K, Way LW. Laparoscopic Heller myotomy relieves dysphagia in patients with achalasia and low LES pressure following pneumatic dilatation. *Surg Endosc* 2001; **15**: 687-690

19 **Chen LQ,** Chughtai T, Sideris L, Nastos D, Taillefer R, Ferraro P, Duranceau A. Long-term effects of myotomy and partial fundoplication for esophageal achalasia. *Dis Esophagus* 2002; **15**: 171-179

20 **Donahue PE,** Horgan S, Liu KJ, Madura JA. Floppy Dor fundoplication after esophagocardiomyotomy for achalasia. *Surgery* 2002; **132**: 716-722; discussion 722-723

21 **Kumar V,** Shimi SM, Cuschieri A. Does laparoscopic cardiomyotomy require an antireflux procedure? *Endoscopy* 1998; **30**: 8-11

22 **Hill LD,** Aye RW, Nilsson C. The Hill Repair. In: Griffith Pearson F, Cooper JD, Deslauriers J, Ginsberg RJ, Hiebert CA, Alexander Patterson G, Hurschel Jr HC (eds): *Esophageal Surgery* (2nd ed.). Philadelphia: Churchill Livinstone; 2002, chapter 22: 345-356. Elsevier Science, PA, USA

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