

Laparoscopic Heller Myotomy and Anterior Fundoplication for Achalasia Results in a High Degree of Patient Satisfaction

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Hypothesis: Laparoscopic Heller myotomy with anterior fundoplication will alleviate the symptoms of achalasia and result in excellent patient satisfaction.

Design: Retrospective study of consecutive patients who underwent laparoscopic Heller myotomy with anterior fundoplication for achalasia between October 1995 and July 1999. A telephone survey assessed symptoms and satisfaction. Patients were asked to quantitate their symptoms on a scale of 0 to 3 (0=none; 1, mild; 2, moderate; and 3, severe).

Setting: University referral center.

Patients: Twenty-four patients who underwent laparoscopic Heller myotomy with anterior fundoplication for achalasia.

Main Outcome Measures: Postoperative symptoms and satisfaction.

Results: Twenty-one patients (88%) were successfully contacted. Mean follow-up was 16.5 months. The lapa-

roscopic approach was successful in all but 3 (88%). The mean dysphagia score was 2.81 preoperatively and 0.81 postoperatively ($P<.000$). The mean chest pain score was 1.57 preoperatively and 0.86 postoperatively ($P<.015$). The mean supine regurgitation score was 2.10 preoperatively and 0.57 postoperatively ($P<.000$). The mean upright regurgitation score was 1.57 preoperatively and 0.52 postoperatively ($P<.000$). The mean heartburn score was 1.57 preoperatively and 0.57 postoperatively ($P<.000$). Postoperatively, 18 (86%) of 21 patients could swallow bread without difficulty and 17 (89%) of 19 patients could eat meat without difficulty (2 were excluded as they were vegetarians). Twenty (95%) of 21 patients reported improvement after the operation.

Conclusions: Laparoscopic Heller myotomy with anterior fundoplication significantly relieves the symptoms of achalasia without causing the symptoms of gastroesophageal reflux disease. This procedure results in excellent overall patient satisfaction.

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ACHALASIA IS a primary disorder of esophageal motility of unclear origin. It is characterized by aperistalsis of the esophageal body and a hypertensive lower esophageal sphincter (LES). Symptoms of achalasia include dysphagia, regurgitation, heartburn, chest pain, and cough. The diagnosis is confirmed by manometric and contrast swallow studies. Current therapeutic options consist of blunt or pneumatic dilatation, botulinum toxin (Botox) injection, and operative esophagomyotomy.

Previously, esophagomyotomy required either a thoracotomy or a laparotomy. Both techniques were shown to have superior efficacy when compared with pneumatic dilatation.^{1,2} With the advent of minimally invasive surgical techniques, esophagomyotomy can now be safely performed either thoracoscopically or laparoscopically with similar results to the open procedures.³⁻⁶ The laparoscopic approach avoids the need for a chest tube postoperatively and it makes it easier to extend the myotomy onto the stomach.⁷ Several recent studies have suggested that the laparoscopic approach may be the procedure of choice for the surgical treatment of achalasia.⁸⁻¹¹ Some controversy exists regarding whether a concomitant fundoplication is necessary to avoid postoperative reflux symptoms¹²⁻¹⁴ and, additionally, whether to perform an anterior or posterior fundoplication.^{15,16}

This study attempts to compare the preoperative and postoperative symptoms of patients treated with laparoscopic esophagomyotomy and anterior fundoplication. Overall patient satisfaction is also assessed. Additional follow-up with 24-hour esophageal pH studies was performed on a limited number of patients.

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PATIENTS AND METHODS

Between October 1995 and July 1999, a total of 24 patients underwent laparoscopic Heller myotomy and anterior fundoplication for achalasia at the Oregon Health Sciences University and Portland Veterans Administration Hospitals in Oregon. All patients were operated on by 1 of 2 laparoscopic surgeons (B.C.S. or C.W.D.) with resident participation.

OPERATIVE TECHNIQUE

The procedure was performed under general anesthesia. With the patient in modified lithotomy position, a pneumoperitoneum was produced using a Veress needle. Five ports were used for the procedure with positioning the same as for laparoscopic fundoplication. The left lobe of the liver was elevated to expose the diaphragmatic hiatus. The gastric fundus was retracted caudally and laterally and the gastrohepatic and phrenoesophageal ligaments were divided. The mediastinal space was dissected to expose 7 cm of esophagus anteriorly. The myotomy was begun several centimeters proximal to the gastroesophageal junction and extended up to 7 cm proximally. It was then carried distally onto the stomach for 1 to 1.5 cm. The myotomy was performed with a 40F dilator in the esophagus to prevent the mucosa from folding. An anterior fundoplication was performed in all patients. This was accomplished by placing a portion of the gastric fundus over the lower anterior esophagus, tacking it to the right crus with No. 2-3 sutures. In most cases, the short gastric vessels were not divided.

POSTOPERATIVE QUALITY OF LIFE SURVEY

Patients were interviewed over the telephone and a symptom assessment survey was completed. The questionnaire

recorded symptoms of dysphagia and chest pain as well of reflux and of irritable bowel syndrome, and dietary habits. Regurgitation was described as the sensation of stomach contents going up the esophagus; heartburn, as a substernal, burning sensation; and chest pain, as a substernal, sharp crushing pain. Patients were asked to score their symptoms on a scale of 0 to 3 (where 0 was none; 1, mild; 2, moderate; and 3, severe). Symptoms of irritable bowel (ie, diarrhea and gas bloat) were included to evaluate for response bias. Inquiry into our patients' ability to eat bread and meat further assessed the symptom of dysphagia. Patients were also asked to assess their overall satisfaction with the results of the procedure.

ESOPHAGEAL pH STUDY

Seven patients agreed to undergo postoperative pH studies. A 2-channel pH probe was placed in the esophagus 5 cm proximal to the LES defined by prior manometry. The pH probe was connected to a portable solid-state recorder (Medtronic Synectics Mark III Microdigitrapp; Medtronic Synectics, Irving, Tex). Continuous pH readings were then performed with patients at home performing normal daily activities. Patients were instructed to keep a diary of food intake, change in body position, and symptoms. An acid reflux episode was defined as a decrease in the esophageal pH below 4. Computer software (Synectics, Inc, Chicago, Ill) was used to analyze the data, and episodes of pH below 4 were identified.

STATISTICAL ANALYSIS

Statistical analysis of patient satisfaction was performed comparing each patient to himself or herself in the preoperative and postoperative states using the paired *t* test. Significance was assigned at $P < .05$.

RESULTS

OPERATION AND HOSPITAL COURSE

We were able to contact 21 (88%) of the patients, of which 12 were women and 9 men. The average age was 51 years (age range, 17-84 years). The average length of follow-up was 16.5 months (range, 1-46 months). Three of the cases were converted to the open procedure. Early in the series, 2 patients had esophageal perforations resulting in conversion from laparoscopic to open myotomy. In 1 patient a laparotomy was performed because of the inability to complete the myotomy laparoscopically. The average length of stay was 4.1 days (3.4 days for those cases completed laparoscopically). There were no operative deaths.

SYMPTOM ASSESSMENT SURVEY

The results of our patients' symptom assessments showed significant improvement ($P < .002$) postoperatively in dysphagia, chest pain, heartburn, supine and upright regurgitation, cough, vomiting, and bad taste (**Table**). Gas bloat and diarrhea did not improve postoperatively suggesting no evidence of response bias. Eighteen (86%) of 21

patients stated that they could swallow bread without difficulty. Seventeen (89%) of 19 patients could eat meat postoperatively without difficulty (2 were excluded as they did not eat meat). Twenty (95%) of 21 patients reported that they felt overall improvement after the operation.

ESOPHAGEAL 24-HOUR pH STUDY

Results were analyzed as per Johnson and DeMeester¹⁷ and 6 of 7 patients had a DeMeester score of less than 4. Although all patients were asymptomatic, one patient had objective findings of reflux with a DeMeester score of 19.8.

COMMENTS

For many years, balloon dilatation was the mainstay for the treatment of achalasia. However, early studies suggested that surgical myotomy produced superior results to balloon dilatation during the period when these procedures were performed in an open fashion. In a prospective trial comparing open transabdominal Heller myotomy with dilatation therapy, Csendes et al¹ found that dysphagia was relieved in 95% of myotomized patients compared with 65% of patients who had balloon dilatation. A recent retrospective review of 61 patients during

Changes in Patients' Symptom Assessments Before and After Surgery*

Symptom†	Preoperative	Postoperative	P‡
Dysphagia	2.81 ± 0.11	0.81 ± 0.19	.000
Supine regurgitation	2.10 ± 0.27	0.57 ± 0.18	.000
Vomiting	1.67 ± 0.30	0.48 ± 0.13	.000
Heartburn	1.57 ± 0.19	0.57 ± 0.19	.000
Upright regurgitation	1.57 ± 0.29	0.52 ± 0.15	.000
Chest pain	1.57 ± 0.31	0.86 ± 0.25	.015
Bad taste	1.43 ± 0.29	0.71 ± 0.22	.004
Cough	1.10 ± 0.29	0.52 ± 0.15	.02
Diarrhea	0.86 ± 0.27	0.57 ± 0.22	.11
Bloating	0.38 ± 0.19	0.43 ± 0.19	.87

*Values are expressed as mean (± SD).

†Symptom rating scale was 0, none; 1, mild; 2, moderate; and 3, severe.

‡P value determined by the paired t test (n = 21).

a 16-year experience with open transthoracic Heller myotomy and pneumatic dilatation at Creighton University Medical Center in Nebraska showed that dysphagia was relieved in 93% of patients who had undergone myotomy while only 39% of those who had undergone dilatation had relief of dysphagia. Additionally, pneumatic dilatation was associated with a 14.5% rate of perforation.² Satisfactory results using pneumatic balloon dilatation can be achieved using a graded approach. In a review article, Vaezi and Richter¹⁸ from the Cleveland Clinic in Ohio noted symptom improvement in up to 90% of patients treated with graduated pneumatic dilatation. However, in a subsequent publication with a minimum follow-up of 4 years, Richter's group noted a failure rate of 74% in their patients who underwent pneumatic dilatation. They also noted a similar failure rate in patients undergoing surgical myotomy. The authors concluded that these failure rates were higher than expected and emphasize the need for long-term follow-up.¹⁹

Botulinum toxin injection into the LES has recently become an alternative method in the medical management of achalasia. Botulinum toxin acts at presynaptic nerve endings and inhibits the release of acetylcholine thereby decreasing LES tone.²⁰ Although initial results were promising, more recent studies have shown the duration of response to be limited with several applications often necessary.^{21,22} A prospective study by Andrews et al²³ compared laparoscopic Heller myotomy to botulinum toxin injections and found that dysphagia was equally relieved in the 2 groups on early follow-up. However, those authors noted that 78% of patients initially treated with botulinum toxin injections required subsequent reinjections. Additionally, 28% of the botulinum toxin-injected patients later had laparoscopic Heller myotomy because of medical treatment failure. Horgan et al²⁴ from the University of Washington, Seattle, demonstrated that prior injection with botulinum toxin made it more difficult to dissect the submucosal plane during subsequent treatment with laparoscopic Heller myotomy, thereby increasing the potential risk of the procedure. Patti et al²⁵ compared the effects of previous botulinum toxin treatment with the results of laparoscopic Heller myotomy performed for achalasia. They found that

laparoscopic Heller myotomy was technically straightforward in patients who did not respond to prior botulinum toxin injection. However, in patients who did respond to botulinum toxin, they found the LES to be fibrotic, thus making the subsequent performance of laparoscopic Heller myotomy more difficult and increasing the risk of perforation. Additionally, postoperative dysphagia was less predictably improved in the latter group of patients. Our experience is similar as we have noted inflammatory changes and destruction of the planes between muscle and mucosa in the distal esophagus in patients who have had botulinum toxin injections.

With the advent of minimally invasive surgical technology, myotomy has become a more accepted procedure. Early results have shown that laparoscopic and thoracoscopic myotomy produce outcomes equivalent to those observed after open procedures. Laparoscopic Heller myotomy has been suggested by some to be the preferred initial operative approach to uncomplicated achalasia. Stewart et al⁸ retrospectively compared their experience with thoracoscopic and laparoscopic Heller myotomy and reported that laparoscopic myotomy with fundoplication was superior to thoracoscopic myotomy without fundoplication in relieving dysphagia and preventing heartburn. Patti et al²⁶ found the thoracoscopic approach to be effective in eliminating dysphagia, while the laparoscopic Heller myotomy with anterior fundoplication additionally prevented postoperative reflux and corrected reflux present preoperatively.

Patti et al²⁷ reviewed 168 cases of myotomy (35 performed thoracoscopically and 133 performed laparoscopically) and concluded that the laparoscopic approach was superior to the thoracoscopic approach because of a shorter hospital stay. In addition, a laparoscopic anterior fundal wrap prevented postoperative reflux. Laparoscopic Heller myotomy is usually accompanied by an antireflux procedure because it is argued that disruption of the LES renders the patient susceptible to reflux.¹⁴ Despite this concern, Robertson et al¹³ performed laparoscopic Heller myotomy without fundoplication in a group of 9 patients without any reported symptoms of heartburn or regurgitation 12 to 21 months postoperatively. Subsequent 24-hour pH analysis in 5 patients revealed 1 patient with elevated upright acid exposure. In our series of 7 patients consenting to pH studies, all were asymptomatic though 1 had objective evidence of reflux by pH study. We agree with those who have proposed that patients with achalasia undergoing myotomy may benefit from anterior fundoplication in terms of preventing postoperative reflux. However, absence of reflux symptoms does not correlate with the objective findings of no reflux. Patients with achalasia treated with myotomy will need to have pH studies to determine the presence or absence of reflux. Patti et al²⁹ performed pH studies in 40 patients following Heller myotomy and found abnormal gastroesophageal reflux in 7 patients, 6 of whom were asymptomatic.

Given the concern of postoperative reflux as well as the relative ease of adding an antireflux procedure, most laparoscopic Heller myotomies are accompanied by a fundoplication. Still controversial is the issue of what type of fundoplication should be performed. Anterior fundoplication

plication and the Toupet posterior fundoplication are 2 commonly employed antireflux procedures used in conjunction with a laparoscopic esophagomyotomy. Proponents of the Toupet procedure argue that it prevents reapproximation of the myotomy and may be better than an anterior fundoplication in preventing postoperative gastroesophageal reflux disease.^{29,30} Advocates of the anterior fundoplication procedure argue that it is easy to perform and can be used to protect the esophagus following myotomy.⁶ Additionally, it has been suggested that the retrosophageal dissection required for a Toupet procedure may increase the incidence of postoperative dysphagia.⁷ Despite the controversy, laparoscopic Heller myotomy is most often accompanied by an anterior fundoplication.¹⁴

Our study shows that laparoscopic Heller myotomy with anterior fundoplication results in significant relief of dysphagia with a low incidence of gastroesophageal reflux disease as demonstrated by pH monitoring. Symptoms of reflux (regurgitation and heartburn) improved in all but one patient. Laparoscopic Heller myotomy with anterior fundoplication resulted in excellent patient satisfaction. Follow up with 24-hour pH assessment in 7 patients confirmed a low incidence of postoperative gastroesophageal reflux disease in our patient population.

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DISCUSSION

Lawrence Way, MD, San Francisco, Calif: In this report Drs Deveney, Sheppard, and their colleagues provide further support for claims that laparoscopic Heller myotomy and anterior hemifundoplication is highly effective in the treatment of achalasia. Dysphagia was relieved, heartburn was avoided, and postoperative reflux scores were normal when pH monitoring was performed. Our experience with minimal invasive therapy for achalasia currently amounts to about 200 patients. As reported previously (*Ann Surg*. 1999;230:587-594), our first minimally invasive approach was a thoracoscopic myotomy carried only 5 mm onto the gastric wall, without an antireflux procedure. We learned early that operative endoscopy was essential during thoracic myotomy in order to tell when the distal extent of the myotomy had included the entire sphincter. Without it, persistent dysphagia was frequent. Nevertheless, after this problem was solved random, postoperative pH monitoring in subsequent patients revealed a 20% incidence of asymptomatic reflux after this operation. This led us to question whether it is truly possible with a limited myotomy to regularly eliminate dysphagia while at the same time avoiding reflux.

Consequently, in 1993 we shifted to a laparoscopic approach, performing an 8-cm myotomy that extended 1 to 1.5 cm onto the gastric wall, accompanied by an anterior Dor hemifundoplication. We routinely divide the upper short gastric vessels

to eliminate torque on the gastroesophageal junction, and we suture the fundus to the left and right borders of the myotomy as well as the anterior rim of the esophageal hiatus. The results showed that this procedure actually did avoid reflux while eliminating dysphagia, results corroborated here by Dr Deveney.

It is encouraging that different groups of surgeons working independently have achieved similar high rates of success with this operation, for reproducibility of results is essential for surgery to assume the central role in the treatment of achalasia that it now seeks. As reviewed by the authors, the alternative forms of treatment, balloon dilatation and Botox injection, have not really lived up to the most optimistic reports of their efficacy. In recognition, gastroenterologists have increasingly been referring patients for laparoscopic Heller myotomy as the initial intervention in preference to these other options. This in turn gives surgeons the opportunity to perform the myotomy in a previously undamaged sphincter, where the ability to get a technically perfect result is greatest. While achalasia is a relatively uncommon disease, its treatment is one of the more dramatic success stories of minimally invasive surgery.

Mark Vierra, MD, Stanford, Calif: I appreciate your including an explicit description of your technique because that is something that often seems to me to be peculiarly absent in surgical forums. Specific issues such as the use of intraoperative endoscopy, whether you are performing an anterior or posterior fundoplication, mobilization of the esophagus, length of the myotomy, and division of short gastric vessels are critical issues that we really need to discuss in trying to standardize as much as possible.

My question has to do with the education that you give to these patients preoperatively because I have a strong sense that the expectations that we create preoperatively have a lot to do with the outcomes that we achieve. So, for example, a young Stanford undergraduate that I recently took care of wanted to be able to swallow in a weightless environment because she wants to be an astronaut. I told her that that was probably never achievable despite a perfect myotomy in a patient with achalasia. Expectations also are important in patients who have a significant component of pain who undergo myotomy, because of course pain relief is not necessarily as reliable as relief of dysphagia.

We give patients a preoperative handout that describes the operation and what to expect, and it is my strong sense that patients' satisfaction depends considerably on the expectations that we create for them preoperatively. This, of course, will affect the outcomes of a study such as this one. I wonder what you do for these patients preoperatively in terms of education.

Bruce M. Wolfe, MD, Sacramento, Calif: I am interested in your exclusions for this laparoscopic approach, such as balloon dilatation, multiple Botox injections, or extent of proximal esophageal dilatation, all of which may make this operation more difficult.

Lee Swanstrom, MD, Portland, Ore: I would like to commend the authors also on making efforts to follow up their patients and presenting the results. I have a couple of technical questions. One patient who had an abnormal 24-hour pH test had a pH of less than four 24% of the time. This would seem to result in a higher DeMeester score than 19. Maybe you could comment on that. Another issue is, in your comparison of preoperative to postoperative relief of dysphagia scores, how did you obtain the preoperative dysphagia scores? My understanding is that this is a retrospective study. Did you obtain this information by asking the patient to recall their preoperative condition or by another method?

It is important that you pointed out that a lot of these patients are asymptomatic refluxers. Of course, this represents the highest risk of late-term resumption of their dysphagia from

peptic strictures. Now that you have found this out, have you made efforts to study these other patients?

And finally, along these same lines, for the 12% of patients who did have problems, do you have any information or objective studies of why they had problems?

Dr Deveney: Our experience has been similar to that of Dr Way. We initially did this procedure thoracoscopically and had trouble identifying the distal sphincter. We also had problems with either dysphagia or reflux after the procedure and for that reason with those patients who had manometry typical of achalasia, that is, hypertension of the lower esophageal sphincter with aperistalsis at the body of the esophagus, we elected to perform our procedures laparoscopically so that we could identify the distal sphincter better and carry the dissection on to the stomach. At the same time we had experienced reflux in these patients when we have done them openly so we added the anterior fundoplication to our procedure because it was easy to do and to our surprise these patients didn't complain of reflux. They had a high degree of satisfaction.

Now regarding Dr Vierra's comments on technique, we routinely don't take the short gastrics when we do this operation and perhaps we should. We routinely divide the short gastric arteries when we do a standard 360° wrap. However, with the anterior wrap, the fundus usually comes over very easily. If it comes over on no tension, it's been our practice to simply bring it over, to suture it to the right crus of the diaphragm, sometimes to the left crus, and to the cut muscular edges of the esophagus.

Regarding Dr Wolfe's comments on exclusions: I would say that the only patients who we were a little reluctant to do this on are those patients whose manometry is not typical of achalasia but is rather more typical of diffuse esophageal spasm or dysmotility, and those patients are an entirely different set of patients and we try to avoid doing anything to them. But if we do have to treat those patients, it usually ends up with a lower myotomy and perhaps then an upper myotomy at a later date. We have not used the fact that they have had Botox injections or repeated dilatations as a contraindication although our experience has been probably similar to yours or Dr Way's or Dr Vierra's. It is technically more difficult, the planes are not nearly as clear, and sometimes they are obliterated so the myotomy is certainly more difficult to perform in those patients.

Dr Swanstrom brought up the point, this is a retrospective study. We did not question our patients preoperatively about their symptoms, so the symptoms they gave us were the symptoms that they recalled. Interestingly enough, I think the key question we asked them was, are you better? Is this better for you? And all but one patient said they were much improved after the operation. But again for the specific questions regarding the degree of dysphagia, the degree of regurgitation, these were from the patients' memory.

As far as Dr Vierra's question, [it] is very important to prepare the patient for what the patient should expect. It is very important that the patient know they have a disease of the esophagus, that it's not normal, and we are not going to make it absolutely normal with our operation. But we are going to make swallowing easier and hopefully improve their condition. They need to realize they are not going to be normal.

Regarding reflux, it has been our experience and the experience of others that performing this anterior fundoplication certainly seems to handle the reflux over the short period, that is, within a couple of years of the operation. As Dr Way mentioned, these patients may be asymptomatic when they reflux, so it will be important in terms of ensuring that this operation has long-term success that we continue to monitor these patients with pH studies periodically, probably out [to] 5 or 10 years.