Functional results after laparoscopic Heller myotomy for achalasia: A comparative study to open surgery

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Background. *Prospective studies comparing laparoscopic to open Heller myotomy for esophageal achalasia are lacking. The aim of this study was to compare functional outcome after laparoscopic and open Heller myotomy for esophageal achalasia.*
Methods. *Eighty-two patients who underwent Heller-Dor myotomy for achalasia, via laparoscopy (n = 52) or open surgery (n = 30) were recorded prospectively (1993-2002). Median follow-up was 51 (12-111) months. Perioperative functional data were assessed via dysphagia and overall clinical (dysphagia, chest pain, regurgitation, gastroesophageal reflux) scores.*
Results. *In laparoscopy patients, the operative time was longer (145 [95-290] vs 120 [70-230] minutes,* $P < .0001$*); the postoperative hospital stay and feeding resumption time was shorter (4 [2-25] vs 7.5 [5-18] days,* $P < .0001$ *and 2 [1-15] vs 4 [1-14] days,* $P < .0001$*). Three mucosal tears necessitated conversion to open surgery (6%). The rates of "excellent" or "satisfactory" results after laparoscopic and open surgery were 92% (n = 48/52) versus 93% (n = 28/30), and 83% (n = 43/52) versus 83% (n = 25/30) on overall clinical score. In both groups, the overall clinical score indicated significant improvement during 12-month follow-up. The laparoscopy and open surgery symptomatic gastroesophageal reflux rates were 10% and 7%, respectively.*
Conclusions. *Laparoscopic Heller myotomy favorably compares with open surgery regarding dysphagia relief and gastroesophageal reflux rate. Overall clinical score indicates gradual improvement in patient functional status during 12-month follow-up. (Surgery 2004;136:16-24.)*

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Primary treatment of esophageal achalasia is currently based on pneumatic dilation or surgical myotomy.[1] Whether endoscopic or surgical treatment should be attempted first is still controversial.[2,3] Excellent results are obtained via both techniques, but a good long-term result rate seems to be higher after surgical treatment.[2,3] On the other hand, previous pneumatic dilations do not preclude successful surgery.[3] Most authors therefore advocate surgical treatment after pneumatic dilation failure or as first-intent treatment in patients under 30 or with high amplitude of esophageal contractions (> 50 mm Hg) who are poor candidates for pneumatic dilations due to higher risk for worse functional results or intraoperative perforation, respectively.[3-5]

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The approach to achalasia management has regained interest and is likely to be modified due to recent development of laparoscopic Heller myotomy.[6-8] This surgical procedure is thought to be associated with less postoperative pain, shorter hospital stay, and fewer parietal complications,[9] and is now considered by some authors as the first-intent treatment.[10] However, most reports have only focused on the feasibility or short-term results; comparative studies to open surgery are still needed for further evaluation.[7,9,11-17] The aim of this prospective nonrandomized study was to compare longer-term functional results assessed on an overall clinical score after laparoscopic and open Heller myotomy for esophageal achalasia.

PATIENTS AND METHODS

The laparoscopic approach for cardiomyotomy has been developed in our unit since 1993. All patients operated on electively for esophageal achalasia at Cochin University Hospital between 1993 and 2002 were recorded and studied prospectively. Eighty-two consecutive patients entered

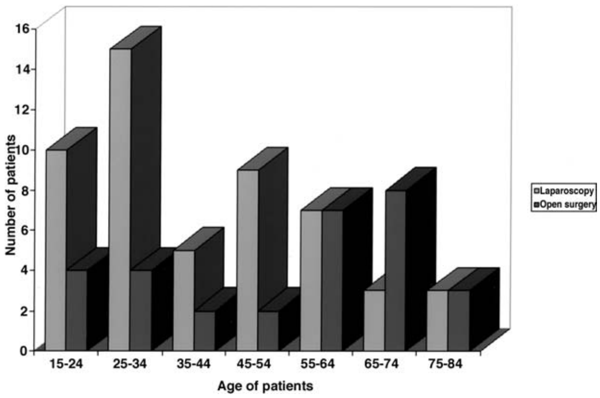

Fig 1. Age distribution of the 82 patients operated on for esophageal achalasia in the laparoscopy and open surgery groups.

the study, including 44 men and 38 women, with a median age of 45 (range, 15-83). The age distribution in both groups of patients is detailed in Fig 1. The patient physical status evaluated by the American Society of Anesthesiologists (ASA) classification[18] was as follows for the laparoscopy group: ASA I, n = 11; ASA II, n = 10; ASA III, n = 9. Evaluations for the open surgery group were ASA I, n = 35; ASA II, n = 12; ASA III, n = 5. All patients had a Heller modified cardiomyotomy with an anterior fundoplication (Heller-Dor procedure) via the laparoscopic approach (n = 52) or conventional open surgery (n = 30). Each of the study patients was operated on by the same senior surgeon (BD).

During the first period of our experience (1993-1996), both procedures were explained and proposed to all patients referred to our unit, open surgery being presented as the gold standard technique. Eighteen of the 30 open surgery patients (60%) were operated on during this period. From 1996 onwards, laparoscopic surgery was proposed as the preferred treatment; open surgery was used mainly in patients unsuitable for laparoscopy. In this early period, the Department of Anesthesiology considered severe cardiac failure or respiratory insufficiency as contraindications to prolonged laparoscopic surgery. With time and increasing experience, indications for open surgery were restricted to patients with high-seated esophageal diverticulum and multiple upper mesocolic surgery (Table I).

Previous endoscopic treatment failure had been experienced by 15 open surgery patients (*Clostridium botulinum* toxin injection [n = 2], 1 to 3 pneumatic dilations [n = 11], both treatments [n = 2]), and by 33 laparoscopy patients (*Clostridium botulinum* toxin injection [n = 3], 1 to 5 pneumatic dilations [n = 28], both treatments [n = 2]). The pneumatic dilations had been performed under general anesthesia by the same senior endoscopist (M.G.) using a Rigiflex balloon (Microvasive; Boston Scientific Cork Ltd, Cork, Ireland). Surgery was proposed as first-intent treatment to patients under 30, patients with high amplitude of esophageal contractions (>50 mm Hg), patients with epiphrenic diverticulum, and patients who refused pneumatic dilations. All patients were assessed at the Gastrointestinal Department of Cochin University Hospital and underwent barium swallow, endoscopy, and esophageal manometry. Pre- and postoperative esophageal motility studies were all performed in the supine position with the use of pneumohydraulically infused catheters with 3 distal radially oriented orifices. Side holes were at 5-cm intervals. The motility catheter was advanced through the nasopharynx under local anesthesia. Lower esophageal (LES) pressure was measured by using the station withdrawal method and calculating the mean of 3 radial measures. LES relaxation was evaluated by the mean relaxation after 3 wet swallows (5 mL water) (n > 80%), and contraction amplitude by the mean amplitude of 10 wet swallows measured 5 cm above the LES. The patients were separated into 4 grades according to the maximal diameter and shape of the thoracic esophagus on the barium swallow study. In the open surgery group, 13 patients (43%) had grade I achalasia (diameter < 4 cm), 13 (43%) had grade II (diameter between 4 and 6 cm), 1 (3%) had grade III (diameter > 6 cm), and 3 (10%) had grade IV (sigmoid esophagus). In the laparoscopy group, 14 patients (27%) had grade I achalasia (diameter < 4 cm), 24 (46%) had grade II (diameter between 4 and 6 cm), 6 (12%) had grade III (diameter > 6 cm), and 8 (15%) had grade IV (sigmoid esophagus).

Table I. Indications for open surgery in patients operated on for esophageal achalasia

Indication	*No.*
Previous upper abdominal surgery	10
Choice of the patient	7
Cardiac or pulmonary insufficiency	6
Epiphrenic diverticulum	7

Esophageal endoscopic ultrasonography was performed (laparoscopy group [n = 13], open surgery group [n = 19]) in patients over 30 with atypical clinical or manometric features. Clinical and manometric data are presented in Table II.

The surgical procedure consisted of a Heller modified cardiomyotomy associated with crural

Table II. Clinical and manometric data in 82 patients operated on for esophageal achalasia

	Laparoscopy (n = 52)	*Open surgery (n = 30)*	P *value*
Age (yr)	37 (15-81)	61.5 (17-83)	*P* = .0053
Cardiac or respiratory comorbidity	1/52	6/30	*P* = .0087
ASA classification I/II and III	35/17	11/19	*P* = .0107
Gender (m/f)	24/28	14/16	NS
Weight (kg)	64 (40-102)	62 (45-100)	NS
Size (cm)	169 (155-192)	168 (150-178)	NS
Symptom duration (mo)	35.5 (4-288)	29 (5-684)	NS
Weight loss (kg)	5 (0-25)	6 (0-25)	NS
Preoperative endoscopic treatment	33/52	15/30	NS
LES pressure (mm Hg)	29 (10-59)	31 (9-75)	NS
Mean LES relaxation (%)	58 (0-90)	56 (0-91)	NS
Contraction wave amplitude (mm Hg)	37 (0-107)	37 (4-223)	NS
Complete aperistalsis	49/52	26/30	NS
Follow-up (months)	50 (12-102)	53 (12-92)	NS

ASA, American Society of Anesthesiologists; *LES*, lower esophageal.

closure and anterior fundoplication (Heller-Dor procedure) in both laparoscopy and open surgery patients. After section of the anterior cardial vessels and location of the vagal trunks, the esophagogastric junction was mobilized with complete esophageal dissection. To facilitate the myotomy, a Faucher tube (36 French) (Vygon, Ecouen, France) was introduced into the esophagus and then replaced by a nasogastric suction tube before completion of the fundoplication. The myotomy extended upwards for 6 cm above the cardia and downwards for 2 cm below the esophagogastric junction. An intraoperative methylene blue test was carried out after myotomy completion by injecting 200 mL of methylene blue colored water via the nasogastric suction tube placed at the middle third of the esophagus to control the absence of mucosal tears. The esophageal hiatus was then closed by using separate stitches of non-absorbable sutures. An anterior fundoplication (Dor procedure) was performed and sutured to the right hiatal pillar and the right edge of the myotomy by using separate stitches of non-absorbable sutures. The fundoplication wrapped up the intra-abdominal part of the cardiomyotomy. This procedure was performed via a supraumbilical midline incision in 30 cases. Transhiatal resection of a low-situated epiphrenic diverticulum was additionally performed in 4 open surgery patients. For open surgery patients, the cardiomyotomy was performed with the use of surgical scissors and on-demand bipolar coagulation. Median size of the 7 diverticula was 4 cm in diameter (3-6); stapled diverticulectomies were performed for > 4 cm diverticula (n = 4). For laparoscopic surgery, the patient was placed supine with legs apart and at a 30° reversed Trendeleburg tilt. Five ports were routinely used. The cardiomyotomy was performed with the use of an L-shaped hook protected on its convex part to keep the electrocautery off the submucosal layer, with on-demand bipolar coagulation. A nasogastric suction tube was left in place and removed at postoperative day 1 except in cases of intraoperative mucosal tear.

All functional parameters (dysphagia, chest pain, regurgitation, gastroesophageal reflux, and weight variation) were recorded prospectively. The patients were evaluated preoperatively, at postoperative months 3 and 6, and annually thereafter. Overall median follow-up was 51 (12-111) months.

The functional results were assessed by using an overall clinical score based on 4 clinical symptoms (dysphagia, chest pain, regurgitation, and gastroesophageal reflux) derived from Eckardt score (Table III).[4] The functional results were considered as excellent (score = 0), satisfactory (score = 1 or 2 with 2 different symptoms), fair (score = 2 or 3), and poor (score > 3 or any patient requiring reoperation or postoperative pneumatic dilation). Dysphagia was also assessed separately by using a dysphagia score and was considered as excellent (none, score = 0), satisfactory (weekly, score = 1), fair (daily, score = 2), or poor (each meal, score = 3). Perioperative data (duration of surgery, morbidity, conversion to open surgery, intraoperative mucosal tear, length of hospital stay, feeding resumption time) were collected for each patient. A barium swallow was performed in all patients 1 month after surgery. A complete workup including esophageal manometry, endoscopy, 24-hour pHmetry, and barium swallow was carried out

Table III. Overall clinical score*

Score	Dysphagia	Chest pain	Regurgitation	Gastroesophageal reflux
0	None	None	None	None
1	Occasional	Occasional	Occasional	Occasional
2	Daily	Daily	Daily	Daily
3	Each meal	Each meal	Each meal	Each meal

*Modified from Eckardt et al.[4]
Functional results were considered as excellent (score = 0), satisfactory (score = 1 or 2 with 2 different symptoms), fair (score = 2 or 3), and poor (score = > 3 or any patient requiring reoperation or postoperative pneumatic dilation).

in patients with a > 2 overall clinical score or any gastroesophageal reflux symptom at 3 months (laparoscopy group, n = 20; open surgery group, n = 14). The postoperative follow-up refers to the time elapsed between surgery and last functional evaluation. None of the patients was lost to follow-up.

Quantitative variables were compared by using nonparametric tests (Wilcoxon rank test for paired data and Mann-Whitney for unpaired data) (Statview Software; SAS Institute Corporation, Cary, NC). Fisher exact test was used to compare qualitative variables. Results are expressed as medians (ranges). Statistical significance was $P < .05$. Functional results were assessed on an intention-to-treat basis.

RESULTS

Clinical and manometric data were similar in the 2 groups except for significantly higher age, higher rate of cardiac or respiratory comorbidity, and worse physical status evaluated on ASA classification ($P<.02$) in the open surgery group (Table II). Pre-, intra-, and postoperative data are shown in Table IV. The operative time was significantly longer in the laparoscopy group. Eight inadvertent intraoperative mucosal tears (10%, n = 8/82) occurred in 6/52 (12%) laparoscopy patients and in 2/30 (7%) open surgery patients. Of the 6 laparoscopy patients, 4 had been previously treated with pneumatic dilation (4, 1, 2, and 2 times, respectively), and 1 with *Clostridium botulinum* toxin injection. Of the 2 open surgery patients, 1 had had previous pneumatic dilation (3 times). Three of the 6 mucosal tears in the laparoscopy patients were located on the intra-abdominal esophagus and sutured under laparoscopic guidance (n = 3/6), whereas the other 3 were mediastinal tears, which necessitated conversion to open surgery (n = 3/6) and were responsible for a global conversion rate of 6% (n = 3/52). The postoperative hospital stay and feeding resumption time were significantly longer in the open surgery group (Table IV).

When patients with severe cardiac or pulmonary insufficiency (n = 6) or patients with epiphrenic diverticula (n = 7) were set apart from the open surgery group, median hospital stay and feeding resumption time remained shorter in the laparoscopy group 4 (3-25) versus 7 (6-12) days ($P < .001$), and 2 (1-15) versus 4 (2-5) days ($P < .001$).

Overall morbidity is shown in Table V. There were no postoperative deaths in either group, and major morbidity rates were not significantly different (2% vs 3%), with only 1 complication in each group. In the laparoscopy group, a postoperative esophageal fistula was diagnosed on day 4 by a pleural effusion in a 74-year-old man who had undergone an uneventful procedure with a negative methylene blue test. Electrocautery-induced thermal damage to the mucosa was possibly responsible for such a complication. The patient was successfully treated with nasogastric suction, parenteral nutrition, antibiotics, and thoracic drainage. In the open surgery group, an intraoperative cardiac failure led to postoperative admission of a 69-year-old woman with a severe cardiovascular disease to the intensive care unit, but the outcome was successful.

In both groups, the postoperative overall clinical score was significantly lower than the preoperative value (open surgery group, 0.5 [0-4] vs 6.5 [3-9], $P < .0001$; laparoscopy group, 0.5 [0-4] vs 6 [3-9], $P < .0001$) (Table IV).

Global excellent or satisfactory results assessed on the dysphagia score and the overall clinical score were observed in 93% (n = 76/82) and 83% (n = 64/82) of patients, respectively. The global symptomatic gastroesophageal reflux rate was 9% (n = 7/82). The rates of excellent or satisfactory results in laparoscopy and open surgery patients were 92% (n = 48/52) versus 93% (n = 28/30) (NS) on dysphagia score and 83% (n = 43/52 vs n = 25/30) (NS) on overall clinical score. The symptomatic gastroesophageal reflux rates in the laparoscopy and open surgery groups were 10% and 7%, respectively (NS).

Among the 34 patients who underwent a complete postoperative workup, postoperative median LES pressures in the laparoscopy (n = 20) and open surgery (n = 14) groups were 10 (7-13) and 11 (7-14) mm Hg, respectively (NS). The postoperative median esophageal diameter measured on the barium swallow in the laparoscopy and the open surgery groups were 4 (3-6) and 4 (3-7) cm (NS). Furthermore, barium swallow and endoscopy

Table IV. Pre-, intra-, and postoperative data in 82 patients operated on for esophageal achalasia

	Laparoscopy (n = 52)	*Open surgery (n = 30)*	P *value*
Preoperative overall clinical score	6 (3-9)	6.5 (3-9)	NS
Operative time (min)	145 (95-290)	120 (70-230)	*P* < .0001
Mucosal tear (%)	n = 6 (12%)	n = 2 (7%)	NS
Feeding resumption time (days)	2 (1-15)	4 (1-14)	*P* < .0001
Postoperative hospital stay (days)	4 (3-25)	7.5 (5-18)	*P* < .0001
Gain of weight (kg)	1 (0-15)	1 (0-7)	NS
Postoperative overall clinical score	0.5 (0-4)	0.5 (0-4)	NS
Excellent and satisfactory results (overall clinical score)	n = 43 (83%)	n = 25 (83%)	NS
Excellent and satisfactory results (dysphagia score)	n = 48 (92%)	n = 28 (93%)	NS
Symptomatic gastroesophageal reflux*	n = 5 (10%)	n = 2 (7%)	NS
pHmetric gastroesophageal reflux*	n = 6 (11.5)	n = 3 (10%)	NS

*pHmetric studies were only performed in 34 patients with either clinical gastroesophageal reflux, or overall clinical score > 2 at 3-month follow-up.

Table V. Overall morbidity in 82 patients operated on for esophageal achalasia

	Laparoscopy (n = 52)	*Open surgery (n = 30)*	P *value*
Mortality	n = 0 (0%)	n = 0 (0%)	NS
Overall morbidity	n = 4 (8%)	n = 5 (17%)	NS
Major complications	Esophageal fistula (n = 1 [2%])	Cardiac failure (n = 1 [3%])	NS
Other complications	Pleural effusion (n = 1)	Wound abscess (n = 1)	NS
	Deep venous thrombosis (n = 1)	Incisional hernia (n = 1)	
		Pneumopathy (n = 1)	
	Urinary bladder retention (n = 1)	Urinary bladder retention (n = 1)	

showed no signs of fundoplication failure (misplaced, herniated, or too tight fundoplication) or gastric outlet obstruction secondary to pylorospasm. Nevertheless, in 17/34 of these patients, the medium contrast progress on barium swallow was found to be relatively slow but with no evidence of mechanical obstruction at the cardial or pyloric level. Radiologic gastroesophageal reflux was shown in 4 of the 7 patients with clinical and pHmetric evidence of acid reflux. The results of pHmetric studies confirmed all the gastroesophageal clinically detected reflux (n = 7) but revealed 2 other clinically asymptomatic cases. Results of 24-hour pHmetry in this 34-patient group (pH < 4, > 4% in 24 hours, n = 9; < 4% in 24 hours, n = 25) indicate an objective gastroesophageal reflux rate of 26% among symptomatic patients. Poor results were however observed in 3 laparoscopy and 2 open surgery patients, mainly due to persistent dysphagia, regurgitation, and chest pain. Repeat complete workup, however, failed to evidence fundoplication failure in any of these 5 patients. LES resting pressure in these 5 patients were 7, 9, 11, 13, and 14 mm Hg. In the present series, no case of recurrent dysphagia among patients with satisfactory postoperative dysphagia relief was observed.

Repeat assessment of functional status over the first-year follow-up demonstrated a significant improvement as shown by the increased number of patients with excellent and satisfactory results assessed on overall clinical score, whereas this number remained nearly unchanged from the 3-month outpatient review onwards for results assessed on dysphagia score (Table VI). This functional status improvement is also illustrated by the decreasing median overall clinical score (Fig 2) and the stable median dysphagia score (Fig 3) during the first-year follow-up. Among the 34 patients who underwent a complete postoperative workup, functional results improved with good or excellent overall clinical score in 11/20 (55%) in the laparoscopy group and in 9/14 (64%) in the open surgery group at 12-month follow-up. In the laparoscopy group, chest pain was observed in 13 of the 20 patients. The pain was scored as follows: weekly, n = 8; daily, n = 3; each meal, n = 2. Chest pain improved in 11 patients with disappearance in

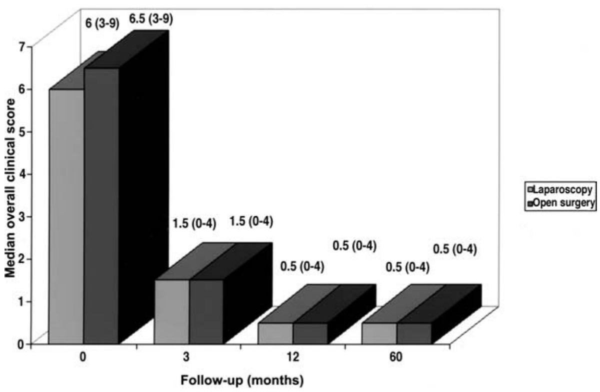

Fig 2. Evolution of functional results on median overall clinical score in the laparoscopy and the open surgery groups. In both groups, the median overall clinical score was significantly lower at 12-month follow-up than at 3-month follow-up. (Wilcoxon signed-rank test, open surgery group $P < .002$, laparoscopy group $P < .0001$).

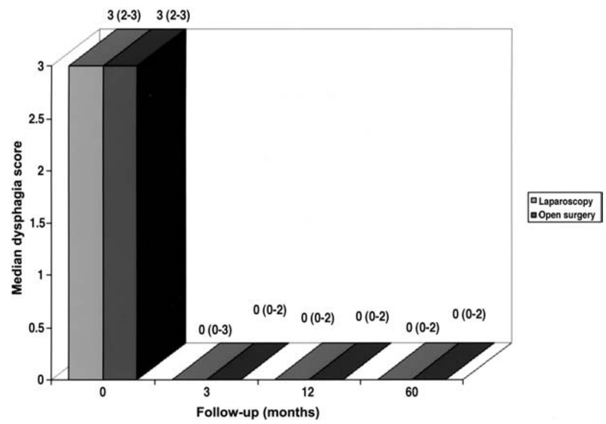

Fig 3. Evolution of functional results on dysphagia score in the laparoscopy and the open surgery groups. Median dysphagia score remained stable after 3-month follow-up in both groups.

Table VI. Number of patients with excellent and satisfactory results at 3, 6, and 12 months evaluated on overall clinical score and dysphagia score

		3 mo	*6 mo*	*12 mo*	P *value*
Laparoscopy (n = 52)	Overall clinical Score	34	40	43	$P = .0056$*
	Dysphagia score	47	48	48	NS*
Open surgery (n = 30)	Overall clinical score	18	22	25	$P < .0001$*
	Dysphagia score	26	27	28	NS*

*Refers to the comparison of satisfactory and excellent results between 3 and 12 months obtained with the Fisher exact test.

9. In the open surgery group, chest pain was observed in 8 of the 14 patients. The pain was scored as follows: weekly, n = 5; daily, n = 2; each meal, n = 1. Chest pain improved in 6 patients with disappearance in 4. Only 1 laparoscopy patient experienced de novo chest pain.

DISCUSSION

Studies comparing laparoscopic to conventional open Heller myotomy for the treatment of esophageal achalasia are very few.[9] Furthermore, most laparoscopy reports have mainly analyzed feasibility, short-term results[7,9,11-17] and good functional outcome mostly referring to dysphagia.[9,11-14,16,17,20] The aim of the present nonrandomized prospective study was to compare laparoscopic to open Heller myotomy focusing on longer-term assessment of functional results via both an overall clinical score and a dysphagia score. This comparative evaluation was unbiased by the operative variability, since all the patients were operated on by the same senior surgeon who used the same Heller-Dor technique for both laparoscopic and open surgery. The 2 groups differed with the open surgery group having higher ages, higher rate of cardiac or respiratory comorbidity, and worse physical status as evaluated by ASA classification. Such differences between the 2 groups could have theoretically biased the functional results. Nevertheless, we considered that, in clinical practice, such preoperative differences between the 2 groups had no potential impact on GI symptoms and were therefore unlikely to affect our outcome assessment tool. The age distribution of our patients (Fig 1) illustrates that open surgery was more frequently proposed to older patients in view of higher prevalence of medical and surgical contraindications and due to greater reluctance to minimally invasive surgery technique in the earlier part of our experience. The indications for open surgery in the current study decreased with time and the growing experience of our anesthesist team. From now on, low situated epiphrenic diverticulum and most patients with impaired general health status are treated laparoscopically. The only indications for open surgery include patients with previous multiple upper mesocolic surgery or high-seated esophageal diverticulum.

The present series confirms the short-term benefits of laparoscopic surgery, including reduced scar, shorter hospital stay, earlier oral feeding resumption, and quicker recovery, as reported by Ancona et al.[9] We also observed a longer median operative time (145 minutes) for laparoscopic myotomy, which is similar to the 114 to 216 minutes of operative time previously reported in most Heller-Dor laparoscopy series.[6,7,9,11,12,16,19-21] The reported rate of esophageal mucosal tears during laparoscopic Heller myotomy ranges from 4% to 15%,[6,7,10-12,15-17,19,20] a rate similar to ours (12%). We agree with most authors[6,11,12,14,16,19-21] that laparoscopic suture of mucosal tears is a safe procedure and particularly adequate for abdominal esophagus tears. In 3 cases, however, intramediastinal tears located at the upper end of the myotomy were repaired after conversion to open surgery. This strategy was responsible for our 6% rate of conversion to open surgery, which is comparable to the 0% to 13% previously reported rates.[6,7,9,11-12,14-17, 19-21] The rate of mucosal tears is found to be lower after open surgery (7%) and similar to other reported rates ranging from 1 to 7%.[22-25] This may be due to better manual perception of the thickened muscular wall of the esophagus during open surgery. The use of intraoperative endoscopy has been proposed to calibrate the esophagogastric junction for safer and more complete myotomy,[10,11,19-21] which is technically similar to the 36-French Faucher tube we used in our patients. A recent study has also advocated the benefit of intraoperative endoscopy to prevent the risk of incomplete myotomy, due to the frequent discrepancy between the anatomic and endoscopic esophagogastric junction.[21] Our manometric data in patients with postoperative symptoms did not evidence the elevated LES resting pressure that is usually observed in case of incomplete myotomy. In view of our results, we believe that extending the myotomy 2 cm below the anatomic cardia ensures adequate length with no need for intraoperative endoscopy. The overall morbidity rates after laparoscopic and open surgery were not significantly different, but the 17% morbidity rate in open surgery patients was nearly twice as high as the 8% laparoscopy morbidity rate, which was comparable to the 0% to 13% rates reported in main laparoscopy series.[7,9-11,14,16,17,19,20] The higher morbidity rate in our open surgery group may be related to higher prevalence of respiratory/cardiac comorbidity and previous upper abdominal surgery. Our only major complication observed in the laparoscopy group was a delayed esophageal fistula potentially related to an electrosurgery induced thermal damage to the mucosa. This complication may be avoided by using laparoscopic scissors rather than an L-shaped hook, even if it is protected on its convex part to divide the muscularis.

At a median 51-month follow-up, laparoscopic Heller myotomy was found to compare favorably with open surgery in view of the excellent dysphagia relief and low symptomatic esophageal reflux rate (10%) observed in our laparoscopy patients. However, our reflux rate may be underestimated in both groups, as only 38% of the laparoscopy patients and 47% of open surgery patients underwent 24-hour pH monitoring, as part of a complete workup selectively performed in symptomatic patients. Similar findings have been reported in most laparoscopy and open surgery series with about 90% excellent or good functional results regarding dysphagia,[2,6,7,9-17,19,20,22-25] and a low gastroesophageal reflux rate of 2.5-17%.[6,7,9,11-17,19,22-25] Unlike most authors,[9,11,12,14,16,20,22-25] we have used an overall clinical score based on 4 clinical symptoms, including dysphagia, regurgitation, chest pain, and gastroesophageal reflux, for functional outcome assessment. Some authors have already used clinical scores to assess clinical symptoms related to achalasia; a significant postoperative decrease in all the symptom scores or overall clinical scores has previously been reported.[6,7,10,13,15,17,19,26] Nevertheless, such clinical scores have rarely been used to determine good or excellent functional results after laparoscopic myotomy.[26] This is the reason why our rate of patients with excellent or satisfactory functional results assessed on an overall clinical score taking 4 symptoms into account was 10% lower (83%) than the dysphagia-based 90% rate reported in our series (93%) and in most reports.[6,7,9,11-17,19,20,22-25] Thus, the overall clinical score indicates that about 20% of our patients still complain of chest pain or gastroesophageal reflux. All of these symptomatic patients underwent a complete postoperative workup. In all patients, whatever the surgical technique, postoperative LES resting pressures were within normal values.[2,6,7,17,19,23] Radiologic and endoscopic findings failed to demonstrate misplaced or herniated fundoplication,[27] or gastric obstruction due to pylorospasm.

Whether an antireflux procedure should be associated with laparoscopic Heller myotomy is still controversial,[24] with some authors advocating minimal esophagus dissection without division of the anatomic antireflux mechanisms.[17] The efficacy of the anterior partial fundoplication technique as an antireflux procedure may be all the more questioned because it is outside the scope of the latest laparoscopic antireflux studies that have been focused exclusively on the results after total and posterior partial fundoplication.[28,29] However, most authors recommend the association of an anterior partial fundoplication with Heller myotomy to prevent both fibrous retraction and gastroesophageal reflux.[6,7,9,12,13,15,19,21,22] Interestingly, a recent prospective randomized trial has compared laparoscopic Nissen fundoplication to anterior partial fundoplication for the treatment of gastroesophageal reflux and proved laparoscopic anterior fundoplication to achieve equivalent control of reflux with significantly less postoperative dysphagia at 6 months.[30] Thus, the short-term efficacy of the anterior partial fundoplication, as an antireflux procedure has first been demonstrated by this randomized trial.[30] Nevertheless, the present study has not been designed to study gastroesophageal reflux as only 34 patients had pHmetric studies. The gastroesophageal rate has certainly been underestimated as demonstrated by the 2 other asymptomatic cases diagnosed by pHmetry. The efficiency of anterior fundoplication on gastroesophageal reflux cannot therefore be sustained by our work.

An unexpected finding of repeat evaluation during follow-up was the significant improvement of functional status over the first year, when assessed on the overall clinical score, whereas the dysphagia score remained nearly unchanged from the 3-month outpatient review onwards. This discrepancy seems to be due to the persistence of chest pain as suggested by a previous report on patients treated for achalasia. In this study, chest pain has been shown to persist despite efficient dysphagia relief after myotomy or pneumatic dilation.[31] Eckardt et al[31] also reported that chest pain diminished in most patients with the passage of time. Our results indicate that a 1-year delay is required for optimal functional assessment after myotomy. Nevertheless, we agree with previous reports that the quality of life after laparoscopic Heller procedure with either partial anterior or partial posterior fundoplication is greatly improved for most patients.[32-34] In return, series focusing on long-term results have shown functional outcome to deteriorate with time, leading to an increased rate of heartburn and recurrent dysphagia.[2,22,25,35] Such deterioration may be due to bridging fibrosis of the myotomy, late consequences of reflux, or natural history of the diseased esophagus. However, no patient of our study population developed recurrent dysphagia after postoperative dysphagia relief at a median follow-up of 51 months.

CONCLUSION

Laparoscopic Heller myotomy favorably compares with open surgery in terms of excellent dysphagia relief and low gastroesophageal reflux rate. Functional results assessed on an overall clinical score gradually improved during the first-year follow-up, but 20% of patients still suffer from occasional chest pain or gastroesophageal reflux, indicating that surgical myotomy is a palliative but not curative treatment of achalasia. As the functional results after surgical treatment of achalasia may deteriorate with time,[2,22,25,35] longer follow-up is needed for long-term result assessment and further comparative evaluation.

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