Acute Care SINS: Surgical Insights for the Non-surgeon

Chapter 4: Stomach SINS

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About the Authors

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Summary

“Surgical Insights for the Non-surgeon,” or SINS, is composed of several short chapters intended to cover fundamental surgical knowledge for non-surgeons. The authors focus on surgical pearls, operative insights, and applied anatomy. In Chapter 4 of this series, the authors discuss stomach anatomy, hiatal hernia, peptic ulcer disease, and gastric surgery.

Résumé

L'ouvrage « Surgical Insights for the Non-surgeon » ou SINS (aperçu de chirurgie pour le non chirurgien) se compose de plusieurs courts chapitres conçus pour couvrir les connaissances fondamentales en matière de chirurgie chez ceux qui ne sont pas chirurgiens. Les auteurs se concentrent sur des « trésors de sagesse » tirés de leur expérience personnelle en chirurgie, certaines idées en matière d'interventions, et sur l'anatomie appliquée. Le quatrième chapitre examine l'anatomie gastrique, la hernie hiatale, l'ulcère peptique et la chirurgie gastrique.

It takes a great surgeon to operate, and, sometimes, an even greater one not to.

– Old surgical adage

Anatomy

The stomach is located in the left hypochondrium (a.k.a. the epigastrium): separated proximally from the esophagus (by the lower esophageal sphincter), and distally from the duodenum (by the pylorus). It has **five distinct areas**:

1. Cardia: the portion around the gastro-esophageal junction
2. Fundus: the floppy top part of this kidney-bean shaped organ
3. Corpus/body: the large central part
4. Antrum: the distal area containing the majority of acid-secreting cells

5. Pylorus: the muscular boundary between the stomach and duodenum

A competent pylorus prevents particles larger than 5 mm leaving the stomach. An **incompetent** (or surgically removed) **pylorus** may cause “**dumping syndrome**” (see below). **Parietal cells** (found almost exclusively in the antrum) produce **intrinsic factor**, which promotes vitamin B₁₂ absorption (in the terminal ileum). Total gastrectomy (or, likewise, ileal resection) usually means lifelong B₁₂ replacement.

The stomach's **arterial supply** has five sources, all based on the **celiac trunk** (which leaves the aorta at L-1). Arteries include the **right and left gastrics**; the **right and left gastroepiploics**, and the **short gastric arterial arcade**. This rich blood supply means that it is difficult to surgically devascularize the stomach. For the same reason, it is easy to make the stomach bleed.

Sympathetics parallel the arteries, and parasympathetics originate via the vagus nerve. The **right (or the posterior) vagus** innervates the midgut (pancreas, small intestine, and proximal colon). The **left (or anterior) vagus** innervates the gallbladder, biliary tract, and liver. Both enter from the stomach's lesser curvature.

Hiatal Hernia

- Refers to the presence of abdominal organs in the thorax
- Abdominal contents push through the diaphragm's esophageal hiatus
- Associated with gastroesophageal reflux disease (GERD), which can involve ulcers, strictures, or Barrett's esophagitis
- Alternatively associated with incarceration/strangulation
  - Requires surgery (after medical stabilization)
  - Can present as acute shortness of breath (SOB)
  - Gastric volvulus suggested by Borchardt's triad: epigastric pain, retching without vomiting, inability to pass a nasogastric tube
  - Diagnosis also aided by chest radiography
  - Elevated lactate suggests ischemia
- Major types are I (sliding) and II (rolling); types III and IV are rarer

Type I (sliding) hiatal hernia:

- Most common: 90% of all hiatal hernias
- Gastroesophageal (GE) junction and portion of stomach "slide" into the thorax
- Hernia's leading edge is the esophagogastric junction
- Often no hernial sac (i.e., no peritoneum surrounding the GE junction)
- Significant only when associated with GERD
- Surgery is rarely indicated for asymptomatic type I hiatal hernia

Type II (rolling) hiatal hernia:

- <10% of hiatal hernias but majority of surgeries are for types II, III, and IV hernias since they can result in serious complications
- Paraesophageal hernia – the gastric fundus herniates alongside the esophagus
- Esophagogastric junction is in its normal intra-abdominal location
  - GERD is therefore uncommon
  - Rotation of the stomach sometimes develops
  - Incarceration and strangulation can occur
  - Like other incarcerated hernias, surgery is then required

Type III hiatal hernia:

- Combination of types I and II – with a large defect in esophageal hiatus
- Like type I, the esophagogastric junction is displaced into the thorax
- Like type II, hernia sac containing the gastric fundus and body is also displaced into the thorax
- Often associated with rotation of the stomach
- May be iatrogenic due to failed gastric fixation, or failure to close the hiatus
- Requires surgery

Type IV hiatal hernia:

- Paraesophageal hernia containing abdominal organs (e.g., spleen, colon, and small bowel) in addition to stomach
- Requires surgery

Hiatal Hernia Surgery

Fundoplication:

- Involves enlarging external esophageal diameter to prevent herniation through the diaphragm
- Typically laparoscopic and requires only a short post-operative hospital stay
- Most popular procedure is Nissen fundoplication – 360-degree wrap of the gastric fundus around the esophagus
- Partial wraps also exist, such as the Hill, Toupet, and Belsey procedures
- Repair can be either transthoracic or transabdominal

Goals of hiatal hernia surgery:

- Reduce the hernia contents back into the abdomen
- Remove the hernia sac to prevent recurrence
- Close the crural/diaphragmatic defect
- Sometimes, to hold the stomach in the abdomen (if gastropexy is performed) – done with either suture or placement of a gastrostomy tube

Complications post-hiatal hernia repair:

- Dysphagia wrap is too tight
  - Most commonly due to edema, which spontaneously resolves
  - Diagnosis with radiology upper gastrointestinal (GI) fluoroscopy study
  - Treat with nasogastric tube placement – after discussion with surgeon
  - Associated retching/vomiting has potential to exacerbate damage
  - Possible need for post-operative endoscopic dilatation

- Esophageal/gastric tear
  - Secondary to damage during the wrap
  - Presents as abdominal pain, “pneumonia,” or sepsis
  - Diagnose with Gastrografin swallow (meglumine diatrizoate, which is water soluble, in contrast to barium swallow, in case of leak into abdominal cavity)
- Pneumothorax
  - Beware! Routine post-operative chest radiography is not performed. There is also some normal post-operative mediastinal air
  - However, be vigilant for shortness of breath and increasing mediastinal air. May require a chest tube
  - If you have any questions, contact the surgeon
- Damage of vagus nerve
  - Can mean delayed gastric emptying/dumping
  - Diagnose with an upper GI contrast study
- Liver and splenic injury – very rare ... thank goodness

Peptic Ulcer Disease

Medical antiulcer therapy (i.e., H_2 receptor antagonists, proton pump inhibitors, and *Helicobacter pylori* eradication) has drastically changed peptic ulcer disease (PUD) from a surgical to a medical disease. Man is the only mammal to secrete acid in the fasting state. (Debate continues as to how pharmaceutical companies arranged this.)

Indications for PUD Surgery

Less than 10% of PUD patients require surgery.

Indications:

- Recurrent hemorrhage occurs or ongoing transfusions are needed; typically 6 units of packed red blood cells (PRBC) in 24 hours
- If there is failure of endoscopic management to control bleeding
- Perforation; acute-onset abdominal pain with chest and/or abdominal radiographs showing free intraperitoneal air
- Gastric outlet obstruction; nausea and vomiting symptoms with abdominal radiographs showing dilated stomach

Potential indications:

- Patient in shock, age >65 years, previous hemorrhage
- Endoscopic evidence of high-risk ulcer for re-bleed

Gastric Surgery

Current Indications for Gastric Surgery

- Complications of duodenal and gastric ulcers (e.g., bleeding, perforation, gastric outlet obstruction)

- Gastric neoplasm
- Part of the Whipple procedure (to be covered in a future issue)

Vagotomy:

- Vagus nerve stimulates parietal cells to secrete hydrochloric acid
  - Therefore, vagotomy was previously used in peptic ulcer surgery
  - However, vagus nerve controls the antral pump, pyloric sphincter, and motor activity of the entire abdominal viscera; therefore, vagotomy also has side effects (see below)
  - Medical therapy obviates the need to surgically suppress acid; therefore, vagotomy currently *not* performed
- With these caveats, and for completeness:
  - **Truncal vagotomy** – cutting the anterior and posterior vagus (performed close to the esophageal hiatus)
  - Gastric motility is affected. A procedure to enable gastric drainage is typically also required (see below): (1) pyloroplasty; (2) antrectomy/gastroduodenostomy, a.k.a. Billroth I – antrectomy further augments acid suppression; (3) gastrojejunostomy a.k.a. Billroth II; or (4) Roux-en-Y gastrojejunostomy

Pyloroplasty:

- Incision of the pyloric sphincter and enlargement of the pyloric opening
- Typically opened longitudinally and closed transversely – Heineke-Mikulicz procedure (Figure 1)

Figure 1. *Left*, Pyloroplasty incision opened longitudinally. *Right*, Pyloroplasty closed transversely to prevent stenosis. Illustrations by Rachel G. Khadaroo and Dawne Colwell.

Figure 2. Billroth I. *Left*, Black area shows resection of stomach and duodenum. *Right*, Anastomosis of gastric remnant to duodenum. Illustrations by Rachel G. Khadaroo and Dawne Colwell.

Figure 3. Billroth II. *Left*, Black area shows resection of stomach and duodenum. *Right*, Anastomosis of gastric remnant to jejunum. Illustrations by Rachel G. Khadaroo and Dawne Colwell.

Figure 4. Roux-en-Y reconstruction. Created by an end-to-side anastomosis of jejunum to jejunum, which creates a jejunojunction. Illustration by Rachel G. Khadaroo and Dawne Colwell.

Subtotal gastrectomy:

- Removal of a portion of the stomach
- Most often for malignancy; rarely for PUD
- Following gastric resection, need to re-establish GI continuity
- Options include
  - Direct anastomosis of gastric remnant and duodenum (**Billroth I gastroduodenostomy** [Figure 2])
  - Connect gastric remnant to jejunum (side-to-side anastomosis) (**Billroth II gastrojejunostomy** [Figure 3])
  - Connect gastric remnant to jejunum and create a Roux-en-Y reconstruction (**Roux-en-Y gastrojejunostomy** with a jejunojunction [Figure 4]). Following total gastrectomy, this would become a Roux-en-Y esophagojejunostomy
  - Can create the gastrojejunostomy anterior (antecolic) or posterior (retrocolic) to transverse colon (This has minimal clinical relevance, but sounds good on handover!)
- A Roux-en-Y reconstruction has fewer late physiological complications (see below)
  - However, it requires a longer operative time
  - It also requires a second anastomosis (hence, an increased chance of anastomotic leak)
  - The surgeon will therefore weigh anticipated benefits and potential risks

Gastrostomy tube (G-tube):

- Indications
  - Need for long-term enteral feeding
  - “Pexy” of stomach to abdominal wall following hiatus hernia repair
  - Gastric drainage
- Direct placement through the anterior abdominal wall
- Typically a Foley or Malecot catheter (see “Chapter 2: Tubes, Drains, and Ostomies” in *CJGIM* Volume 8, Issue 1)

Early Post-operative Complications of Gastric Surgery

Significant upper GI bleeding:

- ABCs (airway, breathing, circulation) to stabilize, and notify the surgeon; few surgeons permit gastroscopy within 7 days of stomach surgery!
- Slight melena may occur due to intraoperative intraluminal blood; only a concern if it lasts or increases
- Nasogastric (NG) tube can be placed, but talk to the surgeon first; surgeons typically want to insert it themselves to prevent injury to the anastomosis or suture/staple lines

Anastomotic leak:

Important reminder: The biliary tree is untouched during gastric surgery.

- Despite this, many falsely assume that post-operative leaks are from disruption of the biliary anastomosis. There is no surgical biliary anastomosis!
- Leaks occur from the gastric anastomosis, jejunal stump, or duodenal stump
- Upper GI contrast study typically performed between days 5 and 7 to assess the integrity of bowel anastomosis

Dislodged G-tube:

- Requires immediate attention since gastric hole will close in <24 hours; call surgeon
- Older tubes may have formed a tract, and a Foley catheter can be inserted
- See “Surgical Pearl.”

Late Complications of Gastric Surgery**Recurrent ulcer disease:**

- Retained vagal nerve activity
- May suggest endocrine disorders
  - Hyperparathyroidism (check Ca^{++} and parathyroid hormone levels)
  - Gastrinoma (order fasting gastrin levels)
- Retained antrum (technetium scan will show a “hot spot”)

Dumping syndrome:

- Due to rapid egress of gastric contents into proximal small bowel
- Occurs in up to 25% of patients following gastric resection or vagotomy

Early dumping:

- 15–30 minutes after eating
- GI and cardiovascular symptoms (nausea, vomiting, lightheadedness, abdominal cramps, diarrhea, diaphoresis, palpitations)
  - Can be misdiagnosed as acute coronary syndrome
  - Mediated by GI peptide hormones
  - Diagnosed using upper GI swallow
  - Recommendations for patient: reduce meal size, lie down after meals, avoid hyperosmolar/high-carbohydrate foods, eat a high-fibre diet
  - Pharmacotherapy: octreotide/somatostatin (to block GI neuropeptides)

Late dumping:

- Several hours after eating

Surgical Pearl: What to Do If the G-Tube Falls Out**If it has been inserted <24 hours:**

1. Call the surgeon immediately.

If it has been inserted >24 hours:

1. Coat the end of a Foley catheter with lubricant.
2. Gently insert the Foley catheter in the hole about 7.5–10 cm.
3. Using a 5 cc syringe, fill the Foley balloon with 5 cc of water.
4. Pull back gently on the tube until you meet resistance.
5. Secure the tube with tape.
6. Attach a 60 cc syringe. Aspirate the stomach.
7. The successful aspiration of fluid ensures proper placement. Confirm the placement with a water-soluble dye and abdominal radiography.

- Occurs in 2% of post-gastrectomy patients
- Symptoms are primarily vasomotor – weakness, sweating, dizziness, flushing, confusion
- Associated with hypoglycemia
- Pharmacotherapy: octreotide/somatostatin
- Surgical therapy: interposition of an antiperistaltic loop of jejunum

Postvagotomy diarrhea:

- Common early side effect; fortunately, <1% persist
- Often confused with dumping, but is not related to meal size or hyperosmolarity
- Likely from excess unconjugated bile in the colon, which inhibits water reabsorption
- Pharmacotherapy: cholestyramine (bile-absorbing resin), antimotility agents, smooth muscle relaxants, opiates
- Surgical option: conversion to a Roux-en-Y

Bile reflux gastritis:

- Also known as alkaline reflux gastritis
- Bile acids in contact with gastric mucosa can erode gastric lining
- Presents as epigastric pain, constant nausea, bilious vomiting
- Rule out: gastric outlet obstruction, GERD, antral gastritis, *H. pylori* gastritis
- Pharmacotherapy: bile adsorbents such as cholestyramine, aluminum hydroxide, sucralfate
- Surgical therapy
  - Conversion to Roux-en-Y gastrojejunostomy
  - Henley jejunal interposition
  - Braun enteroenterostomy

Roux stasis syndrome:

- 30–50% incidence

- Transection of the jejunum during surgery separates the limb from natural small intestinal pacemaker (located in the duodenum)
- Ectopic pacemakers trigger retrograde contractions in proximal jejunal portion
- Contractions slow transit and result in “Roux stasis”
- Pharmacotherapy: promotility agents

Metabolic problems:

- Steatorrhea
- Related to rapid intestinal transit or change in intestinal pH
- Pharmacotherapy: antidiarrheal agents

Chronic anemias:

- Microcytic anemia occurs in 30–50% of patients
- Decreased duodenal iron absorption

- Especially after Billroth II gastrojejunostomy
- Absorption may be affected by loss of hydrochloric acid
- Megaloblastic anemia occurs in 12–30% of patients
  - Vitamin B₁₂ deficiency due to loss of intrinsic factor

Post-gastrectomy “stump carcinoma”:

- Delayed finding; 3% at 15–25 years post-operative
- Possibly due to hypochlorhydria/achlorhydria, bile reflux, and increased *N*-nitrosamine
- Increased incidence with Billroth II gastrojejunostomy

Bibliography

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