

Laparoendoscopic single-site Heller myotomy with anterior fundoplication for achalasia

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Abstract

Background Laparoendoscopic single-site (LESS) surgery is beginning to include advanced laparoscopic operations such as Heller myotomy with anterior fundoplication. However, the efficacy of LESS Heller myotomy has not been established. This study aimed to evaluate the authors' initial experience with LESS Heller myotomy for achalasia. **Methods** Transumbilical LESS Heller myotomy with concomitant anterior fundoplication for achalasia was undertaken for 66 patients after October 2007. Outcomes including operative time, complications, and length of hospital stay were recorded and compared with those for an earlier contiguous group of 66 consecutive patients undergoing conventional multi-incision laparoscopic Heller myotomy with anterior fundoplication. Symptoms before and after myotomy were scored by the patients using a Likert scale ranging from 0 (never/not severe) to 10 (always/very severe). Data were analyzed using the Mann–Whitney *U* test, the Wilcoxon matched-pairs test, and Fisher's exact test where appropriate.

Results Patients undergoing LESS Heller myotomy were similar to those undergoing conventional laparoscopic Heller myotomy in gender, age, body mass index (BMI), blood loss, and length of hospital stay. However, the patients undergoing LESS Heller myotomies had operations of significantly longer duration (median, 117 vs. 93 min with the conventional laparoscopic approach) ($p < 0.003$). For 11 patients (16%) undergoing LESS Heller myotomy, additional ports/incisions were required. No patients were converted to “open” operations, and no patients had procedure-specific complications. Symptom reduction was dramatic and satisfying after both LESS and conventional laparoscopic myotomy with fundoplication. The symptom reduction was similar with the two procedures. The LESS approach left no apparent umbilical scar. **Conclusion** Heller myotomy with anterior fundoplication effectively treats achalasia. The findings showed LESS Heller myotomy with anterior fundoplication to be feasible, safe, and efficacious. Although the LESS approach increases operative time, it does not increase procedure-related morbidity or hospital length of stay and avoids apparent umbilical scarring. Laparoendoscopic single-site surgery represents a paradigm shift to more minimally invasive surgery and is applicable to advanced laparoscopic operations such as Heller myotomy and anterior fundoplication.

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Achalasia is an idiopathic primary esophageal motility disorder characterized by a generally hypertensive lower esophageal sphincter (LES) with unpredictable relaxation

and an aperistaltic esophageal body. Considered a rare disorder, achalasia has a reported annual incidence of 1 per 100,000 patients [1, 2]. The clinical presentation is marked by symptoms of esophageal obstruction including dysphagia, vomiting, regurgitation, and chest pain [3, 4].

The goal of treatment is to palliate the symptoms of esophageal outlet obstruction. Nonsurgical treatments include endoscopic pneumatic dilation or botulinum toxin (Botox) injections (Allergan, Irvine, CA, USA) [5]. However, the results of these management options for achalasia carry either high failure rates or only short-term effects, necessitating recurrent treatment with ever decreasing efficacy [2, 6]. Conversely, because of its efficacy and durability [7–11], laparoscopic Heller myotomy has become the standard “first line” of therapy [12–14]. It also is valuable after failure of nonsurgical management [2, 6, 15–17].

When undertaken, Heller myotomy currently is nearly uniformly applied using minimally invasive surgery techniques [8, 18]. The addition of an anterior fundoplication to the myotomy helps to prevent excessive gastroesophageal reflux that otherwise may develop afterward [2, 19]. Studies have indicated that the laparoscopic Heller myotomy with concomitant anterior fundoplication provides effective and long-lasting results with low morbidity [19–22].

Laparoendoscopic single-site (LESS) surgery, which provides surgical access to the abdominal cavity through only an unapparent scar in the umbilicus, marks the progressive evolution of minimally invasive surgery. The use of LESS surgery enhances cosmesis with “no scar”. Additional benefits of LESS surgery may include decreased postoperative pain and recovery time [23, 24]. Consequently, we have applied the LESS approach to Heller myotomy and concomitant anterior fundoplication in the surgical treatment of patients with achalasia.

This study was undertaken to demonstrate our cumulative experience using LESS Heller myotomy with anterior fundoplication and to compare this experience with that for a contiguous consecutive group of patients undergoing Heller myotomy with anterior fundoplication through a “conventional” laparoscopic approach. We hypothesized in undertaking this study that LESS Heller myotomy with fundoplication can be applied with the same efficacy and safety profile as a conventional laparoscopic Heller myotomy and fundoplication, with superior cosmetic outcomes.

Methods

Patient selection

From August 2006 to December 2009, 132 patients with symptomatic achalasia underwent a Heller myotomy with anterior fundoplication. The final 66 patients received the

transumbilical LESS approach. For comparative purposes, 66 consecutive patients undergoing conventional multi-incision laparoscopic Heller myotomy with anterior fundoplication contiguously before the initiation of LESS surgery were analyzed. Patient characteristics and outcomes including operative time defined as from the time of incision to the time of incision closure, length of stay, and complications were recorded.

Pre- and postoperatively, symptom frequency and severity were recorded at each visit using a Likert scale with a range of 0 (never/not severe) to 10 (always/very severe). Many symptoms of achalasia including dysphagia, heartburn, chest pain, vomiting, regurgitation, choking, and cough were scored. The impact of the myotomy on dysphagia with different substances (liquids, solids, and saliva) and on eating and sleeping was assessed among all the patients.

Preoperative evaluation

Together with clinical presentation, the diagnosis of achalasia was confirmed using endoscopy, radiographic studies, and occasionally esophageal manometry.

Operative technique

Our technique of conventional laparoscopic Heller myotomy with anterior fundoplication has been described previously [1, 25]. Briefly, the operation was undertaken through five trocars placed individually through five incisions, four of which were distant from the umbilicus.

For LESS Heller myotomy with anterior fundoplication, after infiltration with a local anesthetic, a 12-mm incision was made in, not around, the umbilicus. Using the natural defect in the fascia, the peritoneal cavity was entered.

Initially, multiple trocars were placed through a single umbilical skin with different fascial punctures. Once commercially available, a multitrocar port, either a multitrocar single incision laparoscopic surgery (SILS port) (Covidien, Norwalk, CT, USA) or a multitrocar Triport (Olympus, Center Valley, PA, USA), was placed through the umbilical incision and a single fascial incision at the umbilicus.

The abdomen was insufflated with carbon dioxide. A 5-mm deflectable-tip EndoEye laparoscope (Olympus) was used to visualize the operative field. Under videoscopic guidance, a 5-mm liver retractor was placed to elevate the left lobe of the liver. This provided exposure of the hiatus and the gastroesophageal junction. The gastrohepatic ligament was opened with an ultrasonic dissector in a stellate fashion. Dissection then proceeded along the right and left crura to enable adequate mobilization of the esophagus into the peritoneal cavity. Any associated hiatal hernia was reduced. Resection of the esophageal fat pad facilitated exposure of the gastroesophageal junction for the

myotomy. The myotomy was carried along the ventral esophagus and extended onto the cardia of the stomach. Care was taken to protect the vagal trunks.

Intraoperative endoscopy was undertaken for all patients to ensure an adequate myotomy with extension above and below the Z-line. We sought a myotomy sufficiently cephalad and caudad to the Z-line to allow the gastroesophageal junction to open with simple air insufflation. Each patient received an anterior fundoplication.

The anterior fundus was first secured to the esophagus in at least three areas: the left lateral edge of the myotomy, the area cephalad to the myotomy, and the right lateral aspect of the myotomy. Thereby, the entire myotomized segment was covered by the fundoplication. The esophageal hiatus then was reconstructed with a posterior curculoplasty. Next, the anterior fundoplication was secured to the right crus to avoid torsion of the esophagus and tension on the fundus.

Postoperative management

At transfer from the postanesthesia recovery unit, patients underwent esophagography to document adequate esophageal emptying and the absence of a leak. Once these were verified, the patients were started on a liquid diet and prepared for discharge the following day, if possible. The patients were maintained on a liquid diet until they were seen in the outpatient clinic, usually 7 to 10 days after myotomy.

The patients were seen again in the clinic about 2 months after myotomy and then annually, or more frequently if indicated. At each follow-up visit, patients provided feedback regarding degree of symptom resolution, defined as excellent (nearly or completely resolved symptoms), good (greatly improved symptoms—symptoms once or less per month), fair (improved symptoms—symptoms once per week or less), or poor (no improvement, worse symptoms, new troublesome symptoms).

Patients assessed overall satisfaction with the operation, reporting that they were very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, or very dissatisfied. Patients were asked whether knowing what they knew afterward, they would have the operation again. Patients unable or unwilling to be seen in the clinic were followed by phone or mail.

Data analysis

Statistical analysis compared patients undergoing LESS Heller myotomy with anterior fundoplication and patients undergoing conventional multi-incision laparoscopic Heller myotomy with anterior fundoplication using the Mann-Whitney *U* test, the Wilcoxon matched-pairs test, and Fisher's exact test, where appropriate. Graph Instat 3 (Graphpad Software, Inc., San Diego, CA, USA) was used to analyze the data. For illustrative purposes, where appropriate, data are presented as median \pm standard deviation.

Results

The median age of the patients undergoing myotomy with anterior fundoplication through LESS surgery was 51 years versus 58 years for the patients undergoing myotomy with anterior fundoplication through conventional laparoscopy. The median body mass index (BMI) of 25 kg/m² was the same for the patients undergoing either operative approach (Table 1).

Assessment of dysphagia with different substances (liquids, solids, saliva) indicated that more than 80% of the patients undergoing either the LESS or conventional laparoscopic approach reported dysphagia with liquids, solids, or both before the myotomy (Fig. 1). Before myotomy, 90% of the patients undergoing conventional laparoscopic approach and 93% of those undergoing the LESS approach stated that

Table 1 Demographic data of patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication versus laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication

	Lap Heller myotomy	LESS Heller myotomy	<i>p</i> Value
Patients (<i>n</i>)	66	66	NS
Gender (M/F)	32/34	31/35	NS
Age (years)	51 (52 \pm 18.1)	58 (55 \pm 16.6)	NS
BMI (kg/m ²)	25 (25 \pm 4.6)	25 (25 \pm 4.1)	NS
Endoscopic treatment			
w/Botox (before/after)	16/1	18/0	NS
Dilation (before/after)	45/6	36/3	NS
Operation length (min)	93 (102 \pm 32.2)	117 (120 \pm 39.4)	0.003
Blood loss (ml)	66 (< 100)	66 (< 100)	NS
Length of hospital stay (days)	1 (2 \pm 1.9)	1 (2 \pm 1.1)	NS
Conversion to open procedure	0	0	NS

Lap laparoscopic, NS not significant

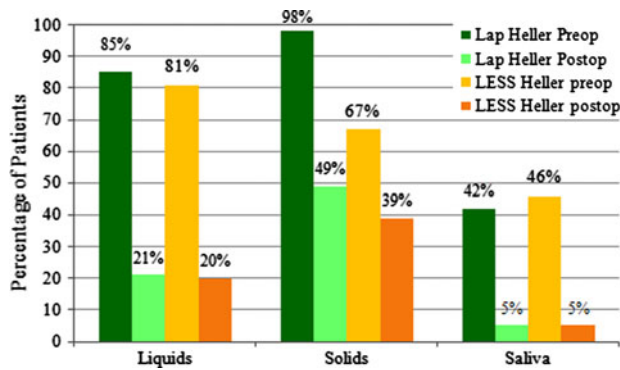


Fig. 1 Percentage of patients reporting dysphagia with different substances (liquids, solids, and saliva) before and after conventional laparoscopic Heller myotomy with anterior fundoplication or laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication (improvement with myotomy, Fisher's exact test; $p < 0.05$)



Fig. 2 Percentage of patients reporting the need to modify their eating habits before and after myotomy in a comparison between conventional laparoscopic Heller myotomy with anterior fundoplication and laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication (improvement with myotomy, Fisher's exact test; $p < 0.05$)

they had to modify their eating habits due to the achalasia (Fig. 2). Similarly, patients (69% of those undergoing conventional laparoscopy approach vs. 76% of those undergoing the LESS approach) stated that they modified their sleeping habits as a consequence of the achalasia (Fig. 3).

Patients undergoing either the LESS or conventional laparoscopic approach had similar presentations in the frequency and severity of their symptoms (Figs. 4, 5). Dysphagia, regurgitation, and choking were particularly frequent and severe (Figs. 4, 5).

Before LESS Heller myotomy with anterior fundoplication, 18 patients (32%) underwent Botox injection, and 36 patients (62%) underwent pneumatic dilation. Among the patients undergoing conventional laparoscopic Heller myotomy, 16 (28%) had previous Botox injections, and 45 (76%) had a pneumatic dilation (Table 1).

The operative duration of LESS Heller myotomy with anterior fundoplication (117 min; 120 ± 39.4 min) was

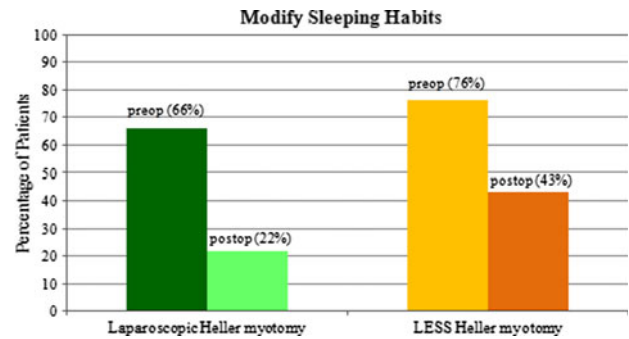


Fig. 3 Percentage of patients reporting the need to modify their sleeping habits before and after myotomy in a comparison between conventional laparoscopic Heller myotomy with anterior fundoplication and laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication (improvement with myotomy, Fisher's exact test; $p < 0.05$)

longer than that of conventional laparoscopic Heller myotomy with anterior fundoplication (93 min; 102 ± 32.2 min; $p = 0.003$). The estimated blood loss was less than 100 ml for all the patients. The median hospital stay was 1 day for patients undergoing LESS or conventional Heller myotomy and anterior fundoplication (Table 1).

Of the patients undergoing LESS Heller myotomy, 11 required placement of additional 5-mm trocars. Nine patients had an additional trocar added for retraction or exposure in the midst of extensive adhesions or intraperitoneal fat, and two patients required additional trocars to assist in the reduction of a large hiatal hernia. None of the operations were converted to open procedure (Table 2). The umbilical incisions for the patients undergoing LESS surgery healed with unapparent scars.

Among the patients undergoing LESS Heller myotomy with anterior fundoplication, there was one inadvertent esophagotomy and one inadvertent gastrotomy. Intraoperatively, among the patients undergoing the conventional laparoscopic approach, there were three gastrotomies, six esophagotomies, and two capnothoracies (Table 2). Although no perioperative deaths occurred, serious complications not related to the Heller myotomy or anterior fundoplication were experienced by 3 of the 66 patients undergoing the LESS approach including dysrhythmia with a new left bundle branch block, a non-ST elevated myocardial ischemic event, and a small leak from an esophageal diverticulectomy site occurring 2 weeks postoperatively.

During the postoperative period, among the patients undergoing the conventional laparoscopic Heller myotomy with anterior fundoplication, one patient had atrial fibrillation, and one patient had a prolonged ileus. No perioperative deaths occurred.

Some patients underwent postoperative endoscopic treatments, always without specific indications for intervention. Among the patients receiving conventional

Fig. 4 Self-assessment of frequency of achalasia symptoms before myotomy in a comparison between patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication and those undergoing laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication

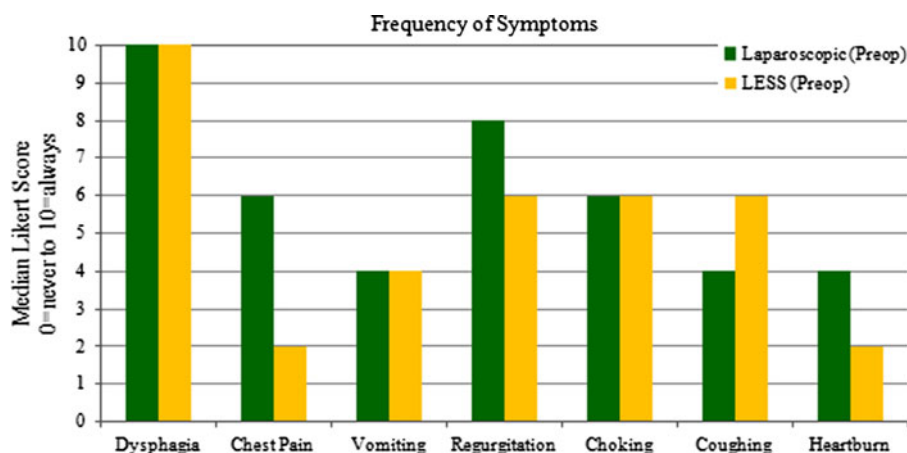


Fig. 5 Self-assessment of severity of achalasia symptoms before myotomy in a comparison between patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication and those undergoing laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication

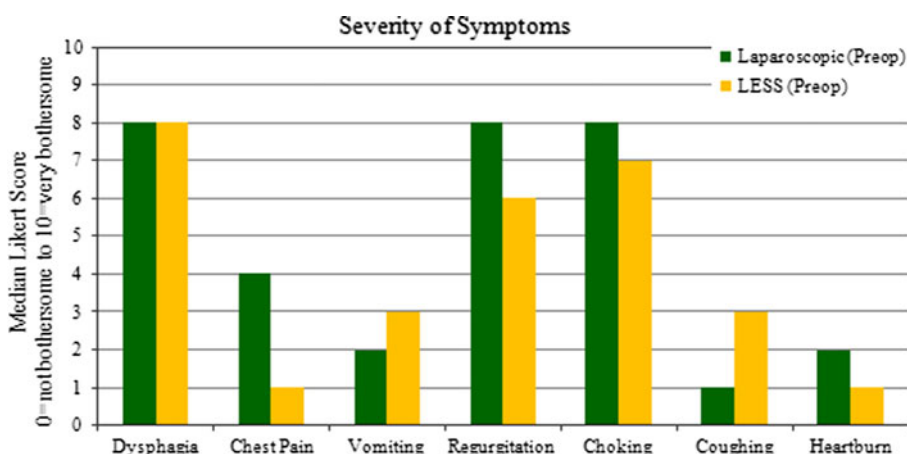


Table 2 Comparison of perioperative events and complications among patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication versus laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication

	Lap Heller myotomy	LESS Heller myotomy
Patients (<i>n</i>)	66	66
Intraoperative events: % (<i>n</i>)	16 (11)	3 (2)
	Esophagotomy (6)	Esophagotomy (1)
	Gastrotomy (3)	Gastrotomy (1)
	Capnothorax (2)	
Postoperative events: % (<i>n</i>)	3 (2)	4.5 (5 in 3 patients)
	Atrial fibrillation (1)	Myocardial infarction (1)
	Ileus (1)	Atrial fibrillation (2)
		Left bundle branch block (1)
		Leak at diverticulectomy site (1)
Perioperative mortality	0	0
Additional ports (1–2) % (<i>n</i>)	NA	16 (11)
		For additional exposure
		Extensive adhesions (2)
		Large hiatal hernia (6)
		Excessive intraperitoneal fat (exposure) (3)

NA not available

laparoscopic Heller myotomy with anterior fundoplication, one patient had a Botox injection, and six patients received a pneumatic or tapered dilation procedure. No patients who underwent LESS Heller myotomy with anterior fundoplication received a Botox injection, but three patients did undergo dilation (Table 1). No patients were suspected or known to have had an inadequate myotomy.

Postoperatively, there was a significant decrease in dysphagia with liquids and saliva ($p < 0.05$ for both, Fisher's exact test; Fig. 1). Of all the patients, 20% reported dysphagia with liquids, and 5% reported dysphagia with saliva (Fig. 1). Patients reported a significant decrease in dysphagia with solids (49% of the patients after the conventional laparoscopic Heller myotomy with anterior fundoplication vs. 39% of the patients after LESS surgery; $p < 0.05$, Fisher's exact test; Fig. 1).

After myotomy, the number of patients requiring adjustments in their eating habits decreased significantly irrespective of operative approach ($p < 0.05$, Fisher's exact test; Fig. 2). Postoperatively, adjustments in sleeping habits significantly decreased for the patients undergoing the conventional laparoscopic Heller myotomy with anterior fundoplication and those undergoing LESS Heller myotomy with anterior fundoplication ($p < 0.05$, Fisher's exact test; Fig. 3).

The patients undergoing the conventional laparoscopic approach and those undergoing the LESS approach all reported significant decreases in the frequency and severity of their symptoms ($p < 0.05$, Wilcoxon matched-pairs test; Figs. 6, 7). Specifically, the reduction in dysphagia was profound and significant. The reduction in frequency and severity of heartburn compared with the preoperative assessment was statistically significant ($p < 0.05$, Wilcoxon matched-pairs test; Figs. 6, 7).

Symptom resolution was perceived to be excellent or good for 82% of the patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication and

88% of the patients after LESS Heller myotomy with anterior fundoplication (Figs. 8, 9). Most of the patients (94%) undergoing LESS Heller myotomy with anterior fundoplication considered the overall surgical experience to be satisfactory or very satisfactory, and 90% of the patients who underwent the conventional laparoscopic approach were satisfied or very satisfied (Figs. 10, 11). All the patients (100%) undergoing the conventional laparoscopic approach and 98% of the patients receiving the LESS approach would have the surgery again knowing what they knew afterward.

Discussion

Achalasia, a disorder of esophageal motility, often is delayed in diagnosis and evolves into a chronic problem. No cure currently exists, and the only way to manage the disorder is with palliative therapies. Laparoscopic Heller myotomy has proved to be superior to endoscopic techniques of Botox and dilation in improving symptoms and duration of effect [2]. The addition of an anterior fundoplication decreases symptoms of acid reflux without exacerbating or promoting dysphagia [19, 20].

Given our uniquely large number of patients with achalasia and our extensive experience using laparoscopic Heller myotomy with anterior fundoplication as well as LESS surgery, application of the LESS approach to Heller myotomy with anterior fundoplication was a natural evolution for advanced minimally invasive techniques. In this article, we document our experience using LESS Heller myotomy with anterior fundoplication and provide the first report on a large continuous number of patients undergoing the procedure. By using a similarly large contiguous number of continuous patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication for comparison, we are able to demonstrate outcomes supporting application of the LESS approach.

Fig. 6 Self-assessment of the frequency of achalasia symptoms before and after myotomy in a comparison between patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication and those undergoing laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication. *asterisk* Less than before myotomy (Wilcoxon matched-pairs test; $p < 0.05$)

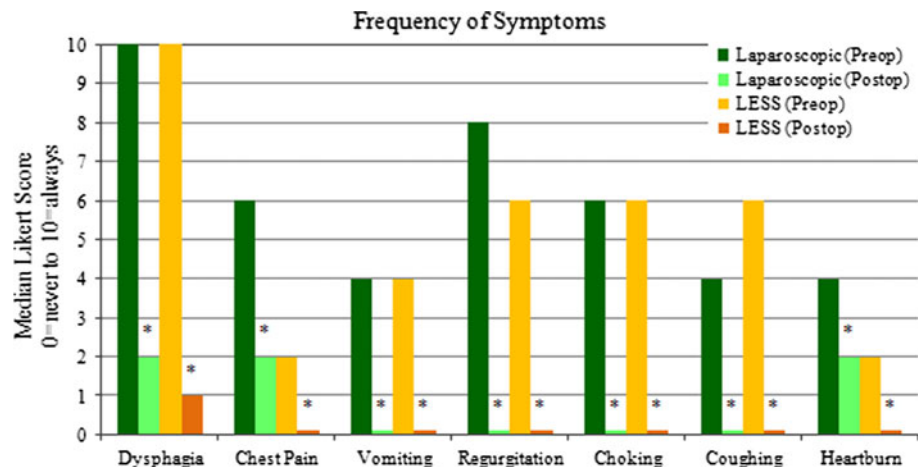


Fig. 7 Self-assessment of the severity of achalasia symptoms after myotomy in a comparison between patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication and those undergoing laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication. *asterisk* Less than before myotomy (Wilcoxon matched-pairs test; $p < 0.05$)

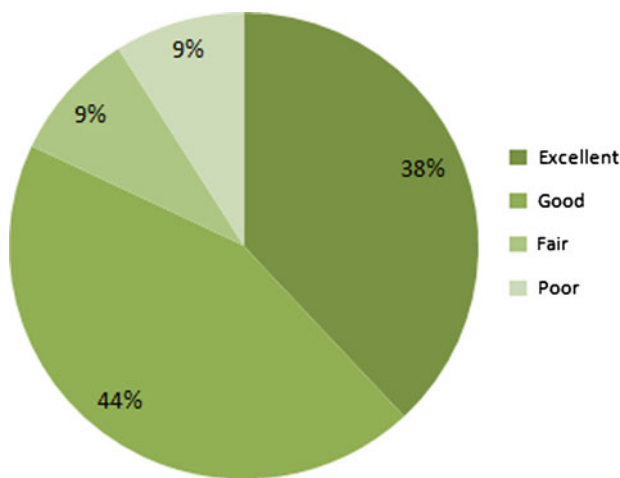
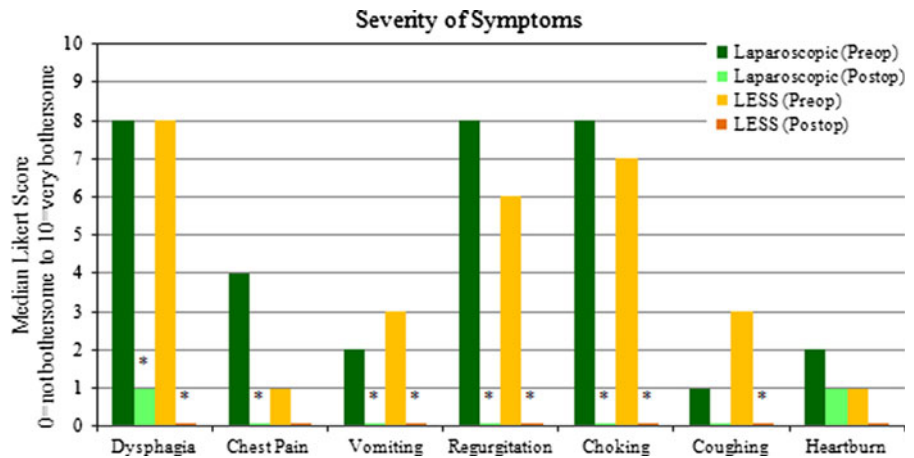


Fig. 8 Self-assessment of the resolution of achalasia symptoms among patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication

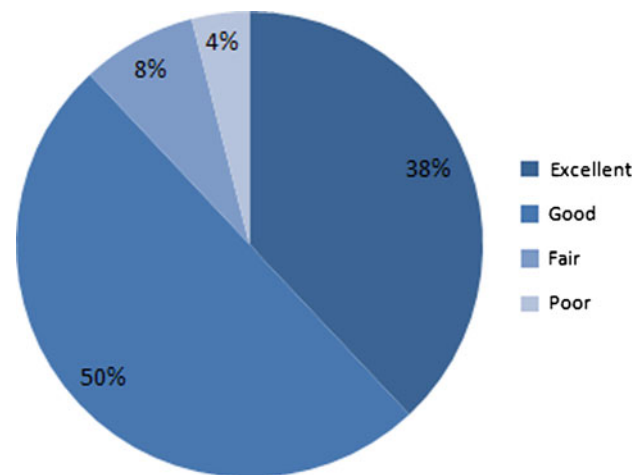


Fig. 9 Self assessment of the resolution of achalasia symptoms among patients undergoing laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication

The patients undergoing Heller myotomy with anterior fundoplication through LESS surgery or conventional techniques were similar in gender, age, BMI, blood loss, and length of hospital stay. The outcomes associated with the LESS approach were not adversely affected by the longer duration of the operation. The longer operative time associated with the LESS approach may be reflective of the learning curve in the application of a new approach. As more patients undergo LESS Heller myotomy with anterior fundoplication, we anticipate that the operation will be shorter in duration.

For a small but select number of patients, placement of an additional trocar distant to the umbilicus facilitated the LESS surgery approach. Only in a minority of patients was an additional trocar added, generally, only one more trocar. Although the original intent was to use the LESS approach, safety was and always is the predominant goal, which may dictate the use of an additional trocar.

Appropriate clinical judgment was and should always be used to determine when additional ports will facilitate the operation. It is important to recognize the circumstances that may warrant an additional trocar to assist with exposure, such as extensive adhesions, a large hiatal hernia, or a concurrent esophageal diverticulum. Even the addition of one or two trocars to the LESS procedure results in less than the five trocars through five incisions used in undertaking conventional laparoscopic Heller myotomy with anterior fundoplication. With the placement of a 5-mm trocar lateral to the anterior axillary line, the additional incisions and their scars were not noticeable to the patients.

No perioperative mortality occurred. Intraoperative events such as esophagotomy, gastrotomy, and capnothorax are known to occur with Heller myotomy regardless of the operative approach used. In our series, these intraoperative events occurred for few patients undergoing LESS Heller myotomy with anterior fundoplication or conventional laparoscopy. The postoperative complications seen,

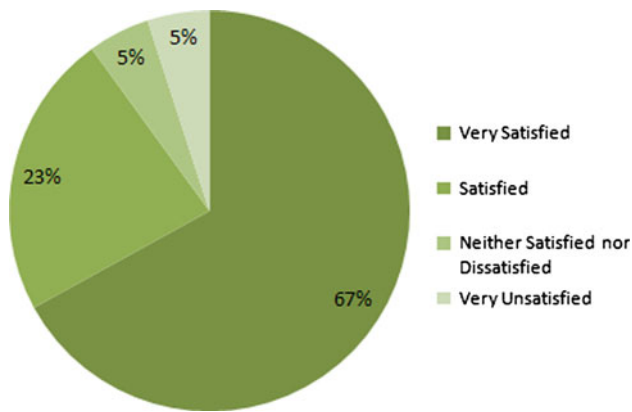


Fig. 10 Self-assessment of patient satisfaction among patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication

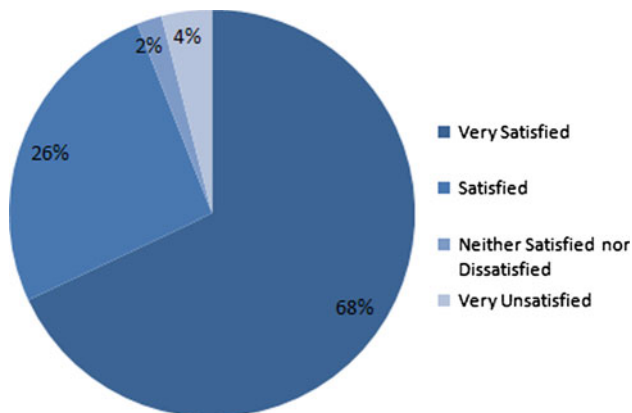


Fig. 11 Self-assessment of patient satisfaction among patients undergoing laparoendoscopic single-site (LESS) Heller myotomy with anterior fundoplication

such as myocardial infarction or dysrhythmia, were related to the underlying comorbidities of the patients rather than the operative approach used or the myotomy/fundoplication itself.

Because the increased operative time could exacerbate medical comorbidities, appropriate patient selection should be used to determine whether a patient is a candidate for a LESS procedure. Additional ports should be used to reduce operating time if there is any concern of increased risk to the patient by extending the operative duration.

The follow-up period was longer for the patients undergoing conventional laparoscopic Heller myotomy with anterior fundoplication because these patients had their operations before we began our LESS surgery experience. We have used the LESS procedure only over the past 2 years.

We previously documented that early results after myotomy predict long-term results, although some less than satisfactory early results improve. With long-term follow-up evaluation of patients after laparoscopic Heller

myotomy, symptoms of achalasia, particularly dysphagia, may recur, but that is uncommon. Patients with long-term follow-up evaluation are significantly improved relative to before their myotomy [26]. We anticipate that with extended follow-up evaluation, the same will be said about the patients undergoing LESS surgery because the laparoscopic approach, not the surgical technique (i.e., the myotomy), is the key difference.

Close patient follow-up assessment demonstrated that patients undergoing LESS Heller myotomy with anterior fundoplication had significant improvement of all the symptoms queried (including dysphagia, vomiting, regurgitation, choking, chest pain, and heartburn), similar to the improvement after the conventional laparoscopic approach.

The benefit of concomitant anterior fundoplication with Heller myotomy for patients undergoing both the conventional laparoscopic and LESS approaches is suggested by the notable reduction in the frequency and severity of heartburn postoperatively. The vast majority of patients undergoing LESS Heller myotomy with anterior fundoplication believed that their overall symptom resolution was either excellent or good by rigorous definition. Patient satisfaction was very high among the patients undergoing the LESS approach and those undergoing the conventional laparoscopic approach.

Because LESS surgery leaves an unapparent scar in the natural defect of the umbilicus, it has been promoted as providing excellent cosmesis [23, 24]. We agree. With the development of new technology and surgical instruments, LESS surgery currently is being applied to a wide variety of surgical techniques, such as cholecystectomy and Nissen fundoplication, as well as Heller myotomy. This study demonstrated that LESS Heller myotomy with anterior fundoplication can be performed safely with efficacy similar to that of the conventional multiport laparoscopic Heller myotomy and a superior cosmetic outcome (i.e., unapparent scarring).

Laparoendoscopic single-site surgery represents a paradigm shift to more minimally invasive surgery and currently can be applied to laparoscopic Heller myotomy with anterior fundoplication. The efficacy of the procedure is validated by very salutary outcomes and high degrees of patient satisfaction. The LESS approach has the additional benefit of improved cosmesis. This study demonstrated that LESS Heller myotomy with anterior fundoplication is a safe, feasible, and cosmetically superior alternative to the conventional laparoscopic approach in the surgical management of achalasia.

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