Laparoscopic Management of Complications of Peptic Ulcer Disease

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Laparoscopic treatment of intractable duodenal ulcers is intended for the treatment of patients who do not heal after a trial of intensive regimen of medication such as H2 blockers and/or therapy aimed at eradication of *Helicobacter pylori*.[1] Patients in a category who are *Helicobacter*-negative can be offered a laparoscopic treatment of their ulcer by vagotomy. Patients who have early relapses on stopping medical treatment are also candidates for vagotomy. Complications of the disease, such as bleeding or pyloric outlet obstruction, represent valid indications in 1995 for performing surgery in patients with duodenal ulcer disease.

Since most of these complications are life-threatening and usually cannot be dealt with medically, the laparoscopic approach is a good option as long as common sense guides the surgeon performing these procedures. It is not recommended that laparoscopic approaches be used in patients with very severe diseases such as diffuse peritonitis with septic shock or life-threatening hemorrhage, or in patients who are at very high risk and need an operation that can be done as quickly and simply as possible.[2-4] Nevertheless, some complications such as early perforated duodenal ulcers with chemical peritonitis, gastric outlet obstruction, recurrences, and moderate bleeding can all be addressed laparoscopically.

MANAGEMENT OF GASTRIC OUTLET OBSTRUCTION

Two types of procedures are possible laparoscopically:
1. Laparoscopic total truncal vagotomy and gastrojejunostomy.
2. Laparoscopic total truncal vagotomy and antrectomy with a Billroth II reconstruction.

The first operation is a simpler one and is known to have a lower morbidity and mortality rate in open surgery. It is associated with a higher recurrence rate and is probably physiologically less satisfying when the stomach is chronically distended, where an element of gastric atony can contribute to poor gastric emptying.

A combination of laparoscopic vagotomy and antrectomy, on the other hand, is a more radical approach, not only denervating the stomach but also removing the gastrin-secreting part of the stomach. It also removes a nonfunctional antrum and probably speeds gastric emptying. This approach does have a higher mortality and morbidity, at least in inexperienced hands, and should be reserved for the more experienced surgeon. The latter procedure can be performed either intra-abdominally or in a laparoscopically assisted fashion, which is preferable.

Technique of Laparoscopic Total Truncal Vagotomy (Fig. 1)

The patient is placed in a supine position with legs spread apart. The operating surgeon stands between the patient's leg in the so-called French position. Operating bimanually is comfortable if the surgeon has the television monitor placed in front of him. The pneumoperitoneum is created by insufflation with CO_2 at a pressure of 14 mm of mercury. Five trocars are then introduced into the upper part of the abdomen, and their placement is very important, as a misplaced trocar will render the procedure very difficult to perform. The trocar positioning for this procedure is the same as for any laparoscopic foregut operation, except that the videolaparoscope will be inserted at the level of the umbilicus to provide good access not only to the hiatus but also to the different parts of the stomach. Mobilization of the greater curvature will require some juggling with the laparoscope, and it is best located in the umbilicus. Two trocars will be inserted, one for the right hand of the surgeon for the operating instruments and the second one for the left hand of the surgeon for the grasping forceps. These two trocars will be triangulated with the umbilical videolaparoscope. Finally, the next trocars will be placed for the grasping forceps of the first assistant, and the last trocar will be the xiphoid trocar, entered at the left side of the falciform ligament for the retraction of the left lobe of the liver. The retraction utilizes an irrigation suction device (American Hydrosurgical Instruments, Inc.), as it can serve both purposes: irrigation of the hiatus and gentle retraction of the left lobe.

The abdomen is entered and a thorough exploration of the peritoneal cavity is undertaken to rule out intra-abdominal lesions that might have been missed by the preoperative workup. The liver is then retracted and the procedure begun.[6,7]

Access to the hiatus is straightforward with recognition of the following landmarks. The avascular aspect of the lesser sac will be opened using electrical scissors to enable recognition of the caudate lobe and the right crus of the diaphragm. A gastric vein might be encountered in the upper part of the lesser omentum and it should be clipped and divided. The purpose of a meticulous dissection is to avoid any bleeding, minimizing the trauma and the blood loss. The right crus is then grasped with the left hand while the patient's head is tilted upwards in the reverse Trendelenburg position. This will enable the stomach and the greater omentum to fall down and give access to the hiatus safely, even in the obese patient.

The vascular plane between the esophagus and the right crus is entered and care is taken not to dissect within the fibers of the esophagus. The right vagus trunk is usually easily recognized as it lies on the left crus and is divided between clips. Care should be taken to look for a second right vagus trunk which was rarely encountered in our series. The phrenoesophageal membrane is then divided which will enable the division of all the small branches of the left vagus trunk.

The fat pad is removed enabling the identification of the inconstant left trunk of the vagus nerve. At this point, a dissection behind the esophagus and under the left crus will enable identification of other branches of the vagus nerve (criminal nerves of grassi). Division of these nerves and the nerve trunks completes the bilateral truncal vagotomy. At the end of this step, the esophagus will be cleared from all the fatty tissues and nerve fibers, using a monopolar hook if needed.

The harmonic scalpel and/or scissors are interesting new instruments that will enable safe hemostasis of this

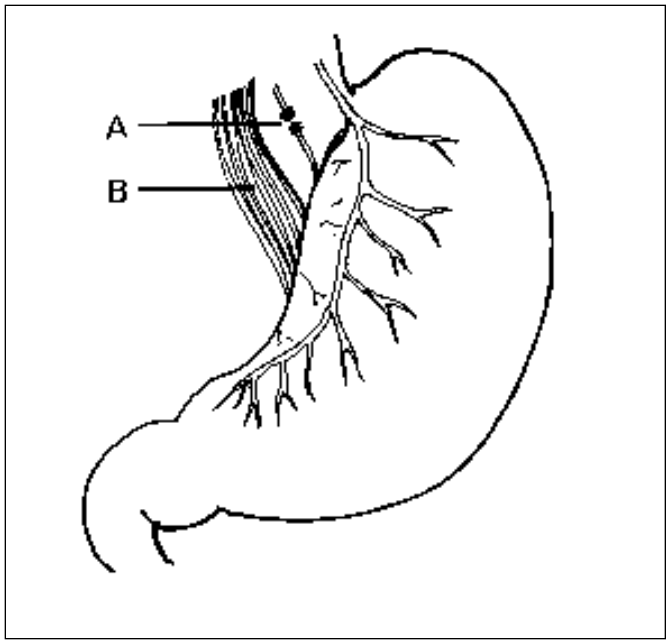

Figure 1. Right posterior vagotomy landmarks. A: right vagus; B: right crus.

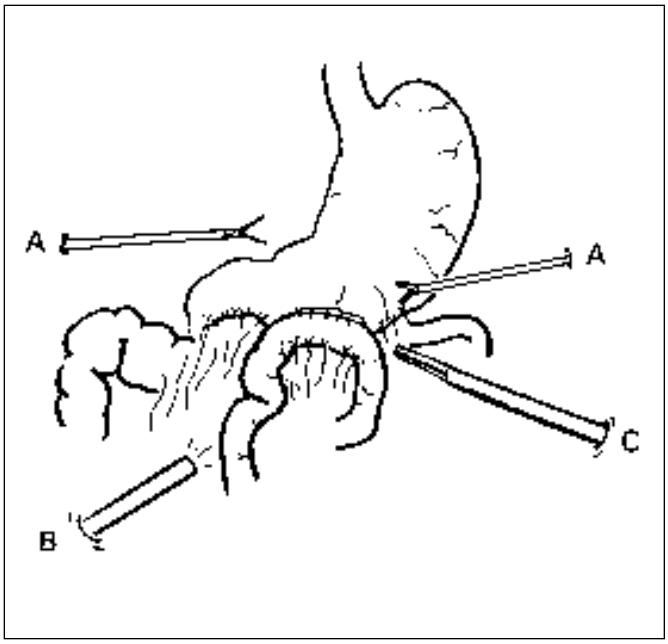

Figure 2. Laparoscopic gastrojejunostomy. A: grasping forceps; B: videolaparoscope; C: endolinear cutter.

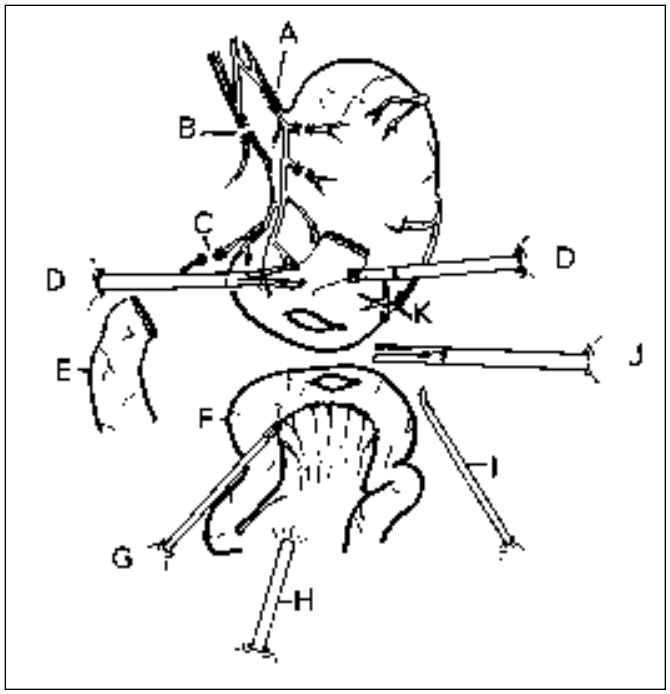

Figure 3. Laparoscopic bilateral vagotomy and antrectomy. A: left vagotomy; B: right vagotomy; C: right gastric artery; D: 10-mm Babcock; E: duodenal stump; F: 2nd jejunal loop; G: 5-mm grasper; H: 30˚ telescope; I: 5-mm scissors; J: endolinear cutter; K: right gastroepiploic artery.

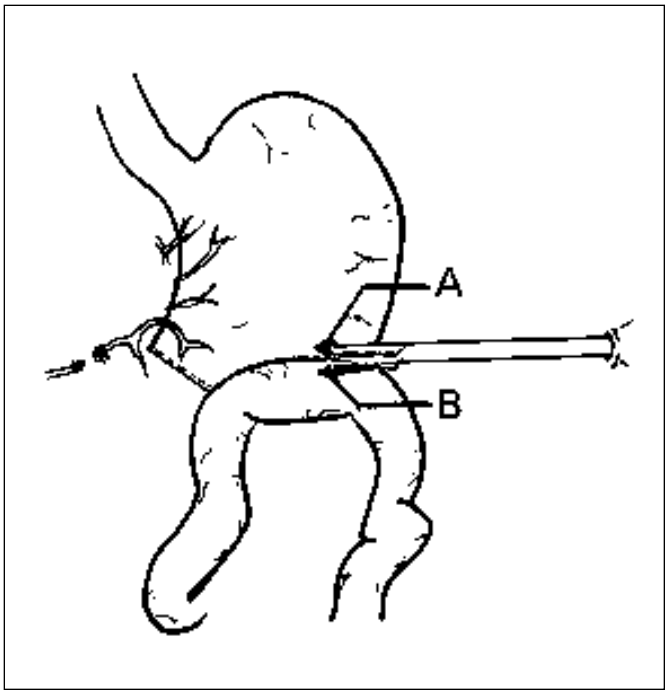

Figure 4. Variant of the previous technique (gastric specimen resected before anastomosis). A: gastrotomy; B: enterostomy.

area with minimal trauma to the surrounding tissue. The principal of this instrument involves a blade oscillating at 55,000 cycles per second, producing heat and coagulation of small vessels, thereby reducing the number of clips required during this step of the procedure. This instrument can also serve as an atraumatic grasper.

Technique of Laparoscopic Gastrojejunostomy (Fig. 2)

This step is straightforward, as only a minor dissection of the gastric pouch is required. The purpose of performing an efficient gastrojejunostomy is to realize this should be performed on the posterior aspect of the stomach about 8 cm proximal to the pylorus. Mobilization of the greater curvature of the stomach will begin at the level of the entrance of the left gastric gastroepiploic artery in the gastrocolic ligament. It is not necessary to divide the gastroepiploic artery, as dissection can be performed distal to the gastroepiploic arcade, thereby preserving it. The gastrocolic ligament is then opened using electric scissors, and again the harmonic scissors can enable a safe and fast dissection of this plane. Superior retraction of the stomach allows exposure of the posterior aspect of the stomach. Division of any adhesions between the stomach and the anterior surface of the body of the pancreas will enable better mobilization of the gastric pouch.

The jejunal loop is then chosen; it is easier for the surgeon to perform this step by moving from the position between the legs to the right side of the patient. Tilting the patient into a Trendelenberg position facilitates an exposure of the small bowel. The best way to recognize the jejunal loop is to follow the jejunum towards the angle of Treitz, which can be recognized by its tension. It is mandatory at this point not to exert much traction on the angle of Treitz, as a mesenteric tear could result, as happened in one of our cases. This tear will need to be repaired using intracorporeal suturing techniques, with 3-0 Prolene on a SH needle (Ethicon, Inc., Somerville, N.J.). Once the second jejunal loop is identified, it is mobilized and approximated to the stomach using two Babcock forceps. At this point of the procedure, the left lateral trocar is removed and replaced by a 18-mm trocar allowing an endolinear cutter 60 (Ethicon Endo-Surgery, Inc., Cincinnati, Ohio) to be introduced with a tip of the cutter pointing towards the liver. It is also advantageous in our experience to use a 35 cutter, as it is easier to handle because of its smaller size. A gastrotomy and enterotomy will then be performed; the stapler is then introduced, and two firings of ELC 35 or one firing of a 60 is then performed. The lumen of the anastomosis is then checked for careful hemostasis, and one suture is placed at the end of the staple line as in open surgery. This stitch is placed using intracorporeal knotting technique. Finally, the two enterotomies are closed, using either two other triangulated firings of the ELC 35, or even simpler, using a running suture of 3-0 Prolene knotted intracorporeally. The operation is then completed by the careful introduction of the nasogastric tube in the efferent loop of the jejunum enabling a decompression of the efferent loop in the immediate postoperative period. This nasogastric tube will be removed the following day.

The postoperative course is usually very simple, but care is taken not to feed the patient immediately the next day, as some stasis might be encountered. This is due to previous distention resulting from the gastric outlet obstruction. The patient is usually fed on the third day after a gastrograffin swallow shows integrity of the anastomosis.

Technique of Distal Gastrectomy or Antrectomy (Fig. 3)

The first step is the opening of the gastrocolic ligament under the right gastroepiploic vessel as described in the gastrojejunostomy. The careful use of the harmonic scissors can render this step quite easy. Clips will be used to secure all large vessels, preventing any hemorrhage. This will allow an anterior retraction of the stomach using Babcocks which will expose the duodenum in its posterior aspect. The area of the posterior aspect of the first part of the duodenum is carefully dissected as in open surgery, using an atraumatic right angle dissector. At this point it is usually necessary to ligate the right epiploic vessel after its division from the gastroduodenal artery. The upper limit of the duodenum is dissected where the right gastric artery is found and ligated precisely between two clips to secure the hemostasis. The next step is the transection and closure of the duodenum using an Endolinear Cutter 60. Once the stapler is fired, the line of sutures is inspected and the hemostasis meticulously completed. This maneuver will allow the distal part of the antrum to be exposed with one grasper, and dissection along the lesser curve will be performed step by step, using the harmonic scissors or the clip applicator as needed. It is important to be able to use the 30° telescope which gives a good view of the posterior aspect of either the stomach or the lesser sac. Any large vessel encountered is dissected and cut between two clips. At this point two techniques are possible: intra-abdominal or extra-abdominal anastomosis.

The intra-abdominal technique involves firing the Endolinear Cutter 60 between the stomach and the jejunum allowing a gastrojejunostomy to be performed in a Billroth II fashion and the specimen resected with several firings of Endolinear Cutter 60 with gastric green staples. Another possibility is to remove the specimen and use the staple line to introduce the cutter between the jejunum and the posterior aspect of the stomach (Fig. 4). The enterotomies and the gastrotomies are then closed with running sutures. The extra-abdominal technique involves a laparoscopically assisted antrectomy and a small abdominal incision of 4 cm which allows exteriorization of the stomach and jejunum enabling the resection and anastomosis to be completed outside the abdomen (Fig. 5). This technique is probably quicker, easier, and safer and is probably amenable to most surgeons; it is our preferred technique, as it cuts the time of the operation by two hours, leading to a mean of 2.5 hours for the total time of the procedures. No drains are needed after vigorous irrigation of the abdomen, but care is taken to close all trocars ports, as small-bowel hernias are possible through the trocar holes.

TREATMENT OF HEMORRHAGIC PEPTIC ULCERS

This is a life-threatening situation due to a visibly bleeding gastroduodenal artery, the treatment of which is controversial. Laser or electrocautery or even the application of clips (except in the hands of a few experts) is not ideal, as there is a significant risk of recurrent bleeding. A definite and reliable option is open surgical treatment using the Weinberg procedure. This consists of opening the duodenum, localizing the bleeding, suturing the bleeder, closing the duodenum, and then performing a truncal vagotomy if the patient's condition will tolerate the extra time required to perform this procedure.

This procedure might be possible laparoscopically (Fig. 6), but usually the patients are not hemodynamically stable for a longer laparoscopic procedure. The open approach is preferable in most cases. However, if the patient is hemodynamically stable, the procedure can be attempted laparoscopically.

An interesting futuristic concept is laparoscopic endo-organ surgery. This could prove to be of great utility in the future for the control of bleeding duodenal ulcers. This consists of an introduction of the laparoscope in the abdomen and a simultaneous introduction of trocars in the gastric pouch. This will allow the introduction of graspers into the stomach itself with the possibility, after

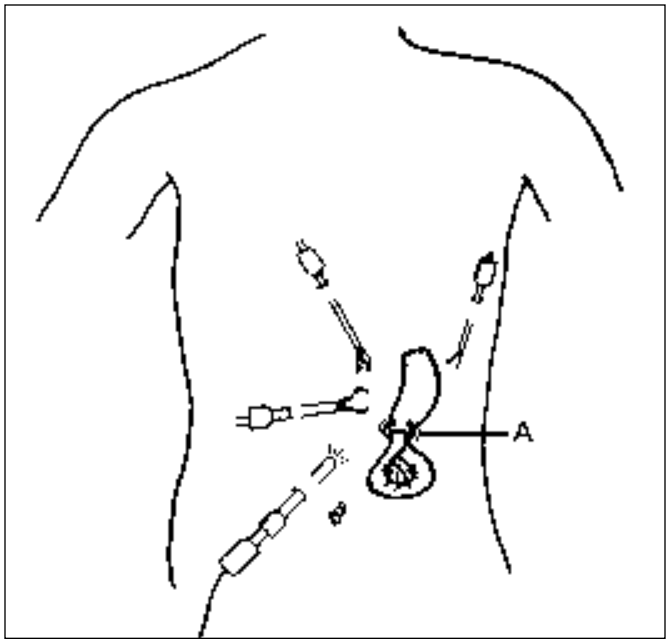

Figure 5. Laparoscopically assisted Billroth II reconstruction after antrectomy. A: 4-cm incision used to exteriorize the specimen.

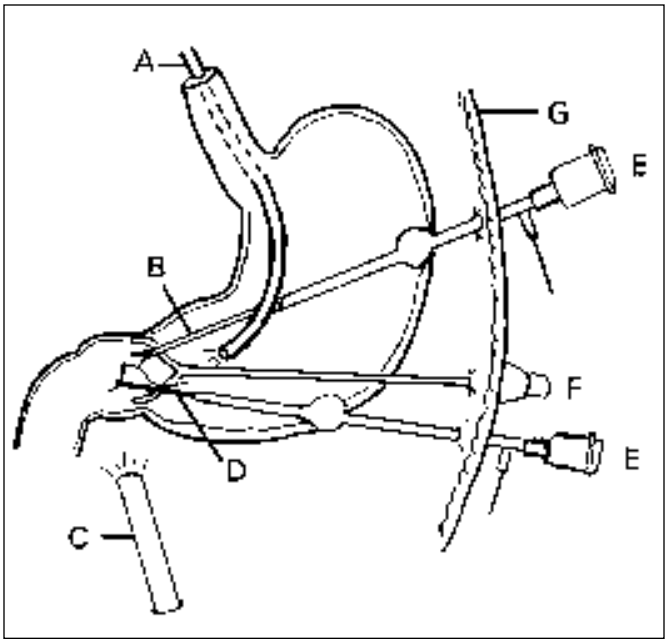

Figure 6. Endo-organ surgery on a bleeding ulcer. A: gastroscope; B: grasper; C: videolaparoscope; D: needle holder and suture; E: percutaneous balloon trocars; F: device to open the pyloric channel; G: abdominal wall.

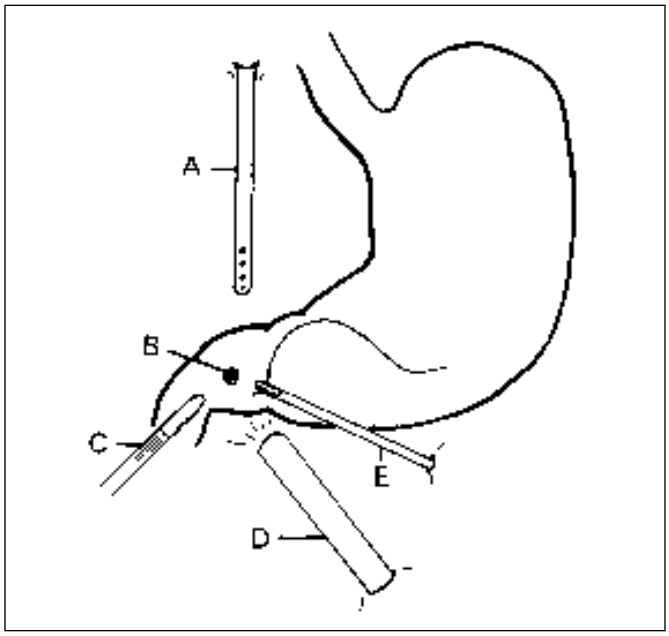

Figure 7. Placement of trocar for laparoscopic treatment of the perforated duodenal ulcer. A: irrigation-suction probe; B: duodenal ulcer; C: grasper; D: videolaparoscope; E: needle holder.

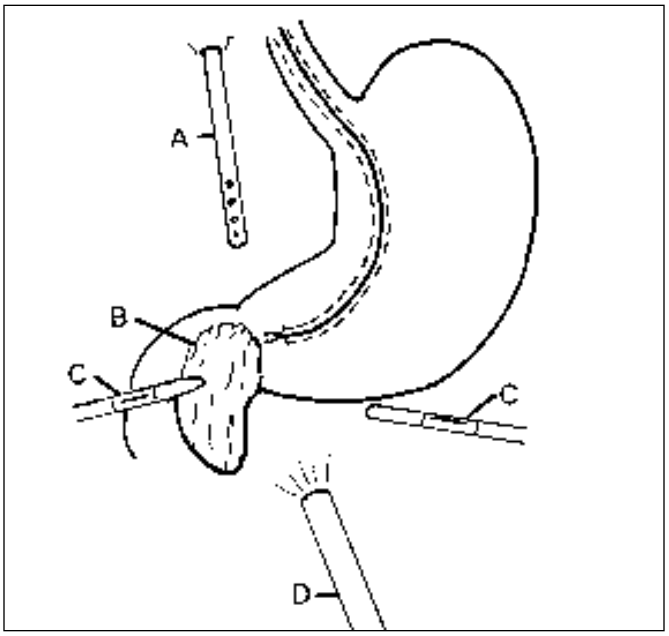

Figure 8. Omental patch combined with flexible esogastroduodenal (EGD) scope. A: Irrigation-suction probe; B: omental patch; C: grasper; D: umbilical laparoscope.

pyloric dilation, of precisely localizing the bleeding area and achieving hemostasis. This could be performed using a specially devised clip,[8] intragastric suture, or even an external suture tied on the external aspect of the duodenum. This concept of endo-organ surgery is still experimental and is probably going to represent a very interesting alternative in the near future.

MANAGEMENT OF PERFORATIONS OF DUODENAL ULCERS

The ability to place sutures and tie surgical knots is extremely important when performing emergency interventional laparoscopy. Laparoscopic closure of a perforated duodenal ulcer can only be accomplished with sutures since there is no stapling device that can perform this closure safely at this point in time.[9] A variety of laparoscopic needle holders is now available. Each one has advantages and disadvantages. The choice of suture material depends on the surgeon's preference. For most laparoscopic procedures, we prefer a monofilament material, such as 3-0 Prolene. The laparoscopic suture of a perforated ulcer represents in our experience a straightforward operation that should be performed by most laparoscopic surgeons today. This presupposes that the patient is stable, and the perforation is seen early in the first 12 hours before massive bacterial contamination.

Operative Technique (Fig. 7)

Usually four trocars are needed for this procedure. One is placed in the umbilicus for the videolaparoscope. A lateral trocar is placed on either side of the camera for each hand of the surgeon, and the final trocar is placed under the right costal margin for the suction irrigator that will also serve as a retractor. After all four trocars are inserted, intra-abdominal exploration is undertaken to locate the suspected duodenal lesion. Diagnosis of perforation is confirmed by the presence of free fluid overlying the distal stomach and duodenum and the presence of food fragments and fibrous membranes. With a perforated duodenal ulcer, there are often numerous false membranes over the intra-abdominal organs, and the ulcer perforation is usually completely covered by the gallbladder. These inflammatory adhesions have to be gently removed usually beginning at the inferior edge of the liver. Once the left lobe and the right lobe of the liver are free, the liver and the gallbladder are retracted superiorly. The dissection is then continued along the surface of the duodenum until the margin perforations are clearly visible. At that time a small-caliber palpation probe can be safely introduced in the perforation which will determine the exact size of the opening and the extent of the inflammation of the surrounding tissues.

It is mandatory, and probably the most important step in this procedure, to perform a thorough peritoneal lavage with at least 8 L of fluid, with the addition of antibiotics. Each quadrant of the abdomen deserves individual attention. This will eliminate all the contaminating liquids, and the procedure should only be completed once the lavage is finished. This will also help stabilize the patient's vital signs as less bacteria will be present in the abdomen and will be less likely to invade the bloodstream.

Closure of the Perforation

Before closure of the perforation is attempted, the duodenum should gently and economically be debrided from any necrotic material. Care should be taken in the debriding so as not to end up with a larger hole than can be sutured. Several different methods of closure have been employed; however, all require the use of intracorporeal tying techniques. If it has been the surgeon's practice to use Graham patches in open surgery, he should then proceed to the same operation laparoscopically and patch the perforation using an omental patch (Fig. 8). Two or three sutures will then bring the edges of the ulcer, the omental patch, and the other edge of the ulcer together. Another technique is to suture the edges of the ulcer, tie the knots, and then apply an omental patch. Both techniques are acceptable and the decision is dependent on the surgeon's

own preference. Care is taken not to damage the duodenum.

The delicate and fragile nature of the duodenum in such patients mandates that sutures be performed intracorporeally. Extracorporeal tying results in excessive tension being placed on the suture which will result in tearing to the inflamed tissues. 2-0 or 3-0 Prolene on a SH needle is usually our suturing material of choice, and it is usually cut to 15 cm in length. Small perforations can be managed with direct suture closure. If the patient has no history of peptic ulcer disease, then our recommendation would be to stop the operation at this point. If results of tests for *Helicobacter pylori* are positive in the postoperative period, the patient should be treated medically for eradication of this organism.

If the patient has a long history of chronic duodenal ulcer with repetitive and intractable disease or with relapse under thorough medical treatment, then a vagotomy should be added to the procedure. Two choices are possible. One is highly selective vagotomy which is probably a longer and more tedious operation in the emergency setting. Another alternative is the posterior truncal vagotomy and anterior seromyotomy, as we described in 1989. This is an easy and straightforward operation that carries minimal mortality and morbidity. It consists of a laparoscopic right truncal vagotomy sparing the left anterior trunk and an anterior lesser curve seromyotomy extending from the posterior aspect of the angle of Hiss to the first branch of the crow's foot, terminal branches of the anterior gastric nerve of Latarjet. The remaining branches of the nerve of Latarjet are sufficient to assure adequate antral motility and emptying. The divided seromuscular layer will then be closed in an overlap fashion to prevent nerve regeneration and control postoperative hemorrhaging from the seromuscular incision.

MANAGEMENT OF RECURRENCES AFTER HIGHLY SELECTIVE VAGOTOMY

It is known that these recurrences after highly selective vagotomy are amenable to medical treatment. In case of intractable disease, it is possible to rely on a combination of bilateral truncal vagotomy and antrectomy as a laparoscopic option.

CONCLUSION

Today, surgeons are performing fewer elective ulcer surgeries, as the eradication of *Helicobacter pylori* represents a major step in treatment of this disease. Nevertheless, patients who present with complications and those resistant to medical therapy should be offered surgical options.

The laparoscopic management of these complications represents an elegant alternative to open surgery as long as it is performed by experienced surgeons. It is always possible to convert the laparoscopic approach to open if a complication should occur during the laparoscopic procedure. We believe that the minimally invasive approach will renew the interest in definitive surgery for the treatment of duodenal ulcer disease. STI

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