

An improved technique for laparoscopic highly selective vagotomy using harmonic shears

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Abstract

Background: Results from classic highly selective vagotomy (HSV) are technique dependent because an incomplete operation will result in early recurrence of duodenal ulcer. Few reports describe laparoscopic completion of the procedure. All techniques use clips for division of neurovascular branches, making the laparoscopic approach tedious and thus the results, uncertain.

Methods: Ten patients with intractable duodenal ulcer and negative *Helicobacter pylori* status underwent an extended HSV. All procedures were performed laparoscopically using a new surgical tool, the harmonic shears.

Results: All procedures were completed laparoscopically and took approximately 1 h. There were no deaths and no postoperative complications. Patients were discharged the next day. Follow-up endoscopy at 2 months showed healing of duodenal ulcer in all cases, and postoperative acid secretion studies demonstrated a decrease in basal acid output (BAO) by 74% (8.2 meq/h to 2.16 meq/h) and maximal acid output (MAO) by pentagastrin stimulation by 79.2% (40 to 8.32).

Conclusions: Harmonic shears expedite laparoscopic HSV. The operation can be taught safely, yields good results in early follow-up, and represents an acceptable option in patients with intractable duodenal ulcers who are *H. pylori* negative.

Key words: Surgery-laparoscopic — Vagotomy — Duodenal ulcer — Harmonic shears

Johnston [10]. The object of the procedure is to divide all vagal nerve fibers innervating the acid-producing cells of the stomach while preserving the terminal branches of the main vagal trunks and the nerves of Latarjet, thereby maintaining adequate antral motility. Numerous clinical studies have found this procedure to be both safe and effective when performed by experienced surgeons [6, 11, 12].

Improved skills have allowed minimal access techniques to assist or replace many “open” procedures. Yet, few reports have described laparoscopic completion of the traditional HSV [4, 7]. The procedure can be difficult and tedious because each branch of the anterior and posterior vagus nerve must be individually dissected, ligated, and divided. Success of HSV depends on meticulous technique because leaving a single fundic nerve branch intact will allow continued acid secretion in the corresponding gastric secretory zone, leading to early recurrence [3, 6]. In fact, many surgeons find laparoscopic HSV to be technically difficult and time consuming, especially in the obese patient. Therefore, alternative procedures have been advocated such as posterior truncal vagotomy with anterior seromyotomy as popularized by Taylor [15] and redefined laparoscopically by the senior author (NK) of this article [13].

Another technique is the posterior truncal vagotomy and anterior highly selective vagotomy described by Hill and Barker in 1978 [9] and performed laparoscopically by Zucker and Bailey [2]. This procedure was not validated in open surgery, and the laparoscopic reports are too scarce to contribute to its acceptance. These procedures represent attempts to circumvent the difficulties of traditional laparoscopic HSV.

The ideal laparoscopic technique is one that is safely taught, reproduced by many, and yields the same or better results than open surgery. The recent development of ultrasonically activated coagulating shears (LCS™, Ethicon Endosurgery, Cincinnati, OH) presents a new alternative to the tedious individual ligation of vagus nerve branches and associated vasculature [14, 15].

Highly selective vagotomy (HSV) as the definitive treatment of peptic ulcer disease was first described by Griffith and Harkins [8] in 1957 and subsequently popularized by

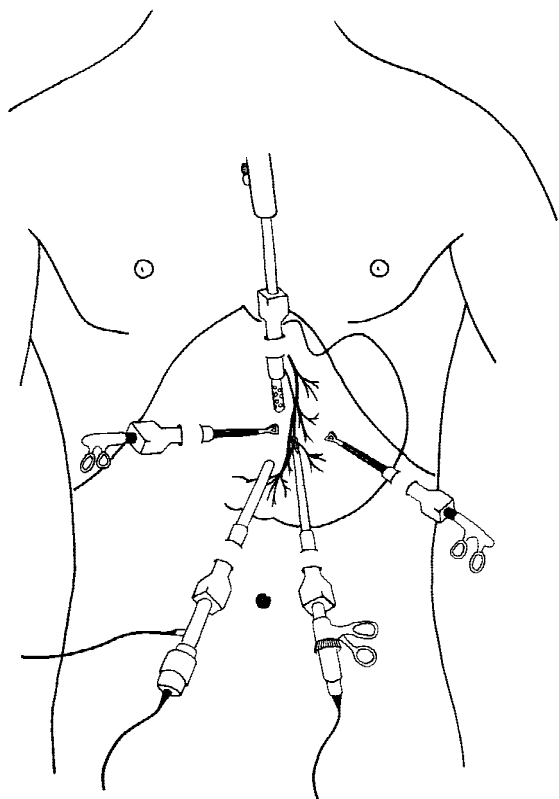


Fig. 1. Trocar placement for laparoscopic highly selective vagotomy (HSV).

Patients and methods

Between January, 1995 and April, 1996, 10 patients presented with chronic duodenal ulcers. All were male with a median age of 46 years (range, 36 to 64 years). All patients had intractable symptoms despite adequate medical therapy for a median duration of 3.5 years (range, 2 to 10.5). Two patients had a history of upper gastrointestinal bleeding. None had a history of symptoms suggestive of gastric outlet obstruction such as vomiting or weight loss. All patients had duodenal ulcer disease documented by upper gastroendoscopy and negative biopsies for *Helicobacter pylori*. Serum gastrin levels were normal in all patients. No patient was on non-steroidal anti-inflammatory drug (NSAID) therapy before presentation.

Patients gave informed consent in all cases. Senior surgical residents under the guidance of attending faculty performed the procedures. Follow-up at 2 months included upper endoscopy, antral biopsies, and acid secretion studies.

Basal and pentagastrin-stimulated gastric acid secretion was analyzed before and 2 months after surgery. Acid output was calculated by multiplying the volume and acid concentration of 15-min samples. Basal acid output was expressed in millimoles of hydrochloric acid per hour. The maximal acid output induced by pentagastrin stimulation was calculated from the two 15-min samples for which the acid output was the highest.

Operative technique

The patient is placed in the inverted Y position with the operating surgeon standing between the legs. The video monitor is positioned at the patient's shoulder. Pneumoperitoneum is established by the Veress needle technique at the umbilicus. The positioning of the trocars is depicted in Fig. 1. The procedure begins by the elevation of the left lobe of the liver using a fan retractor. Endoscopic babcock-type clamps provide lateral traction on the greater curvature of the stomach. The lesser omentum is carefully inspected to identify several anatomic landmarks: the avascular aspect of the lesser omentum crossed by the hepatic branch of the anterior vagus nerve; the terminal branch of the anterior vagal nerve, the nerve of Latarjet, which runs parallel to the lesser curvature; and the terminal "crow's foot."

The anterior leaf of the omentum is incised between the nerve and the stomach proximal to the crow's foot, and the harmonic shears are introduced into this opening and positioned parallel to the nerve trunk (Fig. 2a). The lesser omentum is retracted using atraumatic graspers to ensure that the harmonic shears divide only the branches of the vagus nerve and not the trunk of Latarjet. There is no need to identify and ligate individual neurovascular bundles. The important technical aspect is to assure that the blunt jaws of the shears are applied and coapted beyond the vessel to avoid a partial welding that might lead to hemorrhage. The tissues tend to separate automatically when the welding process is complete, so no traction needs to be placed on these fragile structures. Four or five applications of the shears should suffice to clear the lesser curvature. This dissection then proceeds proximally to include the esophageal branches of the anterior vagus nerve. The fat pad of the cardioesophageal junction containing the anterior nerve trunk is then raised upward and to the right, with care taken to divide the "criminal" nerves of Grassi near the angle of His. The division of those aberrant branches of the main vagal trunks is of paramount importance to ensure complete vagotomy of the posterior fundus.

The dissection then returns to the distal stomach. At this time, retracting the opened anterior leaf of the lesser omentum exposes the posterior vagal branches. The posterior leaf is incised, as before, between the stomach and posterior nerve of Latarjet, opening the lesser sac. Again, the harmonic shears are positioned parallel to, but away from, the vagal trunk, dividing all the branches of the posterior vagus nerve proximal to the crow's foot. At the gastroesophageal junction, the main vagal trunks should be identified and retracted to avoid their injury. The esophagus is exposed circumferentially and an electrocoagulation hook is used to denervate smaller branches easily recognized by the magnification provided by the laparoscope. At the end of the procedure, the distal esophagus should be clear of all nerve fibers for a length of 6 to 8 cm while the two trunks and their terminal gastric branches are preserved. We agree with the concept of "extended highly selective vagotomy" [6] using the magnification provided by the laparoscope to divide the proximal right anterior gastroepiploic nerve along the greater curvature of the stomach.

The nasogastric tube may be removed at the end of the procedure. The patient is encouraged to ambulate and resume a soft diet on the evening of surgery. Discharge is allowed the next day.

Results

All procedures were completed laparoscopically in a median operative time of 55 min (range, 50 to 72). No intraoperative complications were noted. Patients were observed for 24 h and discharged the next day on a soft diet.

There was no postoperative morbidity. All patients experienced resolution of symptoms by 2 months, which correlated to healing ulcers documented by endoscopy. Antral biopsies remained negative for *H. pylori*. Acid secretion studies for the 10 patients, demonstrated a decrease in basal acid output (BAO) of 74% and a decrease in pentagastrin-stimulated maximal acid output (MAO) of 79.2% (Table 1). No patient developed symptoms of gastric stasis. One patient reported intermittent diarrhea, which resolved with medical therapy. All patients remained asymptomatic at 6 months after surgery.

Discussion

Classic HSV has proven to be effective in the treatment of chronic duodenal ulcer with both a low recurrence rate and minimal morbidity in experienced hands. A recurrence rate of 16.5% at 25-year follow-up has been reported [12]. Limited access techniques may offer the patient not only a shorter and more comfortable postoperative course, but possibly fewer long-term complications associated with laparotomy such as adhesion formation. Laparoscopic HSV has been performed using standard hemostatic clips (Fig. 2b). However, the dissection can be tedious and difficult, gen-

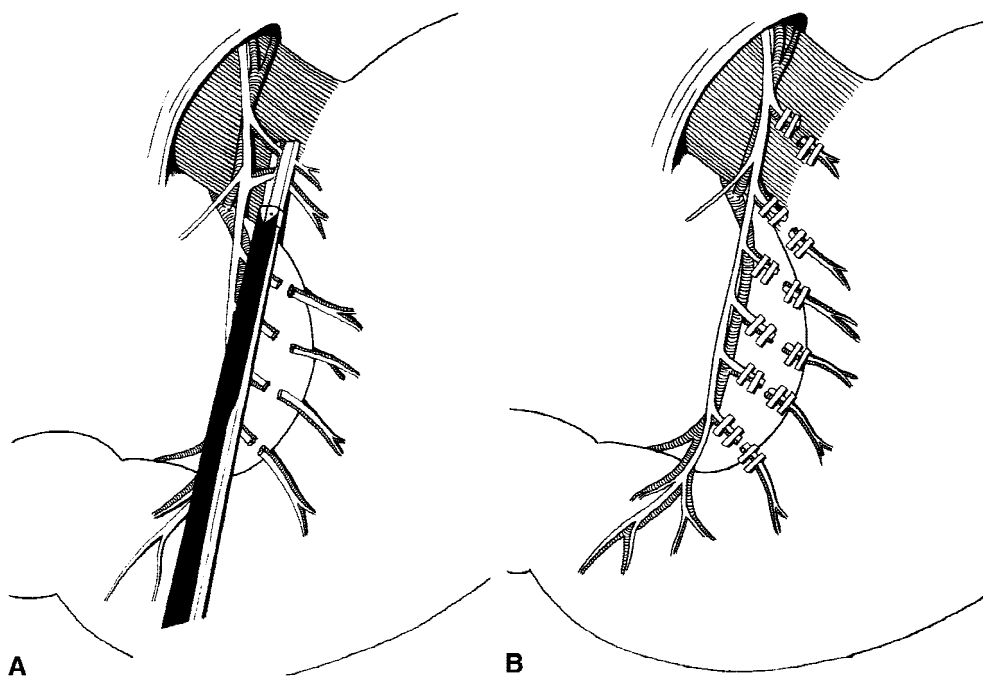


Fig. 2. The techniques of neurovascular ligation in highly selective vagotomy (HSV): (A) laparoscopic technique using harmonic shears, (B) laparoscopic technique using clips.

Table 1. Effect of HSV on gastric acid secretion

	BAO (meq/h)	Pentagastrin stimulated MAO (meq/h)
Preoperative	8.2 (3–13)	40 (28–61)
Postoperative	2.16(1.2–4.1)	8.32(5.8–12.7)

Results presented as median values and range.
BAO, basal acid output; MAO, maximal acid output.

erating poor results due to incomplete vagotomies and leading surgeons to seek alternative techniques such as the posterior truncal vagotomy and anterior lesser-curve seromyotomy. This technique is less familiar to surgeons in North America and thus has limited universal acceptance.

The introduction of the harmonic shears may change many surgeons' attitudes toward laparoscopic HSV. The concept of the shears is based on the transmission of high frequency mechanical energy to a transducer in the hand-piece that creates a longitudinal vibration of 55,000 times per second in one jaw of the clamp to effect a 50–100 μ m excursion. Rapid acceleration of the tissues within the clamp breaks the hydrogen bonds of structural protein, creating a coagulum that seals off coapted vessels up to 6 mm in diameter. "Harmonic ligation" of the short gastric vessels during Nissen fundoplication has been routinely successful [14, 15]. An additional feature of the harmonic shears is a lateral thermal spread of only 0.75 to 1.5 mm, in contrast to standard electrocautery, which is approximately 3 mm [1]. Necrosis of the lesser curve has been reported as a complication of traditional HSV, and one cause is thought to be extensive use of electrocautery. The limited heat generated by the harmonic shears may prove important in minimizing inadvertent thermal injury to the stomach or the nerve trunks.

The other major advantage of the harmonic shears is that branches of the vagus need not be dissected individually.

Four or five applications of the clamp complete the dissection of each leaf of the lesser omentum, thereby greatly reducing the operating time. In one series, 10 patients underwent laparoscopic HSV using standard clips [4]. The median operating time for these experienced laparoscopic surgeons was 110 min (range, 85 to 205) or twice the median operative time in our series of cases performed by surgical residents under faculty guidance.

The results of the acid secretion studies in our series showing a reduction of 79.2% in pentagastrin-stimulated MAO at 2 months compare favorably with the results obtained after open HSV, ranging from 59% [12] to 70% in Johnston and Wilkinsen's original article [10]. This confirms that the use of a new HSV technique did not adversely affect the outcome and achieved adequate vagal denervation.

Although our experience is limited to a small number of patients, we believe that use of the ultrasonically activated harmonic shears significantly enhances the laparoscopic performance of HSV by overcoming extended operating times, tedium, and teaching difficulties attributed to other techniques. Also, there are now fewer patients with peptic ulcer disease who require surgical treatment, limiting the number of cases available to improve the learning curve for any surgical modality. All these factors serve to increase the chances of recurrence because results for HSV are highly technique dependent. The routine use of the laparoscopic harmonic shears overcomes many technical disadvantages, reduces the learning curve, and may further optimize the results for HSV. Although the patients in this series were observed for 24 h postoperatively, we believe this technique is well suited as an outpatient procedure.

We did not perform a cost comparison analysis for this procedure, but a reduction in hospital costs can be expected when reduced operating room time combined with the cost of a standard clip applicator and refills are considered [14, 15].

In conclusion, this article reports technical feasibility

and good early results. Whether this laparoscopic technique of HSV will produce comparable results to its open counterpart will depend on longer follow-up of a larger number of patients.

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