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CHAPTER 7.2

Stomach Surgery

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[1]Open operations for morbid obesity

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Gastric Resections

Surgical Considerations

Description: Total or partial gastrectomy is performed most commonly for gastric cancers (adenocarcinomas or Gastrointestinal Stromal Tumors GIST), and will include **omentectomy, lymph node dissection,** and occasionally resection of adjacent organs such as the **spleen** or **colon,** depending on the extent of the tumor. Historically there have been other indications for gastrectomy such as ulcer disease, Zollinger-Ellison syndrome and uncontrollable hemorrhagic gastritis, but these operations are rarely if ever performed for those indications in current surgical practice. Occasionally patients who suffer from severe and uncontrollable gastroparesis postgastric surgery may require total gastrectomy.

In a gastric resection, the abdomen is entered through an upper midline incision and the lateral segment of the left lobe of the liver is retracted to the patient's right, exposing the esophagogastric junction. The omentum is taken off of the colon and left attached to the greater curvature of the stomach. The spleen may be removed if involved by tumor or if an unplanned splenic injury occurs. The vessels to the stomach are individually ligated and divided. The short gastric vessels high on the greater curvature are difficult to reach and are a source of potential blood loss. This is also the most likely time that a splenic injury may occur by traction or tearing of the capsule in exposing the short gastric arteries. Currently most surgeons are using various devices to ligate the arteries and these occasionally have a technical failure which can result in blood loss. In the lesser sac, the left gastric artery as it branches from the celiac axis and vein needs to be divided and can be another point of potential unexpected blood loss. A total gastrectomy is performed for more proximal cancers and a partial resection for distal cancers. In all cases of gastric cancer, the antrum and pylorus are resected. One area of potential complication when the stomach is resected is the accidental stapling of the NG tube which remains undetected until too late. To prevent this, the NGT should be pulled back well into the esophagus, preferably with manual confirmation by the surgeon that the tube is no longer present in the stomach.

After completion of the gastric resection, reestablishment of intestinal continuity is performed. In the case of a total gastrectomy, a Roux limb of jejunum will be brought up to the distal esophagus; in partial gastrectomies a Roux limb or loop of jejunum (Billroth II) is connected to the stomach. With a Roux limb the jejunum is divided just beyond the Ligament of Treitz, and the distal end is brought up through a hole in the mesentery of the colon and anastomosed to the esophagus or stomach. Intestinal continuity is established by anastomosing the biliary pancreatic limb of the jejunum to the Roux limb of jejunum, approximately 60 cm distal to the anastomosis with the esophagus. A drain is then placed near the closed end of the duodenum. These anastomosis can either be stapled or handsewn depending on the preference of the surgeon. At completion of the anastomosis a NG tube is advanced across the proximal anastomosis, and the abdomen is irrigated. A number of surgeons will then place a feeding jejunostomy tube into the jejunum which adds a few minutes to the procedure prior to fascial closure. Total gastrectomy traditionally has been associated with a morbidity and mortality out of proportion to the operation's apparent magnitude. This is most likely a consequence of the patient's underlying condition, which often includes advanced malignancy and, almost invariably, some degree of malnutrition. Venous thromboembolism (VTE) is a significant concern in these patients because of their increased hypercoagulable state from the cancer and an operation of greater than one hour in duration. Patients undergoing gastric resection should receive sequential compression devices on the lower extremities and 5000 units of standard Heparin subcutaneously after placement of an epidural catheter. If an epidural catheter is not placed, the patient can receive low molecular weight heparin for VTE prophylaxis.

Variant procedure or approaches: Occasionally a gastric cancer can have extensive local involvement of adjacent organs

requiring an **en bloc resection** of the stomach in addition to the colon, spleen, or pancreas. For certain distal gastric cancers a combined gastric resection with a **Whipple procedure (pancreaticoduodenectomy)** may be necessary. The need for en bloc resection of the stomach in combination with other organs increases the complexity of the surgery, risk of blood loss, and postoperative morbidity and mortality. In general, exposure for a **partial gastrectomy** is similar to, but less extensive than that required for a total gastrectomy. The same cancer principles are followed for either a partial or total resection including > 5 cm proximal margin, lymphadenectomy, and omentectomy. A partial gastrectomy is a simpler resection. The blood supply to the distal stomach is divided, and the duodenum is divided just beyond the pylorus. The body of the stomach is divided with a staples (care should be taken to not staple the NG tube) at a level appropriate for the pathology. Reconstruction may be either to the duodenum (**Billroth I**), loop of jejunum (**Billroth II**) (Fig. 7.2-1), or to a **Roux-en-Y loop of jejunum.** The anastomoses may be *(Print pagebreak 491)* stapled or sewn; then the abdomen is closed. Like many operations, gastric resections are increasingly performed using minimally invasive techniques. The **laparoscopic approach** has the advantages of diminished postoperative pain and quicker recovery, but the operations have a longer operative time, require a pneumoperitoneum, and reverse Trendelenburg positioning.

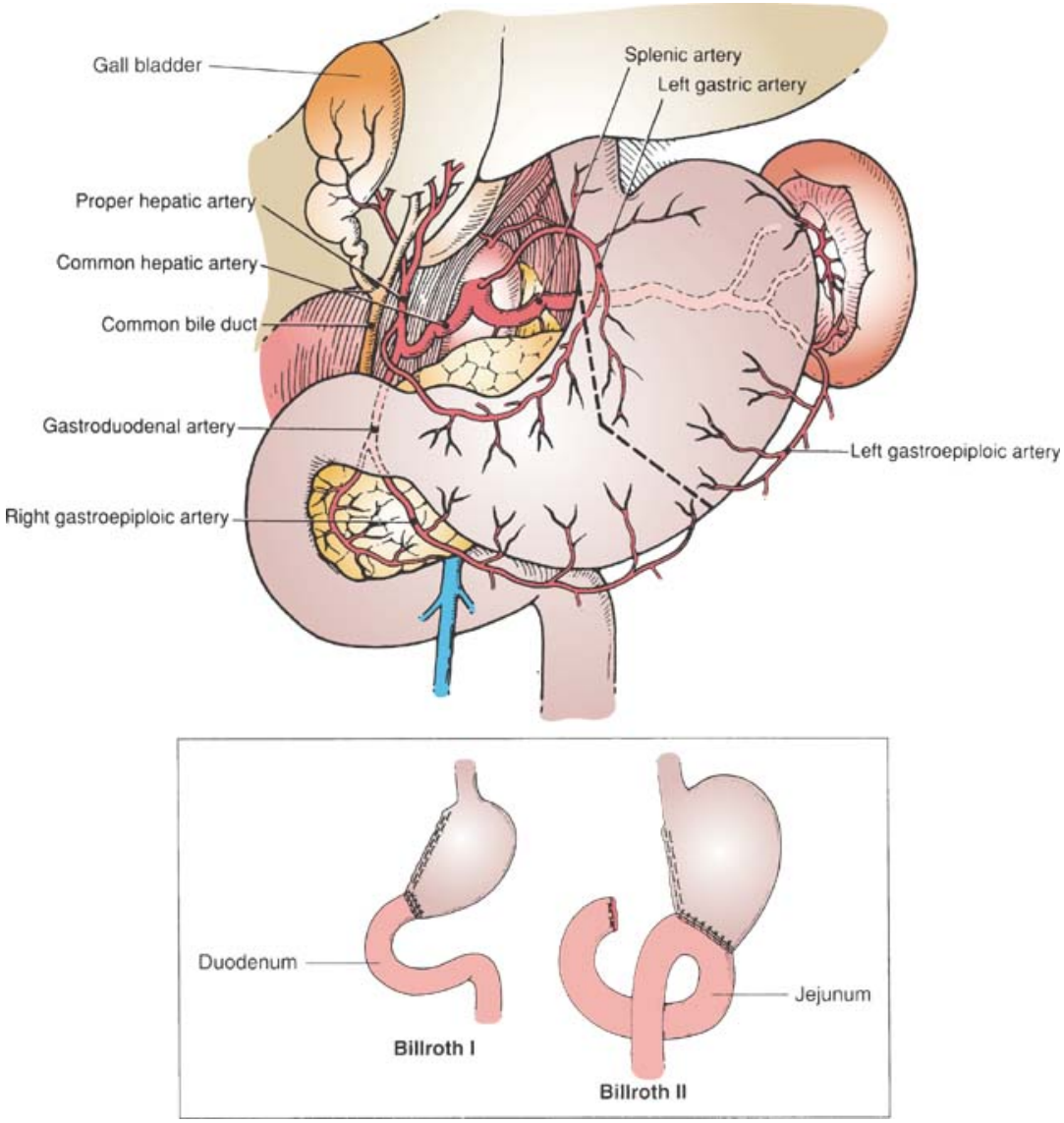

Figure 7.2-1. 1. Anatomy of duodenostomy (Billroth I) and gastrojejunostomy (Billroth II). (Reproduce d with permission from Scott-Conner CEH, Dawson DL: *Operative Anatomy,* 2nd edition. Lippincott Williams & Wilkins, Philadelphia: 2003.)

Tumors (usually adenocarcinoma) of the gastroesophageal (GE) junction are increasing in frequency and may be of either gastric or esophageal origin. Resection frequently requires a team of thoracic, general, or laparoscopic surgeons. If the tumor is associated with Barrett's esophagus (intestinal metaplasia in the esophagus, seen on *(Print pagebreak 492)* endoscopy), surgery consists of either an **Ivor Lewis** (combined abdominal and transthoracic approach) or **transhiatal esophagectomy** (see p. 480) with gastroesophageal anastomosis in the neck. Bulky GE junction tumors that encompass the upper stomach will limit the extent of esophageal resection if stomach pull-up is used. Postop pain can be severe, and most patients will benefit from continuous epidural analgesia.

Usual preop diagnosis: Total gastrectomy: gastric cancers, GIST, gastroparesis; Partial gastrectomy: gastric cancer; GIST, gastric ulcers.

Summary of Procedures

	Total Gastrectomy	Partial Gastrectomy
Position	Supine	
Incision	Upper midline or bilateral subcostal	Upper midline or right subcostal
Special instrumentation	Upper-hand or other self-retaining costal retractor	Upper-hand or other costal retractor
Antibiotics	1st or 2nd generation Cephalosporin iv	
Surgical time	2–4 h	1.5–2 h
Closing considerations	Muscle relaxation required; NG suction	
EBL	500+ mL, with potential for significantly more	100–500 mL
Postop care	PACU → ward, or ICU	
Mortality	0–22%	0–1.8% (may be > 10% if emergent)
Morbidity	Pulmonary complications: 15% VTE Reoperation: 0–5% Anastomotic leak Sepsis Wound infection Late anastomotic stricture	
Pain score	7–8	7–8

Patient Population Characteristics

Age range	Mostly > 50 years
Male:Female	Male predominance
Incidence	In the United States, people of Korean, Japanese, Latino, and African American race have a higher incidence than Caucasians.
Etiology	Gastric adenocarcinoma, gastrointestinal stromal tumors associated with: race, age, alcohol and tobacco use, geographic location, and gastric ulcers.
Associated conditions	Weight loss (common); anemia (common); malnutrition (common); VTE

Anesthetic Considerations

See Anesthetic Considerations following Operations for Peptic Ulcer Disease, p. 497.

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Suggested Readings

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Lippincott Williams & Wilkins, Philadelphia: 2001, 982–96.

3. Bozzetti F: Principles of surgical radicality in the treatment of gastric cancer. *Surg Oncol Clin N Am* 2001; 10(4):833–54, ix.

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Gastric or Duodenal Perforation

Surgical Considerations

Description: Patients who present with gastric or duodenal perforations require emergency surgery since they usually have peritonitis at presentation. The primary reason for perforations that present to the emergency room is ulcer disease most likely from H. pylori infection or from NSAID use. Another cause of gastric perforation is trauma, but that is not in the scope of this section. Simple closure with an omental patch, also called a **Graham's patch,** is the most commonly performed operation. It would be unusual to have a surgeon perform a definitive ulcer operation unless the patient has failed medical treatment regimens aimed at eradication of H. pylori infection along with proton pump inhibitors to suppress acid production.

Duodenal ulcers are almost considered a benign process but gastric ulcer perforation without a history of NSAID use is suspicious of a malignant process. For this reason, surgeons may elect to treat a perforated gastric ulcer by resection. Occasionally in patients who have failed maximal medical management of their peptic ulcer disease and who are not systemically ill at the time of operation, some surgeons may perform **vagotomy and pyloroplasty** or **highly selective vagotomy,** at the time of closure of the perforation.

Many surgeons routinely perform simple closure with **Graham's patch** via a **laparoscopic** approach. This requires a few trocars and a pneumoperitoneum, and can be combined with abdominal washout and irrigation. If an **open approach** is used, an upper midline incision is used. The liver is retracted superiorly and the area of perforation identified. An NG tube will have been placed preop and should remain on suction throughout the case to minimize ongoing leakage from the perforation. Perforation of the stomach may be handled either by resection (see Gastric Resections, p. 490) or by biopsy and simple suture closure. Perforation of the duodenum is usually repaired by simple suture of the site. Omentum often is used to buttress (Graham's patch) the area of closure of the stomach or duodenum. The abdomen is irrigated and closed.

Variant procedure or approaches: In certain patients, **nonoperative management** of perforated ulcer may be appropriate if they have had an upper GI study that shows an ulcer cavity and no extravasation. These patients are treated with NG decompression, antibiotics, and proton pump inhibitors. In general, this has a relatively high likelihood of success if the candidates are chosen well.

Usual preop diagnosis: Free air under diaphragm and peritonitis, perforated peptic ulcer

Summary of Procedures

Position	Supine
Incision	Midline or 3–4 trocars for laparoscopic approach
Special instrumentation	Costal retractor or laparoscopic equipment
Unique considerations	Patients usually have peritonitis.
Antibiotics	Cefotetan or extended spectrum PCN
Surgical time	1 h
Closing considerations	Muscle relaxation required; NG suction

EBL	Minimal
Postop care	PACU → ward
Mortality	5–15%, largely dependent on patient population
Morbidity	Pneumonia Intraabdominal abscess Sepsis Wound infection Reperforation
Pain score	7 for open procedure, 3 for laparoscopic

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Patient Population Characteristics

Age range	Adult, more common in socially disadvantaged populations
Male:Female	Previous heavy male predominance still exists for duodenal ulcer, but there has been a large increase in incidence in gastric perforation in women > 65.
Incidence	Fairly common. Stable incidence, but with change in distribution, especially more elderly women.
Etiology	Peptic ulcer disease (PUD); nonsteroidal medications; malignancy (if gastric)
Associated conditions	Malignancy (if perforation is gastric); nonsteroidal medications; steroid use, especially during pulse therapy; other risk factors for PUD (e.g., alcoholism, smoking, etc.)

Anesthetic Considerations

See Anesthetic Considerations following Operations for Peptic Ulcer Disease, p. 497.

Suggested Readings

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4. Soybel DI, Zinner MJ: Ulcer complications: In: *Maingot's Abdominal Operations,* Vol. I, 11th edition. Zinner MJ, Ashley SW, eds. McGraw-Hill Companies, New York: 2006, 377–416.

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Operations for Peptic Ulcer Disease

Surgical Considerations

These operations are not commonly performed by surgeons and most recently trained general surgeons have never seen or performed an operation for PUD.

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Description: Gastric ulcers are commonly associated with advanced age, and patients often have other medical problems, particularly cardiovascular and pulmonary. Two developments have transformed peptic ulcer disease (PUD) from a common surgical problem to a rare surgical emergency (e.g., perforation and bleeding typically in the chronically ill, hospitalized patient). These developments are: (1) inhibitors of gastric acid secretion, and (2) the role of gastric overgrowth by *Helicobacter pylori.* The first antisecretory drugs were H_2-receptor antagonists (e.g., cimetidine, ranitidine); however, proton pump inhibitors (PPIs) have proven to be more effective. The treatment of *H. pylori* consists of 14 d of a PPI, plus antibiotic therapy. The medical management of PUD has so revolutionized the treatment of this disease that few current graduating residents have seen or done the surgical procedures described below. All operations for PUD require exposure of the upper abdomen and may be performed using either an upper midline or a long, right subcostal incision. The choice of surgical procedure depends on a number of considerations, including: whether it is performed as an emergency or electively; the reason for performing the procedure (common factors include bleeding, perforation, intractability, or gastric outlet obstruction); duration of symptoms; condition of the patient; and experience of the surgeon.

Vagotomy and antrectomy (V&A): This is the most extensive of the operations performed for PUD, and generally is reserved for healthy patients with intractable symptoms. The esophageal hiatus is exposed either by taking down the lateral segment of the left lobe of the liver and reflecting it to the patient's right, or by retracting this segment of the liver superiorly to gain exposure. The phrenoesophageal ligament is divided and the anterior and posterior vagus nerves (there may be more than one of each) are identified by feel. Division of all vagal trunks at the esophageal hiatus is performed. The blood supply to the antrum is then divided, usually by dividing the right gastric and gastroepiploic vessels first. The gastrohepatic ligament is divided and the stomach elevated off of its attachments to the transverse colon. The gastric antrum is resected, leaving the duodenum just beyond the pylorus and dividing the stomach just above the junction of the body with the antrum. Reconstruction may be as a **Billroth I** (stomach-to-duodenum) or **Billroth II** (stomach-to-jejunal loop) (Fig. 7.2-1). The anastomosis may be stapled or hand-sewn. Drains are not commonly used if a Billroth I is performed, but may be used in Billroth II because of the concern for a leak from the duodenal stump.

Vagotomy and pyloroplasty (V&P): This is the most commonly performed operation for PUD in the United States and is especially common for emergency operations. It is generally accepted to be simpler and safer to perform than V&A, but not as effective at preventing recurrence of ulcer disease. The abdominal incision and exposure of the hiatus to perform a vagotomy is the same as for V&P. After division of both vagal trunks (Fig. 7.2-2), a longitudinal incision is made through the pylorus. The incision is then sutured together transversely, completing the pyloroplasty.

Parietal cell vagotomy (PCV): This operation requires even more meticulous exposure of the esophageal hiatus than that needed for a truncal vagotomy. The hiatus is exposed as above, and the main vagal trunks supplying the stomach are identified, but not divided. The stomach is retracted downward, and it is often helpful to divide a portion of the gastrocolic omentum to facilitate grasping the stomach. Branches supplying the body of the stomach (Fig. 7.2-2) are individually divided and ligated with fine ligatures. Because the nerve fibers run with the blood vessels to the stomach, this necessarily involves division of the blood supply to the proximal lesser curvature of the stomach. *(Print pagebreak 496)* This dissection is carried to the region of the “crow's foot” of the stomach, which is preserved. By denervating only the acid-producing portion of the stomach, while preserving innervation to the antrum, gastric acidity is diminished without significantly impairing gastric motility or emptying. A pyloroplasty is, therefore, not necessary. The operation is relatively tedious compared to the other procedures, and usually is performed electively or, rarely, urgently if there is a recent perforation and minimal soilage. It can be recommended only for duodenal ulcer disease, not gastric ulcers. Side effects of this operation are generally less than with other ulcer operations.

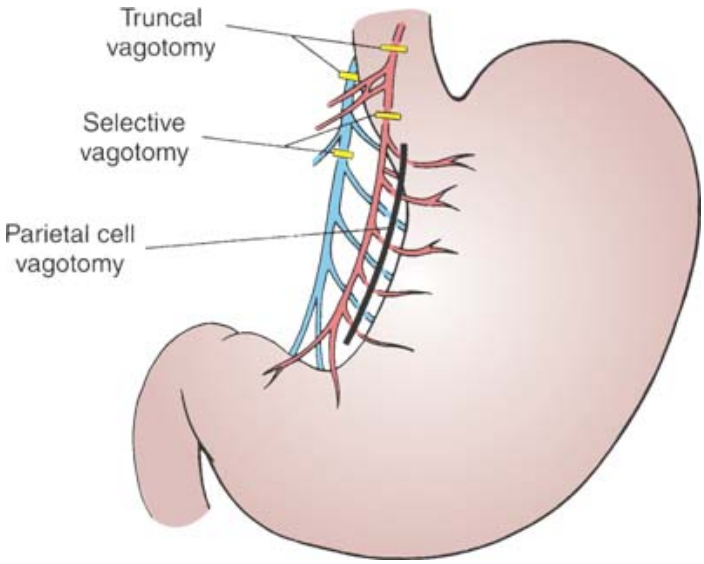

Figure 7.2-2. 2. Types of vagotomy. Heavy lines indicate where vagal trunks are cut.

Variant procedure or approaches: Laparoscopic approaches to the treatment of gastroduodenal ulcer are also being used.

Usual preop diagnosis: V&P: complications of duodenal ulcer disease (bleeding, perforation, and gastric outlet obstruction). V&A: duodenal and prepyloric ulcer disease. PCV: isolated duodenal ulcer disease; recent perforation and minimal peritoneal soilage

Summary of Procedures

	V&P	V&A	PCV
Position	Supine		
Incision	Midline or long subcostal		Midline
Special instrumentation	Costal margin retractor		
Antibiotics	Cefotetan 1 g iv		Cefazolin 1 g iv
Surgical time	1–2 h	1.5–3 h	1.5–2.5 h
Closing considerations	Muscle relaxation required for closure; NG suction		
EBL	< 250 mL; greater for emergency surgeries	250–500 mL	< 250 mL
Postop care	PACU → ward		
Mortality	0–2% (most series include emergencies)	0–1.6% (most series do not include emergencies)	0–0.4%
Morbidity	Dumping and diarrhea: 6–20% Recurrence: 4.9–12.3%	17–27% 0–2%	— 5–15% Impaired gastric emptying: 0.3% Necrosis, lesser curve: < 0.3% PE: rare
Pain score	6	6	6

Patient Population Characteristics

Age range	Adults
Male:Female	Male > female
Incidence	Declining

Etiology	Acid hypersecretion; abnormal mucosal permeability and repair mechanisms; *H. pylori*
Associated conditions	Gastrinoma (rare); hyperparathyroidism (rare)

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Anesthetic Considerations

(Procedures covered: gastric resections; oversew gastric/duodenal perforation operations for peptic ulcer disease; duodenotomy)

Preoperative

Patients presenting for gastric surgery generally comprise two groups: (1) those presenting for emergency surgery following GI bleeding or perforation, and (2) those presenting with gastric carcinoma or elective treatment of PUD (rare). Patients in the first group are often hemodynamically unstable and require rapid preop assessment and appropriate fluid resuscitation. It is prudent to consider full-stomach precautions in both patient groups (see p. B-4).

Respiratory	Patients with GI bleeding are at ↑ risk for aspiration of blood and gastric contents. If this has occurred, patient may have significant respiratory insufficiency (in urgent need of tracheal intubation for "protection" of airway). **Tests:** CXR; consider ABG
Cardiovascular	Hypovolemia may be severe due to N/V, diarrhea, poor po intake, peritonitis, or GI blood loss. Sx include ↓skin turgor, ↑HR, ↓BP, ↓UO. Correct hypovolemia before induction of anesthesia. **Tests:** Orthostatic vital signs; ECG, if indicated from H&P.
Renal	GI fluid loss can lead to renal and electrolyte abnormalities. **Tests:** Consider electrolytes; BUN; Cr.
Hematologic	Misleading ↑Hct 2° GI fluid loss may be present; patients with GI bleeding will likely be anemic and may have a coagulopathy. Correct coagulopathy and anemia before induction, if possible. **Tests:** CBC with Plts, PT/PTT if coagulopathy suspected
Laboratory	Other tests as indicated from H&P
Premedication	Consider midazolam 1–2 mg. Consider H_2antagonist (ranitidine 50 mg iv slowly), metoclopramide (10 mg iv 1 h preop), and Na citrate (30 mL po 10 min preop). Prophylactic antibiotics should be considered if the patient has been rendered achlorhydric.

Intraoperative

Anesthetic technique: GETA ± epidural for postop analgesia (if hemodynamically stable and no coagulopathy). If postop epidural analgesia is planned, insertion of catheter prior to anesthetic induction is helpful to establish correct placement in the epidural space (accomplished by injecting 5–7 mL of 1% lidocaine via the epidural catheter, eliciting a segmental block).

Induction	The patient with gastric disease or upper GI bleeding is often at risk for pulmonary aspiration, and the trachea should be intubated with the patient awake or after rapid-sequence induction with cricoid pressure (see p. B-4). If patient is clinically hypovolemic, restore intravascular volume (colloid, crystalloid, or blood products) before induction, and titrate induction dose of sedative/hypnotic agents. Standard maintenance (see p. B-2). Balanced anesthesia with inhalational agents and/or propofol infusion, and opiates. Maintain muscle relaxation based on nerve stimulator response. Discuss with surgeon the need for postop NG tube. If not needed, place OG tube to evacuate stomach contents intraop. **Combined epidural/GA:** A local anesthetic (2% lidocaine with 1:200,000 epinephrine) can be injected into a thoracic (3–5 mL) or lumbar (3–6 mL q 60–90 min) epidural catheter to provide both anesthesia and optimal

Maintenance	surgical exposure (contracted bowel and profound muscle relaxation). A continuous infusion of local anesthetic (e.g., 2% lidocaine or 0.25% bupivacaine at 3–10 mL/h [lumbar]; 2–5 mL/h [thoracic]), may enhance hemodynamic stability, compared to an intermittent bolus. Be prepared to treat ↓ BP with fluid and vasopressors. GA is administered to supplement regional anes thesia and for amnesia. Systemic sedatives should be minimized during epidural opiate administration as they increase the likelihood of postop respiratory depression. Treat ↓BP with fluid and vasopressors. If epidural opiates are used for postop analgesia, a loading dose (e.g., hydromorphone 0.6–1.0 mg [lumbar]; 0.4–0.6 mg [thoracic]) may be administered at least 1 h before conclusion of surgery.	
Emergence	The decision to extubate at the end of surgery depends on the patient's underlying cardiopulmonary status and extent of the surgical procedure. Patient should be hemodynamically stable, normothermic, alert, cooperative, and fully reversed from any muscle relaxants and without pulmonary compromise before extubation.	
Blood and fluid requirements	Anticipate large third-space losses IV: 14–16 ga ×1–2 NS/LR @ 8–12 mL/kg/h Fluid warmer	T&C for 4 U PRBC. Plts, FFP, and cryoprecipitate should be administered according to lab tests (Plt count, PT, PTT, DIC screen, thromboelastography). Expect higher fluid requirements if epidural used (2° sympathectomy → vasodilation). Maintaining euvolemia is important goal.
Monitoring	Standard monitors (p. B-1) UO ± Arterial line ± CVP	Consider others as indicated by patient's status. Prevent hypothermia: Use forced air warmer, fluid warmer, and consider warming blanket, warm room temperature, keeping patient covered until ready for prep, etc.
Positioning	and pad pressure points eyes	
Complications	Acute hemorrhage Hypoxemia	2° abdominal packs →↓FRC

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Postoperative

Complications	PONV (see p. B-6) Hemorrhage VTE (see p. B-7) Ileus Hypothermia
Pain management	Epidural analgesics (p. C-2) PCA (p. C-3)
Tests	CXR if CVP placed periop

Suggested Readings

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Open Operations for Morbid Obesity

Surgical Considerations

Description: Open procedures for morbid obesity have been largely replaced by the laparoscopic approach (see p. 598). In selected patients (e.g., those with previous upper abdominal surgery or BMI > 60 [see p. 502]), however, open procedures may be more appropriate. Open techniques devised to promote weight loss are of two fundamental types: (1) **gastric partitioning procedures,** which work by decreasing the size of the gastric pouch, thereby limiting the amount of food that can be consumed at one time; and (2) **malabsorptive procedures,** which work by bypassing most of the small bowel and creating a state of chronic malabsorption. Of these two general types of procedures, the partitioning procedures are generally less effective at promoting weight loss than are the malabsorptive procedures, but are much more popular because they are associated with far fewer serious side effects.

One partitioning procedure more commonly used in the past is the **vertical banded gastroplasty (VBG).** The abdomen is entered through an upper midline incision, and the esophagogastric junction is exposed either by retracting the liver superiorly or by taking down the ligamentous attachments of the lateral segment of the left lobe of the liver and retracting this down and to the patient's right. The vessels to the lesser curvature are separated for a short distance near the esophagogastric junction, and the posterior attachments of the stomach are separated. A large bougie is passed by the anesthesiologist into the stomach and a circular stapler is used to create a hole in the stomach adjacent to the bougie near the esophagogastric junction. Through this, a special stapler with thick, strong staples is passed and is fired up along the esophagus, creating a pouch of approximately 30 mL in volume (Fig. 7.2-3). This leaves an outlet to the remainder of the stomach of only 1–2 cm, which is reinforced with a band of mesh. An NG tube is placed through the gastroplasty into the distal stomach and the abdomen is closed without drains.

More commonly performed today than the gastroplasty is the **Roux-en-Y gastric bypass** (Fig. 7.2-4). Exposure is similar to that for a VBG. The upper stomach is mobilized and two rows of staples are used to partition the stomach into a small proximal and large distal pouch. A Roux segment of jejunum is then anastomosed to the small proximal pouch to provide drainage of it. An NG tube is placed and the abdomen is closed without drains.

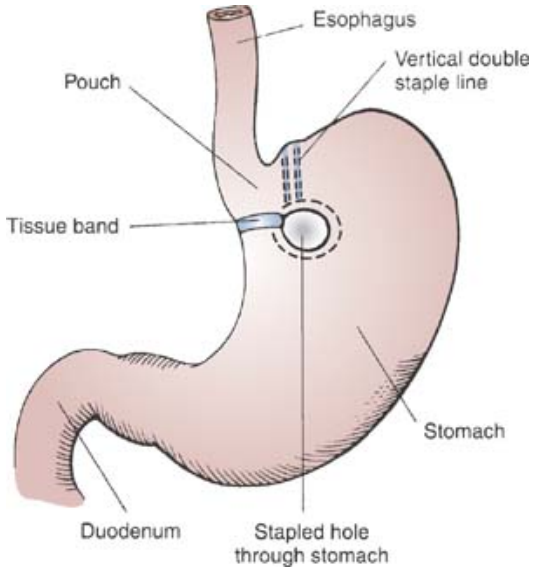

Figure 7.2-3. 3. Vertical banded gastroplasty.

Variant procedure or approaches: An alternative open procedure is the **jejunoileal (JI) bypass** (Fig. 7.2-5), in which the proximal jejunum is anastomosed to the terminal ileum. This procedure has been largely abandoned because of the many associated complications, including cirrhosis, osteoporosis, kidney stones, and intractable diarrhea. Another alternative open procedure is a **sleeve gastrectomy** where a gastric tube is created from the gastroesophageal junction to the pylorus over a 36°F dilator. The remainder of the stomach, based on the greater curvature is resected.

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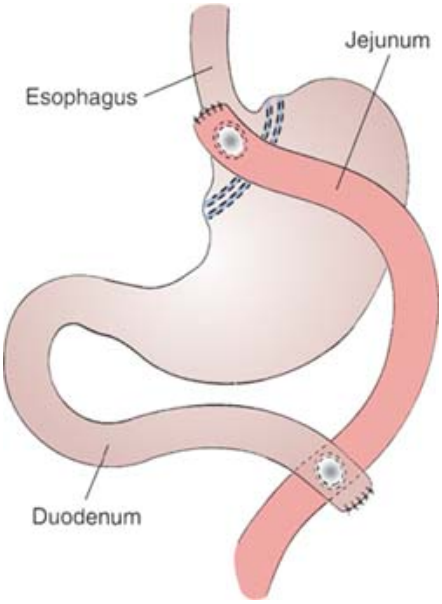

Figure 7.2-4. 4. Proximal Roux-en-Y gastric bypass. (Reproduced with permission from Greenfield LJ, et al, eds: *Surgery: Scientific Principles and Practice,* 3rd edition. Lippincott Williams & Wilkins, Philadelphia: 2001.)

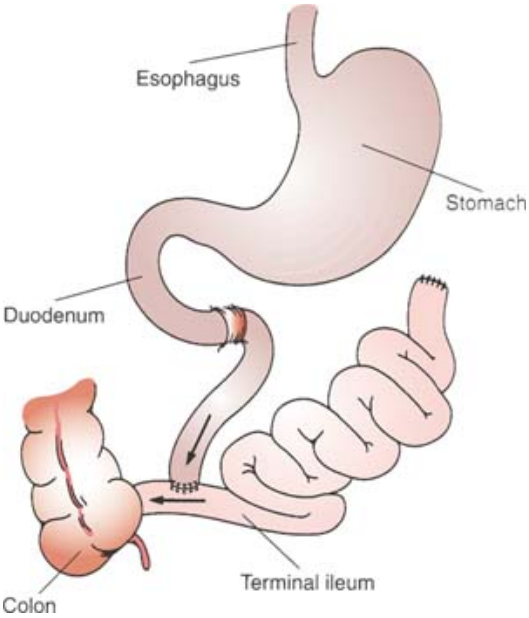

Figure 7.2-5. 5. Schematic representation of jejunoileal by pass. (Reproduced with permission from Greenfield LJ, et al, eds: *Surgery: Scientific Principles and Practice,* 3rd edition. Lippincott Williams & Wilkins, Philadelphia: 2001.)

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Usual preop diagnosis: Morbid obesity (> 100 lbs above ideal body weight, 100% over ideal body weight, or BMI > 40), generally in combination with some medical condition felt to be worsened by the obesity (e.g., osteoarthritis, diabetes, respiratory insufficiency, CHF, hypertension, CAD, sleep apnea).

Summary of Procedure (VGB or Roux-en-Y)

Position	Supine (Fig. 7.2-6)
Incision	Midline
Special instrumentation	Large OR tables; heavy-duty retractors; special stapling devices
Unique considerations	Prophylactic cholecystectomy often advocated. Pneumatic compression boots may not be large enough; heparin (5000 U sc 2 h before surgery, then q 12 h) used commonly. ↑↑ aspiration risk + potentially difficult airway
Antibiotics	± Cefoxitin 1 g iv
Surgical time	2–3 h
Closing considerations	Anticipate 30 min closure time; NG suction
EBL	< 500 mL
Postop care	Postop ventilation may be necessary; VTE precautions.
Mortality	0.5–1.6%
Morbidity	Wound infection: 4–8% Anastomotic leak: 3% Dehiscence: 1.6% PE: 1–1.6%
Pain score	7

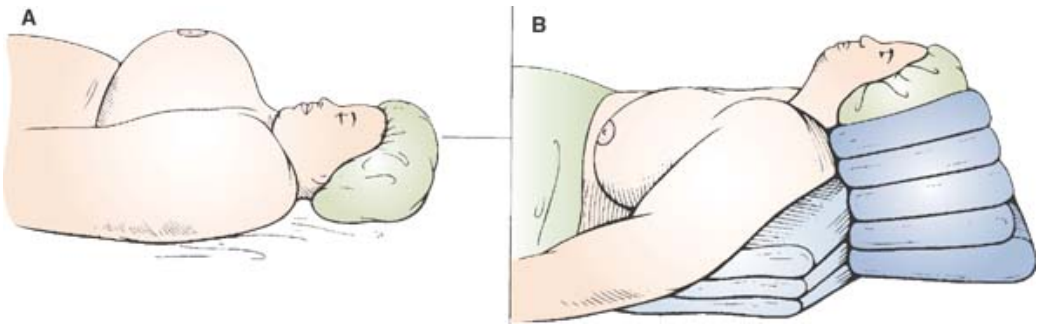

Figure 7.2-6. 6. (A) In standard supine position, the atlantooccipital gap of morbidly obese patient is obliterated by fat, and access for laryngoscope is hindered by large breasts. **(B)** By elevating the shoulders and occiput so that head is in the 'sniffing' position, airway access is greatly facilitated.

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Patient Population Characteristics

Age range	Adult
Male:Female	< 1:1 for disease but 80% of patients who undergo surgery are female
Incidence	5% of males and 7% of females in U.S. population considered morbidly obese
Etiology	Multifactorial
Associated conditions	Sleep apnea ± CO_2 retention; CAD/CHF/cardiomyopathy; pulmonary HTN/systemic HTN; diabetes; unusually high risk of DVT and PE; GERD

Anesthetic Considerations

Preoperative

Morbid obesity is variably defined (i.e., >100 lbs over ideal body weight, 2 times ideal body weight, or BMI > 40 [BMI = weight (kg) ÷ height (m)]), and is associated with increased periop mortality/morbidity. Obstructive sleep apnea (OSA) is common in the morbidly obese patient.

Respiratory	Increased O_2 consumption and CO_2 production (e.g., ↑basal metabolic rate). ↓chest-wall compliance (↓20–60%) with normal lung compliance. ↓ERV and FRC; so tidal breathing may fall within the range of closing capacity → V/Q abnormalities. Supine position further ↓FRC → worsening hypoxemia. ↑MV is required to remain normocarbic. There is a normal response to CO_2 unless patient develops the obesity hypoventilation (Pickwickian) syndrome (↑$PaCO_2$ ↓PaO_2 loss of hypercarbic drive, sleep apnea, hypersomnolence, polycythemia, pulmonary HTN, CHF). **Tests:** CXR; PFTs (FVC, FEV_1, $MMEF_{25–75}$ ± bronchodilators; room-air ABG)
Cardiovascular	Blood volume and CO ↑ with increasing weight. HTN is very common (use correct size BP cuff). LV dysfunction may be present; patient unable to increase CO or tolerate ↑ blood volume. Pulmonary HTN may be present in OSA. Obesity is a risk factor for CAD and sudden death. Anticipate problems with vascular access. **Tests:** ECG; others as indicated from H&P. (Patient with SOB may require MUGA scan and ECHO for LV function, as SOB can have a cardiac or pulmonary etiology.)
Endocrine	Glucose intolerance and diabetes mellitus (DM) common. **Tests:** Fasting glucose
Hepatic	Liver function is often abnormal. Drug metabolism can be significantly affected. Combined with altered pharmacokinetics, many drugs (e.g., midazolam and vecuronium) may have unpredictably prolonged action.
Gastrointestinal	↑intraabdominal pressure, gastric volume, and acidity, with ↑ incidence of hiatal hernia, make this patient population at risk for pulmonary aspiration of gastric contents. Particular risk in patients with previous restrictive bariatric surgery.
Airway	Obese patients can have airway problems including frequent difficult mask ventilation. Careful airway examination (e.g., mouth opening, Mallampati classification, thyromental distance, neck ROM) is paramount. Awake fiber optic intubation should be considered if difficult airway access is anticipated. Establish availability of OR table large enough to accommodate morbidly obese patient. Special tables are now available.
Hematologic	Polycythemia may occur 2° chronic hypoxemia. **Tests:** CBC
Laboratory	Other tests as indicated from H&P.
Premedication	Sedatives are best avoided for patients with OSA. A small dose of iv midazolam (0.5–1.0 mg) may be appropriate for the especially anxious patient. In the bariatric patient, intramuscular medications can be erroneously injected into adipose tissues. Consider anticholinergics if performing awake fiber optic intubation (glycopyrrolate 0.2 mg iv 30 min preop). Consider full-stomach precautions (p. B-4): metoclopramide (10 mg iv 60 min preop), H_2-antagonist (ranitidine 50 mg iv), and nonparticulate antacid (3 M Na citrate) 30 mL, 10 min prior to induction.

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Intraoperative

Anesthetic technique: GETA ± epidural for postop analgesia in open surgeries. If using a combined anesthetic approach, placement of an epidural catheter should be accomplished before induction, with the patient in the sitting position. A bilateral sensory block (using 5–7 mL 2% lidocaine) will help confirm correct placement of the catheter within the epidural space. Verification of placement is particularly important in this population since regional anesthesia in the obese patient may be technically more difficult.

Induction	Patients are at risk for aspiration of gastric contents and should be intubated either awake (p. B-4) or after rapid-sequence induction with cricoid pressure. Mask ventilation and ET intubation may be difficult (2° rapid desaturation, head elevated laryngoscopy position, redundant tissue). Following successful intubation and induction of anesthesia, an OG/NG tube should be placed and the stomach contents suctioned. Lipophilic drugs (e.g., STP) will have a greater volume of distribution, necessitating increased dosage.	
Maintenance	Standard maintenance (p. B-2). Obese patients metabolize volatile anesthetics to a greater extent than their nonobese counterparts. **Combined epidural/GA:** A local anesthetic (2% lidocaine with 1:200,000 epinephrine) can be injected into a thoracic (3–5 mL) or lumbar (5–10 mL q 60 min) epidural catheter to provide both anesthesia and improved surgical exposure (contracted bowel and profound muscle relaxation). A continuous infusion of local anesthetic (e.g., 2% lidocaine or 0.25% bupivacaine at 5–10 mL/h [lumbar], 3–5 mL/h [thoracic]) may enhance hemodynamic stability. The dose of local anesthetic given via epidural catheter should be decreased to 75% of normal dose. Be prepared to treat ↓BP with fluid and vasopressors (ephedrine 5–10 mg iv, phenylephrine 50–100 mcg iv). GA is administered to supplement regional anesthesia and for amnesia. Sedative drugs (opiates, benzodiazepines, etc.) should be minimized in the presence of epidural opiates, as they increase the likelihood of postop respiratory depression. If epidural opiates are used for postop analgesia, a loading dose (e.g., hydromorphone 0.6–1.0 mg with lumbar catheter and 0.4–0.6 mg for thoracic) should be administered 1–2 h before end of surgery.	
Emergence	The decision to extubate at the end of open surgery depends on patient's underlying cardiopulmonary status and the extent of the surgical procedure. Patients should be hemodynamically stable, normothermic, alert, cooperative, and fully reversed from any muscle relaxants before extubation. Elective ICU admission for postop care may be appropriate. Following laparoscopic surgery, in contrast, patients typically are extubated and admitted to PACU.	
Blood and fluid requirements	Anticipate large fluid loss. IV: 14–16 ga ×1–2 NS/LR @ 10–15 mL/kg/h T&S for 2 U PRBC. Warm fluids.	Third-space losses greatly exceed blood loss. Guide fluid management by UO, filling pressure. Euvolemia is an important goal.
Monitoring	Standard monitors (p. B-1) UO ± Arterial line	Invasive monitoring as clinically indicated. Arterial line if noninvasive BP unreliable 2° extremity size.
Positioning	Supine position = ↓FRC and pad pressure points eyes * **NB:** Avoid Trendelenburg	Supine positioning →↓lung volumes, which may ↑ V/Q mismatch → hypoxemia. This is exacerbated by use of the Trendelenburg position, which usually is not well tolerated by morbidly obese patients.
Complications	Hypoxemia 2° ↓FRC	100% O_2→ absorption atelectasis

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Postoperative

	Hypoxemia	Recover patient in sitting position to

Complications	Hypercarbia VTE (see p. B-7) Atelectasis	improve ventilatory mechanics. Give supplemental O_2 Verify VTE prophylaxis.
Pain management	Epidural analgesia: hydromorphone (0.6–1.0 mg with lumbar cath and 0.4–0.6 mg for thoracic cath) load then 0.1–0.3 mg/h infusion) PCA (p. C-3)	If epidural is used for postop analgesia, Pain Service management recommended.
Tests	ABG CXR	Others as clinically indicated. CXR for central line placement

Suggested Readings

1. Brodsky JB, Lemmens HJM, Brock-Utne JG, et al: Morbid obesity and tracheal intubation. *Anesth Analg* 2002; 94:732–6.

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Gastrostomy Placement

Surgical Considerations

Description: A **gastrostomy** is a tube placed through the abdominal wall directly into the stomach. Such tubes can be used for gastric decompression or for feeding, and they may be permanent or temporary. Patients undergoing gastrostomy placement often have neurologic impairment that compromises their ability to handle oral secretions and *(Print pagebreak 505)* increases their risk of aspiration. **Percutaneous endoscopic gastrostomy (PEG),** in contrast to the other techniques, most commonly is performed using iv sedation and local anesthesia.

Variant procedure or approaches: The traditional **Stamm gastrostomy** usually is placed at the time of a laparotomy performed for another purpose; or it may be performed through a separate, small laparotomy incision in patients in whom endoscopic placement is not possible for technical reasons. The incision may be upper midline or transverse directly over the stomach. The anterior wall of the stomach is identified, and two purse-string sutures are placed in the stomach around the site where the tube will enter. The gastrostomy tube is introduced through the abdominal wall directly over the intended site of entry into the stomach. A small hole is made in the stomach in the center of the purse-string sutures, the tube is introduced into the stomach, and the purse-strings are tied securely around the tube. The wound is then closed. GA usually is preferred, but the operation may be performed under local anesthesia in thin patients.

The **Janeway gastrostomy,** a technical modification, also requires a laparotomy. The greater curvature of the stomach is identified and a stapler placed across a portion of this, creating a tube that arises from the main body of the stomach. The staple line may be oversewn, and then the end of the tube is brought through the abdominal wall and matured to the skin as a small stoma. This allows for permanent access to the stomach with removal of the tube between feedings and is useful in patients with long-term dependence on gastrostomy access. The Janeway gastrostomy is rarely used, although young patients with neurologic impairment who are expected to need lifetime gastrostomy feeding are good candidates.

For a **PEG,** the stomach is intubated endoscopically and the gastric and abdominal walls punctured under endoscopic guidance. The gastrostomy tube is introduced through the mouth and passed through the stomach and abdominal wall from inside out. In most centers, this has become the most common technique of gastrostomy placement due to its simplicity and because, in many patients, it can be performed under local anesthesia with MAC. Previous gastric operations may make endoscopic placement difficult or dangerous, as may some obstructing lesions of the esophagus or pharynx. To avoid damage to the back wall of the stomach, the anesthesiologist may be asked to inject air forcefully into the stomach.

Usual preop diagnosis: Temporary gastrostomies often are used after major abdominal surgery as an alternative to NG suction. Percutaneous gastrostomies often are placed in patients with advanced malignancy and intestinal obstruction or inadequate oral intake, and in patients with neurologic impairment and difficulty eating.

Summary of Procedures

	Stamm	Janeway	PEG
Position	Supine		
Incision	Midline or transverse		Puncture
Special instrumentation	None		Endoscope, percutaneous gastrostomy kit
Antibiotics	± Cefazolin 1 g iv		
Surgical time	45 min	1 h	0.5–1 h
Closing considerations	Muscle relaxation for closure		None
EBL	Minimal		
Mortality	Minimal		
Morbidity	Wound infection: 2.1–9% Hemorrhage: 0.9–1.1% Aspiration pneumonia: 2.2% Failure to function: 2.2%		– 1.6% –
Pain score	4–5	5	1–2

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Patient Population Characteristics

Age range	All ages, though with peaks in infancy and the elderly
Male:Female	1:1
Incidence	Common
Etiology	See Preop Diagnosis, above
Associated conditions	Gastrostomy placed at time of laparotomy, when NG drainage is anticipated for prolonged period. For feeding in the neurologically impaired or in those with complex upper digestive difficulties. Advanced malignancy (for either feeding or palliative decompression).

Anesthetic Considerations

See Anesthetic Considerations for Ostomy Procedures in Intestinal Surgery, p. 515.

Suggested Readings

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