Vagotomy with Laparotomy

ARTICLE BY RICHARD E. WILLS, MD, AND PEGGY E. GRUSENDORF, MS, RNP

Vagotomy with laparotomy is performed in order to reduce the amount of gastric juices produced by the stomach, which may cause intractable duodenal or gastrojejunal ulcers. The vagus nerves, which control the amount of gastric acid present in the stomach, are surgically transected, thereby interrupting the neural pathway.

There are three methods used to interrupt the vagus nerves. The proximal gastric vagotomy divides the vagal nerves to the proximal stomach, but maintains the entire stomach and the vagal nerves to the antrum. The selective vagotomy transects the gastric branches, preserving the innervation of organs other than the stomach. The truncal vagotomy divides the vagal nerves at the distal esophagus and provides total vagal denervation of all structures below the diaphragm.

This article will focus on the surgical procedure for the truncal vagotomy, including anatomic and physiologic considerations.

Anatomy

The stomach (Figures 1 and 2) is a saclike area of the alimentary canal. Superiorly it is closed off from the esophagus (see Figure 1) by the cardiac sphincter and from the duodenum by the pyloric sphincter (see Figures 1 and 2). The stomach functions by peristaltic activity that churns and homogenizes the swallowed foods, liquids, and saliva enzymes in addition to its own enzymes. The end product that is passed into the duodenum is called chyme. The stomach lies under the ribs and the costal cartilage that form the upper left quadrant.

The cardia (see Figure 1) is located behind the 7th costal cartilage, 2 to 3 cm left of midline. The pylorus is 2.0 to 2.5 cm right of midline in the trans-pyloric plane. The pylorus is found in the area of L-1, but the cardia is some distance anterior to T-11. These points and positions may vary considerably with individual body build. Between the cardia and pylorus of the stomach is the fundus, pyloric antrum, and the pyloric canal (see Figure 1). In the upper left area of the cardia is the cardiac incisure (see Figure 1). This area is between the left border of the esophagus and the stomach (see Figure 1).

The body of the stomach is continuous above with the cardia and below with the pyloric antrum, which connects with the pyloric canal. The pylorus is apparent by a small prepyloric vein in a shallow groove, which is used as a landmark during surgery. The stomach is oblique and extends from the fundus downward, anteriorly and to the right. The lesser curvature is the right border, and the greater curvature is the left and inferior border of the stomach (see Figure 1).

The stomach is covered by peritoneum except for an area posterior to the cardiac orifice and one area where the blood vessels course the two curvatures. The two layers of peritoneum continue as the lesser omentum at the lesser curvature and at the greater curvature where the greater omentum spreads out into

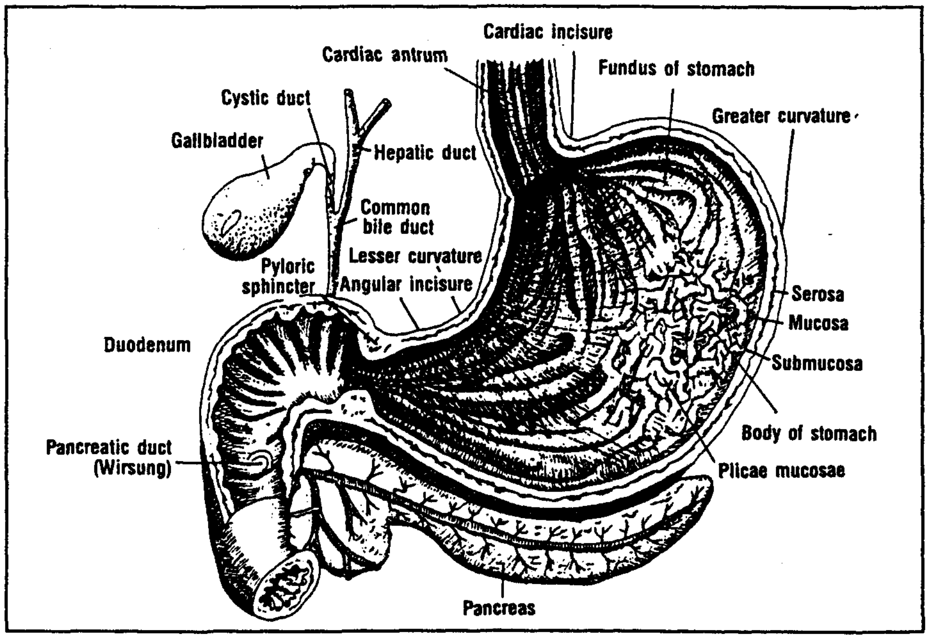

Figure 1. Longitudinal section of the stomach.

the gastrophrenic, gastrosplenic, and gastrocolic ligaments.

Histology

Inside the esophagus and at the opening of the stomach, the epithelium of the esophagus changes abruptly from stratified squamous cells to simple columnar cells. The mucosa of the stomach has numerous folds or ridges, known as rugae. The rugae vary in height and number with the degree of distention of the organ. The entire surface of the gastric area is lined with depressions called gastric pits or foveolae. These depressions are shallow within the fundus while in the pyloric region they are much deeper. The epithelium that lines the inner surface of the stomach and gastric pits is made of columnar cells that function differently from the cells of the gastric glands. Overall, the characteristics of the stomach lining cells differentiate them from the lining cells of all other parts of the digestive tract.

Physiology

The three functions of the stomach are to (1) mix food with gastric secretions, (2) store large quantities of food immediately after a meal, and (3) empty food from the stomach into the small intestine.

A myriad of microscopic glands penetrate the mucous layer of the stomach, which is lined with mucous-secreting cells. The glands are categorized according to their anatomic location within the stomach. Cardiac glands are near the cardiac orifice and secrete mucous. Fundic glands of the stomach body are composed of three types of cells: (1) chief cells that secrete mucous and pepsinogen, (2) parietal cells that secrete hydrochloric acid and water, and (3) mucous neck cells that secrete only mucous.

The unstimulated stomach is coated with visceral mucous mixed with an alkaline fluid. Argentaffin cells produce an intrinsic factor and an antiemetic factor that allow vitamin B_{12} to be absorbed.

The pyloric glands are near the pylorus and secrete pepsinogen and mucous. A hormone called gastrin is secreted within the pyloric glands and the upper proximal part of the jejunum. Gastrin is carried to the fundus, causing the parietal cells to produce hydrochloric acid. Hydrochloric acid then converts inactive pepsinogen from the chief cells into active pepsin, which acts as a digestive protein.

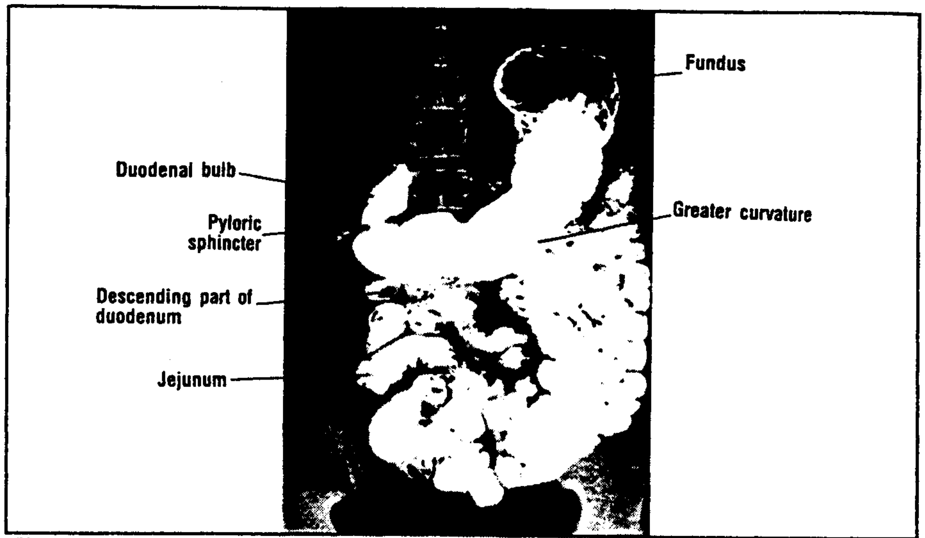

Figure 2. Barium swallow of the stomach and small intestines.

Neurophysiology

Extrinsic innervation to the stomach comes from both sympathetic and parasympathetic branches of the autonomic nervous system. Both carry afferent and efferent fibers. The parasympathetic innervation occurs via branches of the vagus nerve that, when stimulated, cause increased gastric secretion of acid, gastrin, and pepsin, as well as increased gastric motor activity. The vagus nerve splits, forming two main trunks at the level of the hiatus (Figure 3). The anterior, or left, vagus (see Figure 3) is found on the anterior wall of the esophagus and divides into the hepatic and anterior gastric branches. The anterior branch runs on to the front of the fundus and body of the stomach while the hepatic branch runs into the lesser omentum of the liver, bile ducts, gallbladder, duodenum, pylorus, and right side of the pancreas.

The posterior, or right, vagus (see Figure 3) divides into two branches: one at the posterior wall of the fundus at the body of the stomach and one at the posterior wall of the antrum. During surgery, it may be overlooked since it is more easily separated from the esophagus. The posterior vagus also goes to the celiac ganglion (see Figure 3), where parasympathetic fibers are distributed to the body and the tail of the pancreas with communication to the entire small intestine and proximal colon.

The sympathetic nerves innervate via the greater splanchnic nerves and the celiac ganglion. The afferent branches from T-6 to T-10 conduct the visceral gastric pain impulses, which are stimulated by muscle contraction, distention, and inflammation. The efferent fibers inhibit gastric secretion and motility.

There are two nerve plexus in the gastric wall: (1) Auerbach's, which influence gastric motility, and (2) Meissner's, which provide innervation to the stomach and cause the release of gastrin from the antrum. Together they coordinate the motor and secretory activity of the gastric mucosa.

Use of Truncal Vagotomy

Bilateral resection of the vagus nerves in the region of the lower esophagus reduces the amount of gastric juices produced by the stomach and is one method for treating intractable duodenal or gastrojejunal ulcers.

Vagotomy eliminates cephalic (vaga) stimulation of acid secretion and reduces basal acid output by 80% to 90% and maximal (peak) acid output by 50% to 60%. Truncal vagotomy also denervates the antral pump mechanism, leading to delayed gastric emptying. With the motor paralysis, gastric retention that follows the vagotomy must be accompanied by a concomitant gastric resection and/or drainage procedure. This can be done with a pyloroplasty or a gastroenterostomy placed in the pyloric antrum. There is a slight preference for pyloroplasty over gastroenterostomy in combination with vagotomy for the treatment of peptic ulcers.

The use of truncal vagotomy to control the cephalic phase of secretion (the phase mediated by efferent activity of the vagus nerve) is preferred when it is desirable to retain as much gastric capacity as possible because of the preoperative nutritional status of the patient with a duodenal ulcer. Truncal vagotomy with pyloroplasty or gastroenterostomy conserves the gastric reservoir and can be performed with a lower risk to these patients, who may have incompletely corrected fluid and electrolyte imbalance or malnutrition.

While the vagotomy may control the cephalic phase of secretion, a combination of vagotomy with a hemigastrectomy may be required to control the gastric phase of secretion (the phase during which gastrin is secreted).

For controlling acid in managing chronic recurrent pancreatitis, the vagotomy has been used in combination with other procedures, including the use of nasogastric feeding tubes, treatment with an H_2 blocker, and pancreatico-jejunostomy.

Surgical Procedure

The first step is to perform a laparotomy. Routines that are followed during every abdominal procedure are discussed here (adapted from Schwartz S. *Principles of Surgery*).

The patient is placed in the supine position, prepped, and draped for the specific abdominal incision. Once'draping is completed, the technologist moves the Mayo stand up to the field below the wound site. The cautery and suction tubing are clamped to the top drape by the technologist or surgeon. The technologist places two dry lap sponges on the field and passes a number 10 or 20 knife blade to the surgeon. This knife will hereafter be referred to as the skin knife and is designated for use only on the skin. Most surgeons believe that the skin knife carries bacteria from the skin into deeper layers, although some surgeons dispute this.

The skin incision exposes the subcutaneous or fatty layer that lies just under the skin. This layer is usually incised with the cautery pencil or knife. The surgeon clamps large bleeders in this layer with Kelly or Crile hemostats and ligates them with an absorbable suture, size 3-0, or the surgeon may simply cauterize them.

The incision is carried through to the next layer, the fascia. At this level the scrub person should have small Richardson or USA retractors available for the assistant. The surgeon incises the layer with a number 10 or 20 knife blade, from then on referred to as the deep knife. Throughout the procedure, the technologist must exchange soiled lap sponges for clean ones.

The surgeon may lengthen the fascial incision with the cautery pencil or may use curved Mayo scissors. If the incision is on the midline, no muscle tissue is encountered. If, however, the incision lies off the midline, there will be a layer of muscle tissue that the surgeon will separate manually or with the scalpel. In preparation for entrance into the abdomen, the technologist should have several lap sponges and a self-retaining retractor such as a Balfour retractor available. The lap sponges are dipped in warm (not hot) saline solution and wrung as dry as possible. If small 4x4 sponges have been used prior to the opening of the peritoneum, the technologist must remove them from the field immediately. They may not be used again (unless mounted on a sponge forcep) until the peritoneal layer has been closed. The surgeon and the first assistant each pick up the peritoneum with hemostats and elevate it. The surgeon then nicks the peritoneum with the deep knife and extends the incision with Metzenbaum scissors.

The abdominal contents are now exposed. From this point on, only saline-moistened sponges are allowed on the field to protect the abdominal contents from injury. The technologist passes the moistened sponges to the surgeon, who covers the tissue edges to protect them from the self-retaining retractor. The Balfour retractor is now placed in position by the surgeon and assistant. When the area of dissection has been

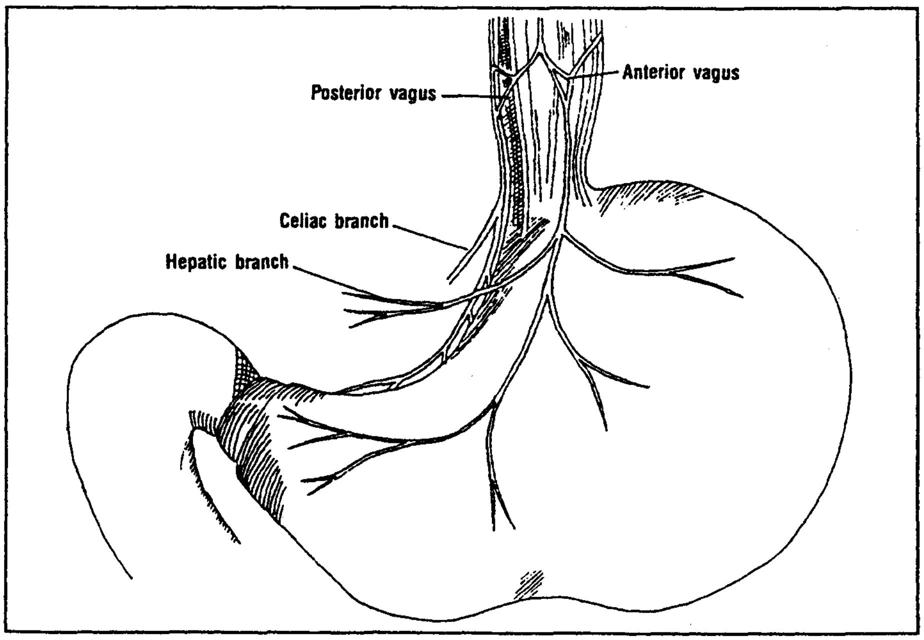

Figure 3. Neurophysiology of the stomach.

located, the surgeon packs the abdominal contents away from the area with several lap sponges. The esophagus is exposed using long Metzenbaum scissors and long fine tissue forceps. The vagotomy can then be initiated. During the procedure, the responsibilities of the technologist in the scrub role include the following: (1) passing the instruments; (2) keeping the field clear of instruments not in use; (3) ensuring the cautery pencil is free of tissue debris; (4) exchanging soiled sponges for clean ones; (5) keeping loose items such as needles, small dissecting sponges, and suture wrappers off the Mayo stand (needles and sponges go on the field or Mayo tray only when mounted on the appropriate clamp); (6) protecting the field from contamination through proper aseptic technique and notifying the surgeon of any breaks in technique; (7) anticipating the surgeon's needs; (8) notifying the circulator when the surgeon needs his/her brow wiped; and (9) participating in sponge counts at the appropriate times.

During the procedure, the surgeon may request that the patient be tipped into the reverse Trendelenburg position if necessary to push the bowel downward for more visual exposure. As soon as this request is made, the technologist should immediately raise the Mayo stand to prevent injury to the patient's legs and feet. The Mayo stand must never be allowed to rest on the patient.

For the truncal vagotomy, the vagus nerves may be divided several centimeters above the esophageal junction. Good exposure at the lower end of the esophagus is needed; the xiphoid may be removed and the left lobe of the liver may be mobilized for better visualization of the lower esophagus.

It is up to the surgeon whether to use hemoclips or ligatures in the dissection. Most surgeons will ligate the posterior vagus to control possible bleeding that may take place in the mediastinum.

The surgeon first divides the esophagus from the attached peritoneal membrane. Once it has been detached from peritoneal membrane, the esophagus is retracted to the side with a long, 1-inch Penrose drain that has been dipped in saline solution by the technologist.

The surgeon catches a portion of the vagus nerve with a long nerve hook. Two long right-angle clamps are placed over the vagus nerve proximal and distal, allowing the nerve to be cut with the Metzenbaum scissors between the two right-angle clamps. The sectioned nerve is passed to the technologist as either right or left vagus nerve specimens. These specimens are sent to the pathologist to confirm the type of nerve tissue excised. The severed edges of the nerve are clamped with ligation clips or ligatures and the procedure is repeated on the other side.

Many surgeons irrigate the wound with warm saline solution just before the abdomen is closed. The technologist must check the saline to be sure that it is not too hot; it should feel comfortable to touch.

Following irrigation, the wound is closed. The surgeon and assistant remove all sponges and instruments from the abdomen and grasp the edges of the peritoneum with several Mayo clamps. The peritoneum is usually closed with absorbable sutures swaged to a taper needle, size 0 or 2-0. Next, the fascia is closed with any of a variety of materials–silk, polyester, and polyglycolic acid sutures are commonly used. Since the fascia is the strongest layer of the abdominal wall and the integrity of the closure depends upon its strength, interrupted sutures are used to close it in most cases. Size 2-0 suture is most commonly used, although size 0 may be used if the patient is very large or obese. The suture may be mounted on a taper or cutting needle, according to the surgeon's preference. During fascia closure, the assistant retracts the skin and subcutaneous layer with USA or Richardson retractors. The subcutaneous layer is closed next with interrupted sutures of 3-0 polyglycolic acid, chromic catgut, or plain catgut. Fine tapered needles are used.

At the completion of skin closure, the technologist or surgeon places the dressings over the wound. The drapes are then removed and tape is applied to the dressings.

Complications

Operative mortality with vagotomy and pyloroplasty is less than 1% (Table 1). Even when this procedure is performed as an emergency, operative mortality is relatively low in

(Continued on page 24)

Table 1. Surgical Procedures for Treatment of Peptic Ulcer Disease*

Procedure	Operative Mortality		Late Postoperative Complications				
			Dumping		Diarrhea		Recurrent Ulcers
	Elective	Emergency	Mild	Severe	Mild	Severe	
Truncal vagotomy and pyloroplasty	<1%	<7%	20%	2%	20%	2%	7%-10%
Truncal vagotomy and antrectomy	1%	9%-15%	30%	2%-5%	20%-30%	2%	1%
Proximal gastric vagotomy	0.1%	1%	0.5%	0%	1%-2%	0%	10%

*Adapted from Kinney et al. *Manual of Preoperative and Postoperative Care.*

Expanding Horizons-*continued*

On a case such as the one last evening, I was kept busy with setting up the room, opening supplies, and assisting with the prep in addition to completing the large amount of paperwork generated by lab requisitions and chartwork.

Processing is another area where surgical technologists are found. Sterile procurement of the tissue also requires sterile processing. Having technicians trained in the art of sterile technique is important. They are responsible for preparing the tissue for transplant: clearing muscle from the bone and cutting it into pieces and sizes we have requested. If they are working on a heart, they will excise the pulmonary and aortic valves and freeze them in liquid nitrogen.

Allograft tissue usage has grown in the past few years. Heart valves are in great demand and are used primarily in pediatric surgery. Surgeons are able to repair a tear of the anterior cruciate ligament using an iliac wedge. Limb salvage is now possible, in some instances, utilizing a large allograft such as a distal femur. Using cadaveric tissue eliminates the need for additional surgery and cuts down the possibility of infection, as well. Patients whose lives are enhanced through transplantation truly feel they have received a gift.

As you can see, there are many changes and challenges to be met for surgical technologists. The field of transplantation will continue to expand into the twenty-first century. My career has been, and remains, very rewarding. I would encourage anyone who has an interest in transplantation to explore the opportunities available in this exciting field. Δ

Susan Warren, CST, CTBS, is a contributing editor for The Surgical Technologist.

CE Exam-*continued*

contrast to an operative mortality of 9% to 15% following emergency vagotomy and antrectomy.

Postoperative Care

The postoperative management is identical for pyloroplasty and gastroenterostomy. Dissection from manipulation around the left leaf of the diaphragm makes left lower lobe atelectasis a frequent occurrence. Adequate ventilation should begin immediately in the postoperative period. Intermittent positive pressure breathing should be used freely during postanesthetic recovery. Particular attention is paid to tracheobronchial toilet. The patient is encouraged to deep breathe and cough, with tracheal aspiration and bronchoscopy used freely. Temporary tracheostomy may be life-saving in patients with preexisting chronic lung disease. Temporary gastrostomy is used in all cases to prevent distention of the vagotomized stomach by swallowed air and retained secretions. The gastrostomy catheter is connected to straight drainage for 3 continuous days, and is clamped on the evening of the third postoperative day. Gastric residual is measured the next morning; if it is less than 100 cc, the tube is reclamped and the patient is given 30 cc of water each hour. Residual is measured twice daily. If it remains low, fluid intake is increased on day 5 to 60 cc of clear liquids each hour. On day 6, clear liquids are permitted and intravenous administration of fluids is discontinued. As a result of continued low gastric residual, a soft diet should be given for day 7 following surgery.

Since the pyloric sphincter has been ablated, the patient may be subject to "dumping." High carbohydrate liquids should be specifically prohibited for 6 weeks postoperatively. The gastrostomy tube is removed no earlier than 10 days postoperatively and may be done on an outpatient basis.

Three months after surgery the patient is recalled for a clinical evaluation for an upper gastrointestinal x-ray evaluation to determine the adequacy of gastric emptying and for a basal gastric analysis to evaluate the adequacy of the vagotomy. Δ

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Richard E. Wills, MD, is medical director and Peggy E. Grusendorf, MS, RNP, is president of Intermountain Medical Research in Orem, Utah.