

Minimal Access Surgery — The Renaissance of Gastric Surgery?

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Peptic ulcer surgery has been revitalized by the introduction of minimal access techniques for surgery of chronic and perforated peptic ulcer. A wide range of vagotomies, including truncal vagotomy, anterior lesser curve seromyotomy with posterior truncal vagotomy and proximal gastric vagotomy, have been performed laparoscopically. Short-term (two-24 month) follow-up of laparoscopic anterior seromyotomy with posterior truncal vagotomy cases has been promising, but long-term follow-up is required to confirm these early good results. Laparoscopic repair of perforated peptic ulcers has also been described. Initial reports of laparoscopic gastrojejunostomy and Billroth II partial gastrectomy have also appeared. These procedures are technically very demanding and are currently being performed in only a few "centers of excellence" around the world. Cost-benefit analyses of medical treatment with proton-pump inhibitors versus laparoscopic vagotomy are necessary to determine which form of treatment is more economical in the long run. Criteria for patient selection need to be defined and substantiated by audit of outcome.

INTRODUCTION

In the 50 years since it was first performed in a human subject by Dragstedt [1], vagotomy has become one of the most intensively studied and carefully documented operations in the history of modern surgery. Its safety and efficacy in the treatment of peptic ulcer are well established.

The advent of H₂-receptor antagonists and later proton-pump inhibitors led to the virtual demise of elective "open" surgery for peptic ulcer disease but did little to reduce the incidence of perforated and bleeding ulcers [2]. More recently, the crucial role of *Helicobacter pylori* in the pathogenesis of peptic ulceration is likely to offer a cure for all but a handful of ulcers if the organism is successfully eradicated. Whether long-term risks of complications will be avoided has yet to be proven. It is probable that the few patients who require surgery will be operated upon in specialist centers.

The development of minimal-access techniques for vagotomy has led to a renewal of interest in peptic ulcer surgery. Several operations, tried and tested at "open" surgery, have been modified and adapted for the laparoscopic approach. The range of minimal-access operations described for peptic ulcer disease is shown in Table 1. Technically, they are among the most demanding laparoscopic procedures being attempted. The number of patients undergoing elective surgery for peptic ulcer disease nowadays is very small. For these two reasons, minimal-access surgery for peptic ulcer disease has not attained the same popularity as laparoscopic cholecystectomy and has remained confined to the "centers of excellence." A considerable amount of practice on experimental models is advisable before a laparoscopic surgeon embarks upon these operations in human patients.

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WHY ADOPT THE LAPAROSCOPIC APPROACH?

The same question had been raised earlier with respect to cholecystectomy. When the standard "open" operation is proven to be safe and effective, why opt for an approach that is technically more difficult, and whose results are as yet unproven? There are all the accepted advantages of any minimal access operation: less pain, rapid recovery and return to normal activities and cosmetic advantages. In the case of vagotomy, points in favor of the laparoscopic approach are:

1. Excellent visualization of the vagal nerve branches at laparoscopy, both on the stomach and at the diaphragmatic hiatus, a factor essential to the success of any acid-reducing operation.
2. Minimal wound-related and respiratory morbidity with the laparoscopic operation as compared to the open procedure.
3. Earlier return to work and full activity after laparoscopic vagotomy.

The laparoscopic approach, thus, provides an attractive alternative to prolonged medical therapy in the fit young patient who has previously shunned gross open surgery.

Demands have been made for a controlled trial of laparoscopic versus open vagotomy [3]. As in the case of cholecystectomy [4], the main obstacle to conducting such a trial is obtaining informed consent from patients. Patients nowadays are better informed, and want to know all the treatment options. They wish to participate in decision-making about their treatment rather than leaving the decision to chance [5]. Recruitment of adequate numbers of patients for prospective studies requires the cooperation of a number of expert centers. Only one comparative study of laparoscopic and open vagotomy is under way [6], and the results are eagerly awaited.

Two studies have compared the costs of open surgery with those of medical treatment with H₂-receptor antagonists. Jensen [7] showed that in Europe, surgery was more cost-effective than medical treatment after eight years; whereas Sonnenberg [8], found that in the U.S.A., the cost of surgery was equivalent to 32 years of medical treatment. In the 1990s, these analyses need to be reworked, comparing the costs of modern effective medical treatment with proton-pump inhibitors versus laparoscopic vagotomy.

TECHNICAL ASPECTS OF LAPAROSCOPIC VAGOTOMY

Laparoscopic approaches to vagotomy can be classified as:

1. Truncal vagotomy (trans-abdominal or trans-thoracic) with drainage.
2. Anterior lesser curve seromyotomy with posterior truncal vagotomy.
3. Proximal gastric vagotomy.

Table 1. Minimal access operations for peptic ulcer.

<ul style="list-style-type: none"> • Laparoscopic truncal vagotomy without drainage [13] • Laparoscopic truncal vagotomy + pyloric stretch [9] • Laparoscopic truncal vagotomy + pyloromyotomy [9] • Laparoscopic truncal vagotomy + pyloroplasty [9] • Thoracoscopic vagotomy [16, 17] • Laparoscopic anterior lesser curve seromyotomy + posterior truncal vagotomy • Laparoscopic proximal gastric vagotomy [26-29] • Laparoscopic anterior proximal gastric vagotomy + posterior truncal vagotomy [30] • Laparoscopic gastrojejunostomy [32] • Laparoscopic Billroth II partial gastrectomy [33] • Laparoscopic repair of perforated peptic ulcer [34-38]
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In all cases, the use of the 30° telescope improves visualization of the vagal nerve branches. Four to six ports are usually required, and retraction of the liver through a port situated in the epigastrium just below the right costal margin is crucial for exposure of the hiatus.

Truncal vagotomy

This procedure would seem to be technically the easiest form of minimal-access vagotomy. It has been attempted laparoscopically and thoracoscopically. The abdominal approach [9] requires four or five ports. The left lobe of the liver is retracted to expose the hiatus. The peritoneum over the esophagus and the phrenoesophageal membrane are divided. The posterior vagus is found between the right diaphragmatic crus and the esophagus and is clipped and divided. The anterior vagus can be dissected free from the anterior surface of the esophagus, clipped and divided. The "criminal nerve" of Grassi should be sought in the left lateral peritoneal reflection of the angle of His and divided.

Following truncal vagotomy, a drainage procedure is required, and this has been achieved laparoscopically in different ways: pyloric stretch or pyloroplasty [9] and pyloromyotomy [10]. Mouiel and Katkhouda report a pyloric stretch, achieved by passing a balloon dilator through an endoscope, confirming its position across the pylorus laparoscopically and dilating the pylorus using a pressure of 14-16 mm Hg [9]. Pyloroplasty has been performed in the standard fashion, employing a horizontal incision over the pylorus created with diathermy or laser and suturing intracorporeally at right angles to the direction of the incision [9]. Pyloromyotomy has been described in dogs using a laser [10]; a seromuscular incision is made until the mucosa bulges out.

It must be emphasized that pyloromyotomy and pyloric stretch have not stood the test of time when used in man as drainage procedures and cannot be recommended for routine use as an adjunct to laparoscopic vagotomy. Furthermore, truncal vagotomy is associated with a rate of dumping of 11-20 percent [11, 12] at open surgery, and there is no reason to believe that this should be any different when the procedure is performed laparoscopically.

Laparoscopic truncal vagotomy has been performed unaccompanied by a drainage procedure [13], and we mention this report only to condemn this kind of operation. Dragstedt had observed as early as 1947 that truncal vagotomy without a drainage procedure was followed by significant gastric stasis in one third of patients [14], and since then, drainage procedures have become a standard adjunct to truncal vagotomy. It seems foolish to try and "relearn" lessons gained during the era of open surgery. In their enthusiasm to adopt new laparoscopic procedures, surgeons should not abandon time-honored surgical principles without good reason [15].

Pleuroscopic vagotomy

This procedure has been described by Laws et al. [16] and Chisholm et al. [17] for recurrent peptic ulcer after previous vagotomy and drainage. The operative approach involves a four-port cannulation of the left chest. The left lung is allowed to collapse and is retracted with division of the left pulmonary ligament. The mediastinal pleura can be identified over the esophagus and incised. The esophagus can then be dissected out. A grasping forceps [17] or a gastroscope in the esophagus [18] is useful to retract this organ and facilitate the dissection. The anterior and posterior vagi can then be identified, clipped and divided. An intercostal underwater seal drain is placed at the end of the procedure through the lowermost port.

The results of thoracoscopic vagotomy are as yet undocumented. At open surgery, the results of re-vagotomy for recurrent peptic ulcer were poor, whether performed

transthoracically or transabdominally, with one third to one half of all patients requiring a third operation for failure of re-vagotomy [19, 20].

Laparoscopic anterior lesser curve seromyotomy with posterior truncal vagotomy

Initially described by Taylor [21], this operation was first performed laparoscopically by Katkhouda and Mouiel [22]. It maintains the pyloric sphincter mechanism and achieves acid suppression and a rate of morbidity comparable to proximal gastric vagotomy [23], but at an ulcer recurrence rate that is slightly higher [24]. A four- or five-port cannulation of the abdomen is required. The left lobe of the liver is retracted, exposing the hiatus. Dissection in the hiatus enables exposure of the posterior vagus between the right crus of the diaphragm and the esophagus. It can then be clipped and divided. The seromyotomy is performed at least 1.5 cm away from the lesser curve to avoid damaging blood vessels. Laser or diathermy may be used, and the incision is carried down to the nerve of Latarjet. The stomach is then filled with dilute methylene blue, and the incision is checked for leakage, indicating mucosal damage that needs suture closure. Diathermy produces an unpredictable depth of tissue damage, and hence, the incision in the sero-muscular layer must be sutured intracorporeally after completion of the seromyotomy, and this prolongs the duration of the operation. The NdYAG contact tip laser, used in the continuous wave mode at a power of 20 W, produces a depth of tissue damage of 200-300 μm [25], and therefore, seromuscular suturing is not required. Katkhouda and Mouiel [22] reported an average operating time of 60 min for this operation using a laser. They have followed up 50 patients who underwent this procedure for periods ranging from two to 24 months and reported an average reduction in basal acid output of 79 percent and a peak acid output reduction of 83 percent [6]. Most patients were discharged within five days. Only one patient required re-operation for gastro-esophageal reflux, while the others were doing well without recurrent ulceration.

Laparoscopic proximal gastric vagotomy

This is the most tedious form of laparoscopic vagotomy, but the initial reports are promising [26-29]. The procedure [28] involves a six-port cannulation of the abdomen. The left lobe of the liver is retracted, and a 30° telescope is used. The nerve of Latarjet is identified in the lesser omentum, and this is dissected out and retracted by means of a nylon tape, which is held in a grasping forceps. The upper branch of the "crow's foot" vessels is divided. Then the anterior leaf of the lesser omentum is divided from below upwards, clipping and dividing the branches of nerve and blood vessels before cutting. The posterior leaf is then tackled. The dissection is then carried upwards through the hiatus

Table 2. Acid output data pre- and three months post laparoscopic proximal gastric vagotomy: experience at Manchester Royal Infirmary.

Patient	BAO			PAO-sham			PAO-Pg		
	Preop.	Postop.	% Red.	Preop.	Postop.	% Red.	Preop.	Postop.	% Red.
Mr. A.H.	4.7	0.7	86%	18.8	0.5	97%	52.6	27.3	48%
Mr. J.H.	6.0	1.2	80%	17.3	3.0	83%	59.8	26.1	44%
Mr. R.D.	6.8	3.7	45%	11.3	6.9	39%	63.3	25.4	60%
Mean			70%			73%			51%

Values are expressed as mmol/hr.

Abbreviations: BAO, basal acid output; PAO, peak acid output; Pg, pentagastrin; % Red, percentage reduction in acid output.

into the lower mediastinum to bare the lower 6-8 cm of the esophagus. Another nylon tape can be passed around the esophagus to retract it and facilitate the dissection. Care is taken to divide the "criminal nerve" of Grassi supplying the fundus of the stomach. Our operating time decreased from 4.5 hr in the first case to 2.5 hr for the third, and we were able to achieve satisfactory reduction of basal, modified sham feed and pentagastrin-stimulated acid outputs with mean reductions of 70 percent, 73 percent and 51 percent, respectively (see Table 2). In subsequent cases, we have found it easier to commence the dissection at the hiatus, and carry it downwards toward the nerve of Latarjet, since the main difficulty with the lesser curve dissection of the anterior and posterior peritoneal layers was breaking through the posterior leaf into the lesser sac. This above-down approach made it easier to identify the posterior leaf of the lesser omentum. All our patients have been discharged within three days of surgery. Our early experience has been achieved on very thin patients, and if a patient is very obese, with much fat in the lesser omentum, it will not be easy to visualize and dissect the nerves in the lesser omentum. In such cases, it may be preferable to perform an anterior lesser curve seromyotomy with posterior truncal vagotomy.

Bailey et al. [30] described a laparoscopic modification of the Hill and Barker procedure [31]. This involves dividing the anterior leaf of the lesser omentum, effecting an anterior highly selective vagotomy and adding to this a posterior truncal vagotomy. This procedure may seem easier than a formal proximal gastric vagotomy, but it does not achieve the same degree of acid suppression [31], and its long-term results have not been documented.

SELECTION OF PATIENTS FOR LAPAROSCOPIC VAGOTOMY

In these days of effective medical treatment for peptic ulcer, very few patients come to elective surgery. Those who have recurrent ulcers after treatment with H₂ receptor antagonists or proton-pump blockers should be checked for *H. pylori* and have eradication therapy prescribed if the organism is present. Today's candidates for elective laparoscopic surgery for peptic ulcer are usually young and thin, with frequently relapsing ulcers and in whom eradication therapy for *H. pylori* has failed, or those who have recalcitrant *H. pylori* negative ulcers [2]. For perforated peptic ulcers, initially, simple laparoscopic closure is all that is required, followed by a healing course of an antisecretory drug. Definitive acid-reducing surgery should be performed only on those patients who continue to have ulcer-related symptoms after simple closure [2].

WHICH VAGOTOMY?

It is difficult to endorse any one type of vagotomy as being the most suitable for the laparoscopic approach. The choice of operation will have to be made by each individual surgeon, depending upon which operation he or she is most comfortable with. The best results will be achieved by a "vagotomist who does laparoscopy," not a "laparoscopist who does vagotomies." Also, the surgeon should perform the same operation that is done at open surgery. Any modification of established procedures will require its own validation.

OTHER LAPAROSCOPIC GASTRIC OPERATIONS FOR PEPTIC ULCER

Laparoscopic gastroenterostomy, although described for malignant duodenal obstruction [32], could be used as a drainage procedure as an adjunct to laparoscopic vagotomy. An Endo-GIA® stapler (U.S. Surgical Corporation, Norwalk, CT) is used to achieve the anastomosis, and the opening in the stomach and jejunum is oversewn. Two firings of the stapler may be used to produce a larger stoma.

Laparoscopic Billroth II partial gastrectomy has been reported for benign gastric ulcer [33]. Though technically feasible, one doubts that this operation is economically viable in its present form, since in this report, 17 firings of the Endo-GIA® stapler were required to transect the stomach, close the duodenal stump and effect the anastomosis.

LAPAROSCOPIC APPROACHES TO PERFORATED PEPTIC ULCER

Laparoscopic approaches described for perforated peptic ulcer include a formal oversew [34, 35], repair with an omental patch held in place with fibrin glue [36] or staples [37], and repair using the ligamentum teres hepatis [38]. Sunderland et al. [35] achieved good results in six patients by laparoscopic oversew, peritoneal toilet and drainage. A four-port abdominal cannulation was performed; the operations took an average of 108 min, and the mean hospital stay was 6.5 days. Mouret et al. [36] achieved good results in four patients by means of patching the perforation with an omental patch and a fibrin sealant, peritoneal lavage and drainage. Hospital stays for these patients ranged from six to 10 days. Cheshire et al. [37] have described the use of staples to hold an omental patch in place, a maneuver that reduces the time taken to perform this operation. Costalat et al. [38] utilized an ingenious technique to seal perforated ulcers laparoscopically using the ligamentum teres hepatis. The umbilical end of the ligament was freed by laparoscopic dissection. A gastroscope was inserted into the duodenum, and a Dormia basket was passed through the perforation into the peritoneal cavity to grasp the free end of the ligamentum teres, which was then drawn inwards through the perforation into the duodenal lumen, thereby sealing it. Peritoneal lavage was performed, followed by insertion of a drainage tube. Good results were achieved in nine patients. The drawback of this method is that it cannot be used if the perforation is larger than 1.5 cm in diameter, since such perforations are too big to be sealed by the ligamentum teres hepatis.

Laparoscopic repair of perforated peptic ulcers deserves more detailed study. The incidence of postoperative intra-abdominal abscesses following laparoscopic repair would indicate the efficacy, or otherwise, of laparoscopic peritoneal lavage. Obviously, this would be inadequate in the face of generalized fibrinoid peritonitis. A senior surgeon would need to be available at night to operate upon these cases. So far, the laparoscopic approach does not seem to result in earlier patient discharge. It has been claimed [36] that laparoscopic repair would result in fewer postoperative adhesions and could render a formal vagotomy performed at a later date much easier, but this remains to be seen.

CONCLUSIONS

Laparoscopic surgical procedures for chronic and perforated peptic ulcer have been successfully introduced in a handful of centers around the world. Their complexity precludes adoption by any and every laparoscopic surgeon. Proper follow-up of patients and documentation of pre- and post-operative acid secretion is necessary if laparoscopic vagotomy is to be established as a viable alternative to medical treatment. Cost-benefit analyses of laparoscopic vagotomy versus medical treatment with proton pump inhibitors are necessary. If the good results reported from some centers can be reproduced in other series, then laparoscopic vagotomy will pose a serious challenge to long-term medical treatment in selected patients at centers of excellence. Such patients are likely to be thin, fit and young, with severe recalcitrant peptic ulcer disease and in whom eradication of *H. pylori* has failed.

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