Surgical Management: Truncal, Selective, and Highly Selective Vagotomy

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Introduction

Peptic ulcer disease is a common cause of epigastric pain. Every general surgeon must be familiar with the treatment options available to manage the disease. In the past, surgical management of ulcer disease was a common practice. However, since the advancement in medical therapy and its success in managing patients with PUD, the number of surgical procedures being performed for ulcer disease has dramatically decreased. Historically, indications for surgical management of PUD included intractable pain, obstruction, bleeding, and perforation. In recent times, medical management has made surgery almost obsolete for the first two indications with surgery being performed primarily for the latter two scenarios in an emergency setting [1, 2].

It is not possible to understand the concept of surgical vagotomy without having some basic knowledge of gastric acid secretion and the anatomy of the vagus nerves and its branches.

Gastric Acid Secretion

Secretion of gastric acid is divided into three phases. The cephalic phase starts with mere sight or smell of food. It is primarily mediated by the vagus nerve. The vagus nerve then activates chief cells to release acid. It also activates

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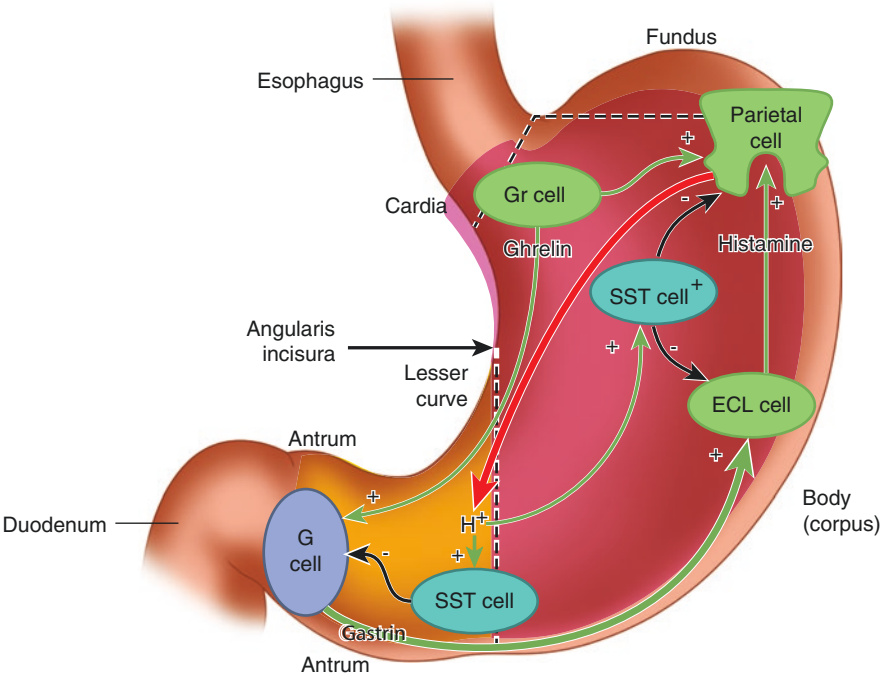
enterochromaffin-like cells (ECL) and G-cells in the antrum to stimulate release of gastric acid by releasing histamine and gastrin, respectively. This phase is responsible for about 25% of acid output. Next is the gastric phase which is responsible for the majority of gastric acid output. It is also primarily mediated by the vagus nerve and also by local activation of stimulatory peptides by breakdown products in chyme. The last phase is the intestinal phase which is responsible for only 5–10% of acid secretion and is primarily mediated through chemical stimulation of peptides and amino acids entering the small bowel [3] (Fig. 56.1).



Anatomic areas	Functional areas
Cardia fundus body	Oxyntic gland area (80%)
Antrum	Pyloric gland area (20%)

Fig. 56.1 Gastric acid secretion

Anatomy of Vagus Nerves

The right and left vagus nerves are located posterior and anterior to the esophagus, respectively, due to the embryological clockwise rotation of the foregut. Both nerves descend along the esophagus and enter the abdomen through diaphragmatic hiatus. The anterior vagus nerve is closely adherent to the esophagus and can have one or more trunk or form a plexus at the level of the hiatus. The posterior vagus nerve can be up to one centimeter away from the esophagus and usually has only one trunk. The anterior vagus nerve gives off two terminal branches. These include the hepatic branch that runs in the gastrohepatic ligament and the principal gastric branch or nerve of Latarjet that runs along the lesser curve. The nerve of Latarjet gives off five to seven gastric branches that supply the stomach and have a characteristic crow's foot appearance along the lesser curve. This nerve continues off to supply the pylorus. The posterior vagus gives off a sizeable branch right after emerging through the hiatus or sometimes above the hiatus called the criminal nerve of grassi. This must be identified during vagotomy as this is believed to result in ulcer recurrence if not sacrificed during the procedure. It also gives branches to the celiac axis and then continues down as the posterior nerve of Latarjet [4, 5].

Surgical Management

As mentioned previously, the surgical management of ulcer disease has been largely limited to emergency management of complications including bleeding and perforation. Obstructions still do occasionally occur due to ulcer disease. In the past vagotomy was recommended at the time of surgical management of ulcer complications to decrease risk of recurrence. Nowadays, preference is given to emergency management, diagnosis and treatment of *H. pylori*, and acid blocking medications before planning vagotomy to avoid the complications of vagotomy.

Three types of vagotomies are described: truncal vagotomy (TV), selective vagotomy (SV), and highly selective vagotomy (HSV). The schematic diagram shows location for these three types of vagotomies (Fig. 56.2).

While these operations were classically performed as open procedures, successful cases of laparoscopic vagotomies have been described in literature [6, 7]. We describe details of the laparoscopic approach to these vagotomies.

Port Placement

Port placement is key to successful foregut surgery. We utilize five incisions. The initial port is a 10 mm trocar which is placed 15 cm below the xiphoid just to the left of midline using a direct cutdown technique. This is the camera port. The abdomen is insufflated to allow placement of the remaining ports under direct visualization. A subxiphoid incision is used for placement of a Nathanson liver retractor. A 12 mm

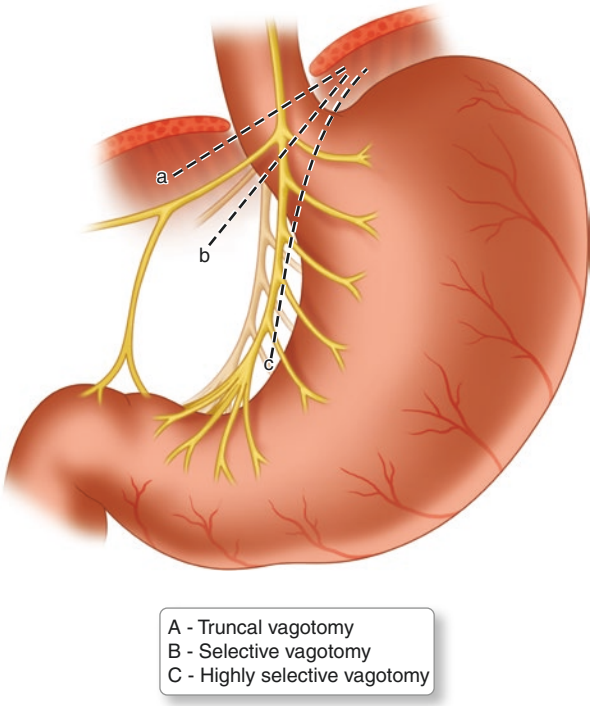


Fig. 56.2 Anatomy of vagus nerves and their branches

port is placed 10 cm from xiphoid process in subcostal area in the left midclavicular line off of the costal margin. A 5 mm port is placed in the left anterior axillary line off of the left costal margin. Finally a 5 mm port is placed 4 fingerbreadths from xiphoid process on the right side with entry at the base of the falciform below the left lobe of the liver.

Exposure

The abdomen is entered using an open Hasson technique and insufflated with CO2 to a pressure of 15 mm Hg. A liver retractor is placed to retract left lobe of the liver and expose the hiatus. Using hook electrocautery, we incise the pars flaccida and open it in a horizontal fashion above the hepatic branch of the vagus. It is opened in a transverse fashion below the hepatic branch. We preserve the hepatic branch of the vagus routinely. The peritoneum overlying the medial border of the right crus is opened and we enter the mediastinum. A retroesophageal window is created to expose the left crus. The esophagus is mobilized in a circumferential fashion by dissecting along the border of the crura. At this point the anterior vagus can be identified overlying the esophagus. The posterior vagus is noted along the posterior esophagus.

Vagotomy Techniques

After adequate dissection, traction with a Penrose is used on the esophagus to expose the anterior and posterior vagi. For truncal vagotomy, 2–3 cm of each nerve is clipped and transected above the level of GE junction (Fig. 56.2). These transected segments should be sent to pathology to confirm that the nerves have been transected. Since this procedure also interrupts the motor fibers to the pylorus and can lead to gastric outlet obstruction, it must be combined with a drainage procedure such as a pyloroplasty. Alternatively one can resect the gastric antrum to decrease acid output. With distal gastrectomy, reconstruction is accomplished with either Billroth I or Billroth II reconstruction. The details of these procedures are described in another chapter.

For selective vagotomy, the vagal nerves are transected distal to the LES (Fig. 56.2). Gastric emptying is also a concern with these procedures and a drainage procedure is usually added.

For highly selective vagotomy, the hiatal dissection is omitted, and trocar placement is the same as described. Highly selective vagotomy (HSV) divides only the gastric branches of the vagus nerves and preserves the innervation to the pylorus, thereby obviating need for any drainage procedure (Fig. 56.2). It is performed by identifying nerves of Latarjet and then dividing the nerves supplying the stomach. These branches are present in the classic crow's foot configuration and are 5–7 in number. Usually transection is started 5–6 cm proximal to the pylorus and is carried along the way up to 5 cm distal to the GE junction. Great attention must be paid to criminal nerve of grassi in any of these procedures as sparing this nerve leads to a high recurrence rate.

Postsurgical Management

The patient is admitted to the hospital for postoperative recovery. A liquid diet is started on POD # 1 and advanced as tolerated. If a drainage procedure is performed, then an upper GI study is done to rule out any leaks prior to resuming oral intake. Oral pain medications are started, and patient can be discharged home once tolerating adequate oral intake.

Outcomes and Complications

The three procedures have variable effectiveness in control of acid secretion. While studies have shown that TV and SV have almost comparable decrease in basal acid output (BAO) and maximal acid output (MAO), HSV is less effective in this regard [8]. This difference is further accentuated over long-term follow-up, and recurrence rate for patients with HSV is much higher compared to other two types of vagotomies. Oftentimes, the procedure selection is based more on the possible complications versus the success in controlling acid secretion.

The incidence of various morbidities is variable depending on the type of vagotomy procedure and also the type of drainage procedure performed. Overall, the

Table 56.1 Complications after ulcer operations [10, 12]

Percent of patients with	HSV	TV + D	TV + A
Epigastric fullness	14.3	19.1	36.2
Early dumping	0	8.5	12.8
Late dumping	0	4.3	8.5
Nausea	6.1	8.5	8.5
Vomiting (food)	6.1	0	2.1
Vomiting (bile)	0	0	4.3
Heartburn	8.2	8.5	17
Flatulence	18.4	21.3	29.8
Diarrhea	10.2	14.9	21.3

HSV highly selective vagotomy, *TV + D* truncal vagotomy and drainage with pyloroplasty, *TV + A* truncal vagotomy and antrectomy

incidence of recurrent ulcer is lowest with TV and highest with HSV. On the other hand, the incidence of postoperative morbidities is higher with TV and SV and lower with HSV. One of the largest prospective studies reporting these complications was published in 1989 with 248 patients that had follow-up to 11–15 years [10, 11]. The incidence of recurrent ulceration was 28.5%, 37.4%, and 39.3% for TV, SV, and HSV, respectively. The incidence of diarrhea was 9.8%, 11.8%, and 4.4%; incidence of dyspepsia was 18.4%, 20.5%, and 8.6%; and incidence of dumping was 5.9%, 19.6%, and 2.2% for TV, SV, and HSV, respectively [9]. Patients who underwent TV with antrectomy (to remove the G-cells) had the lowest ulcer recurrence but higher morbidity compared to TV with pyloroplasty [10, 11]. A study done 6 years prior demonstrated TV with antrectomy had no case of recurrent ulceration but was associated with the highest incidence of postoperative complications compared with other procedures (Table 56.1) [10].

We describe these post-op morbidities in further detail below.

Diarrhea The incidence of diarrhea is variable depending on type of vagotomy. The incidence is 25% after truncal vagotomy and only about 5% after highly selective vagotomy [13]. Different etiological explanations are given for cause of diarrhea including rapid transit of food through the bowel, disturbance in bile acid metabolism, and dysregulation of enteral hormones. The diarrhea is usually self-limiting in most cases and rarely requires surgical intervention.

Dumping syndrome This is one of the common and oftentimes most debilitating outcomes after gastric ulcer surgery. It consists of symptoms that occur after ingestion of food. Two forms are recognized. Early dumping occurs 20–30 min after ingestion of food. Patients complain of epigastric fullness, cramping abdominal pain, nausea, explosive diarrhea, and cardiovascular manifestations including palpitations, tachycardia, flushing, and diaphoresis. This is believed to occur due to the sudden shift of fluid as hyperosmotic chyme enters the small bowel. Later

dumping syndrome occurs 2 to 3 h after food ingestion. Rapid gastric emptying leads to hyperinsulinemia in response to sudden appearance of large quantities of food in the small bowel. The resulting hyperinsulinemia leads to manifestation of hypoglycemia including tremors, sweating, light headedness, and confusion. Dietary changes and use of somatostatin analogues help ameliorate symptoms in majority of patients.

Gastric atony The vagus nerve has a major role in gastric emptying. After truncal and selective vagotomy, gastric emptying is significantly affected and needs a drainage procedure as mentioned earlier. Unfortunately, even after a drainage procedure, some patients will continue to have delayed emptying of solids. On the other hand, emptying of liquids can increase due to loss of receptive fundic relaxation. This can usually be managed with prokinetic agents after other causes of delayed gastric emptying are ruled out.

Bile reflux gastritis This is a common problem after antrectomy and reconstruction. Patients have epigastric pain and bilious vomiting. Diagnosis is confirmed on upper endoscopy which reveals inflamed mucosa and superficial ulcerations. Classically this syndrome does not respond well to medical therapy, and conversion to Roux-en-Y gastrojejunostomy is required.

Afferent loop syndrome This syndrome can result from a variety of causes, including kinking of the afferent limb, internal herniation, or stenosis of the gastrojejunal anastomosis. It can present as an acute or chronic syndrome. In case of the latter patients may present with megaloblastic anemia due to deficiency of vitamin B-12 from bacterial overgrowth. In both acute and chronic afferent loop syndrome, surgery is indicated. Options include shortening of afferent limb, conversion of Billroth II to Billroth I anastomosis, creation of enteroenterostomy past the stoma, or conversion to Roux-en-Y gastric bypass.

Efferent loop syndrome This syndrome is relatively uncommon. It usually results from herniation of efferent limb behind the anastomosis. Patients present with abdominal pain and bilious vomiting. Diagnosis is usually established with a CT scan with oral contrast. It reveals failure of contrast to enter the efferent limb. Treatment is surgical with reduction of hernia and closure of defect to prevent herniation in the future.

Conclusion

Vagotomies have mostly become procedures of the past due to excellent medical options, available now for the treatment of PUD. However, surgeons should be familiar with the anatomy and physiology of this region of the foregut. There are still some situations such as obstruction, perforation, or bleeding due to PUD that are not responsive to medical therapy where these procedures may still be considered.

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