Common postbariatric surgery emergencies for the acute care surgeon: What you need to know

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ABSTRACT: The field of bariatric and metabolic surgery has changed rapidly over the past two decades, with an exponential increase in case volumes being performed because of its proven efficacy for morbid obesity and obesity-related comorbidities. Although this increased volume of procedures has been accompanied by significant decrease in postoperative complication rates, there are numerous potential complications after bariatric surgery that may require urgent or emergent surgical evaluation or interventions. Many of these risks extend well beyond the early postoperative period and can present months to years after the index procedure. Acute care surgeons are increasingly covering most or all of the emergency general surgery services at many centers and must be familiar with the numerous bariatric surgical procedures being performed and their individual complication profile to provide optimal care for these frequently challenging patients. This article provides a focused and concise review of the common bariatric procedures being performed, their early and late complication profiles, and a practical guide to the optimal diagnostic evaluations, surgical interventions, and perioperative management options. The author group includes both acute care surgeons and bariatric surgeons with significant experience in the emergency management of the complicated postbariatric surgical patient. (*J Trauma Acute Care Surg.* 2023;95: 817–831. Copyright © 2023 Wolters Kluwer Health, Inc. All rights reserved.)

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CASE VIGNETTE

A 48-year-old woman presents to the emergency department with 24 hours of intense epigastric pain, nausea, and fevers. Her surgical history is significant for bariatric surgery 10 years ago, but she is unsure of the exact operation and no operative reports are immediately available. On physical examination, she has an upper midline scar with diffuse peritonitis. An upright chest x-ray shows free air under both hemidiaphragms. The hospital does not have a bariatric surgical program, and they are unable to transfer the patient to the nearest bariatric center because of the lack of bed availability. The on-call acute care surgeon is consulted for management and potential surgical intervention but is unsure of the optimal approach, the potential anatomy that he or she may encounter, and the full spectrum of interventional and surgical options that are currently available or recommended.

The field of bariatric and metabolic surgery has changed rapidly over the past two decades, with an exponential increase in case volumes being performed because of its proven efficacy for morbid obesity and obesity-related comorbidities.[1–4] In addition, there have been major evolutions in the commonly performed bariatric operations and their numerous variants, as well as the shift to minimally invasive techniques as the standard approach for most patients.[5–7] There are now 862 bariatric surgery programs in the United States accredited by the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program, with joint oversight from the American College of Surgeons and the American Society for Metabolic and Bariatric Surgery.[8] Not unexpectedly, the high and continually increasing numbers of patients undergoing bariatric surgery have translated to increasing volumes of patients presenting with urgent or emergent surgical complications that are related to their primary bariatric surgery or that are complicated by their existing bariatric anatomy.[9–13]

Over this same period, there has been a major shift in the coverage of emergency general surgery as it has become integrated (along with trauma and surgical critical care) into the specialty of acute care surgery (ACS) at most major academic and trauma centers. Since bariatric centers now far outnumber hospitals with ACS fellowships, or even trauma centers, the strong potential exists for bariatric patients with acute surgical emergencies to present to centers without bariatric surgical expertise, experience, or coverage.[11] Although transfer to a verified Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program center may be ideal, it may not be possible because of bed availability, remote distance, or patient stability and the emergent need for intervention. Fortunately, the vast majority of these issues can be definitively managed by the well-trained acute care surgeon with a good foundational understanding of the common anatomy, pathology, and pathophysiology in this patient population.[12,13] The purpose of this review is to provide that core knowledge regarding the most common current bariatric operations and anatomy, the likely early and late emergent surgical complications or issues that may develop, and to couple this with practical advice on evaluation and management options for both temporization or definitive interventions from authors with extensive experience in both ACS and metabolic/bariatric surgery.

OVERVIEW AND SURGICALLY RELEVANT ANATOMY

The initial approach to the patient who has had prior bariatric surgery should not differ significantly from any other patient presenting for urgent or emergent evaluation of some abdominal complaint. However, there are a number of significant caveats and anatomic considerations that must be factored in and that will usually impact the interpretation of diagnostic studies and the choice of any medical or surgical interventions as

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well as the surgical approach. Table 1 provides a "Top 10" list of high yield principles and practices that should be understood and followed and that may be neglected at your (or your patient's) peril. Arguably, the most important of these revolves around obtaining a thorough and accurate history or understanding of exactly what prior bariatric surgical procedure was performed and clarification of the existing anatomy. We have found that this patient population tends to be highly educated and knowledgeable regarding which procedure they underwent, but this may vary by patient or be compromised because of mental status changes associated with the emergent process or medications administered before the surgical evaluation. It is also not uncommon that the label "gastric bypass" is erroneously applied and reported by less familiar providers for any patient with a history of bariatric surgery. We recommend always personally confirming this with the patient or through chart review rather than accepting the initial report and proceeding based on bad information. In our experience, there is also frequent misreporting of whether prior procedures were performed via an open or laparoscopic/robotic approach, and close inspection of the abdomen for scars from prior incisions should always be performed by the responsible surgeon. Table 2 lists key components of the initial history and physical examination that will help rapidly clarify information that will be critical to diagnosis and management of any emergent surgical pathology in this patient population.

The initial evaluation should also be closely correlated with any fluoroscopic or cross-sectional imaging results, as these can help definitively identify the bariatric anatomy that is present in addition to evaluating for any acute pathology.[14,15] Historically, bariatric procedures have been mechanistically classified as either restrictive, malabsorptive, or combined restrictive/malabsorptive. Although this does not adequately represent the actual complex metabolic and neurohormonal mechanisms that are seen postoperatively,[16,17] this classification scheme is helpful as an initial dichotomization to tailor the differential diagnosis and evaluation options. All current bariatric surgical procedures are either purely restrictive and involve only the stomach or are combined restrictive/malabsorptive and involve both resizing of the stomach and manipulation of the small intestine to bypass normal digestion. As shown in Table 3, current restrictive operations are the sleeve gastrectomy (SG) and the adjustable gastric band (AGB), although use of the AGB has fallen dramatically over the past decade (Fig. 1*A*).[18–20] The most common current combined operation being performed is the Roux-Y gastric bypass (RYGB), with the duodenal switch (DS) and several newer single-anastomosis variants being performed less frequently (Fig. 1*B*). Starting with this classification can help narrow down the primary concerns and guide the radiologic workup to focus on the likely areas of concern. For example, while internal hernias or small bowel anastomotic leaks would be of concern in a patient who underwent an RYGB, those should not even be in the differential for the patient who underwent one of the purely restrictive operations such as the SG. The other critical point in the workup of this patient population is that postbariatric surgery patients have the same risk of common abdominal surgical issues like appendicitis or diverticulitis and, in fact, have an increased risk of acute biliary disease.[21,22] The differential and initial evaluation should include these considerations and not focus purely on the assumption that the presenting complaint is directly related to the bariatric surgical procedure.

Roux-Y Gastric Bypass

The RYGB was long considered the criterion standard bariatric operation for its reliable weight loss and comorbidity resolution but is now the second most commonly performed procedure following the SG.[5] It entails the formation of a very small

TABLE 1. Top 10 Principles for Bariatric Emergencies

1. There is nothing unique about abdominal emergencies in the bariatric patient versus other patients who have undergone prior foregut surgery, but there are specific additional considerations and triggers for interventions of which the acute care surgeon should be aware. Bariatric patients still develop appendicitis, gallstone disease, etc., so work up the common problems.
2. A bariatric history is critical! Establish exactly what procedure the patient had done (many times they will all be labeled as having a "prior gastric bypass"), when and where it was done, open versus laparoscopic, and any immediate postoperative complications or problems. Contacting the original bariatric surgeon can provide critical information or advice.
3. In the early postoperative period (i.e., 1–4 weeks), any significant abdominal complaints should be assumed to be a leak (anastomotic or staple line) until proven otherwise.
4. Leaks can present insidiously with minimal abdominal complaints. Relatable early signs are fever, tachycardia, or unexplained elevation of the white blood cell count. However, each of these findings lacks specificity.
5. Many abdominal emergencies present with associated pulmonary symptoms, and pulmonary emboli can present similar to a leak. Both should be considered and ruled out, usually by CT imaging combined with clinical assessment.
6. Postoperative bowel obstructions after a gastric bypass are due to an internal hernia until proven otherwise. Computed tomography scan can provide evidence of an internal hernia, but no imaging study is reliable enough to rule out an internal hernia. This "proof" usually requires surgical exploration done in a timely fashion to avoid catastrophic small bowel strangulation or blowout of a proximal staple line.
7. The SG is the fastest growing bariatric procedure being performed, so be familiar with the anatomy and the common emergencies with this procedure. Although touted as a "safer and less invasive" option than gastric bypass, the leak rate is similar (or higher) and more difficult to manage.
8. Many acute abdominal complaints with the adjustable gastric band can be relieved by complete band deflation (i.e., can be done at bedside), turning an urgent issue into an elective one. Although now rarely performed as a primary bariatric operation, there are many patients who have a gastric band and who may present with some acute complication that requires urgent bedside or surgical intervention.
9. Upper gastrointestinal fluoroscopy studies alone will miss a significant number of leaks. Following the UGI study with a CT scan (i.e., combined CT/swallow protocol) will greatly improve detection of leaks and evaluate for most other emergent abdominal pathologies.
10. The acutely decompensating patient belongs in the operating room as soon as possible. The stable patient with persistent and unexplained abdominal pain after complete radiologic evaluation usually warrants endoscopy and/or laparoscopic surgical exploration.

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TABLE 2. Critical Bariatric History Questions, Physical Examination Items, and Resources

History Questions	Physical Examination/Laboratories
1. What operation was performed? When?	• Current vital signs, temperature
2. Open or laparoscopic (also see examination)?	• Any tachycardia?
3. Any subsequent operations or revisions?	• Subjective abdominal pain, nausea, other complaints before examination
4. Location and name of the hospitals and the surgeons?	• Tenderness location, referred pain, rebound, guarding
5. How long was your hospital stay after the bariatric surgery?	• Location and size of scars (consistent with the given surgical history?)
6. Any complications related to the surgery?	• Incisional or groin hernias
7. Any endoscopy performed since the surgery? Any other imaging studies?	• Pleuritic chest pain/tenderness
8. How much weight did you lose? Regained?	• WBC, CMP, lipase/amylase
9. Current smoking or tobacco use?	
10. All medications, including over-the-counter meds, herbs, supplements	

Other Helpful Resources

1. MBSAQIP program website: www.facs.org/quality-programs/mbsaqip
2. Listing of all accredited bariatric centers (searchable): www.facs.org/search/bariatric-surgery-centers
3. Listing of individual surgeons (American College of Surgeons): www.facs.org/search/find-a-surgeon
4. Searchable listing of bariatric surgeons (ASMBS): www.asmbs.org/patients/find-a-provider
5. Overview of currently performed bariatric procedures: asmbs.org/patients/bariatric-surgery-procedures
6. ASMBS "Clinical Pearls for Emergency Care of the Bariatric Surgery Patient" poster (downloadable): s3.amazonaws.com/publicASMBS/ASMBS_Store/ASMBS_ER_Poster9-20-10.pdf

ASMBS, American Society for Metabolic and Bariatric Surgery; CMP, complete metabolic panel; WBC, white blood cell count.

proximal gastric pouch that is separated from the remainder of the stomach (usually labeled as the "gastric remnant" or "excluded stomach") using linear staplers (Fig. 1*B*). The jejunum is then divided, and the distal stapled end is brought up as the Roux limb to connect to the small gastric pouch via a stapled or handsewn gastrojejunostomy. The Roux limb is most commonly placed in the antecolic position with an antegastric anastomosis, but retrocolic routing (via a window in the transverse mesocolon) and retrogastric anastomotic techniques also continue to be used.[23,24] The excluded stomach is left in situ and remains connected to the duodenum and first portion of the jejunum that forms the biliopancreatic (BP) limb. The BP limb is anastomosed to the Roux limb as a jejunojejunostomy, typically 100 to 150 cm distal to the gastrojejunostomy. This variable length of the Roux limb is commonly used to dictate the degree of malabsorption, with longer lengths providing greater malabsorption. The small bowel from the jejunojejunostomy to the ileocecal valve is typically labeled as the "common channel" and is the primary site of nutrient absorption after surgery. Leaks most commonly occur at the gastrojejunostomy but are also possible at the jejunojejunostomy or from the staple line of the excluded gastric remnant.[25,26] Mesenteric defects are usually closed but can reopen because of technical failure or from weight loss as patients lose fat in the mesentery. Because of the anatomic reconfiguration involved in RYGB, the gastric remnant, duodenum, and biliary system are not accessible with standard upper endoscopy. This can complicate surveillance or diagnosis of this area for neoplasms, evaluation, or intervention for upper gastrointestinal bleeding, but most commonly (and of most relevance to the acute care surgeon), it typically eliminates the possibility of standard endoscopic retrograde cholangiopancreatography (ERCP) for treatment of choledocholithiasis.[27,28]

Sleeve Gastrectomy

The SG has rapidly risen in popularity over the past decade and has now become the most commonly performed bariatric surgical procedure in the United States.[1,4] It entails stapling and removing the lateral stomach, forming a narrow gastric tube (Fig. 1*A*) from the gastroesophageal junction to the antrum. The lateral divided portion of the stomach is removed, and thus, there is no gastric remnant or excluded stomach. The antrum and pylorus are typically left intact to preserve the antropyloric pump and normal gastric emptying. No small bowel is manipulated or rearranged, and no anastomoses are performed. The staple line is at risk for leaks and bleeding anywhere along its length. However, leaks most commonly occur at the angle of His, just below or at the gastroesophageal junction.[29–31] This can be the result of ischemia, inadvertently stapling on the esophagus rather than the stomach at the gastroesophageal junction, or due to pressurization from a distal stricture or obstruction. The source of obstruction or narrowing will most commonly be at the distal third of the sleeve because of inadvertently stapling

TABLE 3. Overview of Simplified Classification of Current Bariatric Procedures and Uncommon or Historical Procedures

	Restrictive	Restrictive ± Malabsorptive
Current	Adjustable gastric band	Gastric bypass (aka "Roux-Y" bypass)
	SG	DS (aka "the switch")
		SADI and one-anastomosis or "mini" gastric bypass
Historical or uncommon	Gastric plication	BP diversion
	Vertical banded gastroplasty	Jejunoileal bypass (purely malabsorptive, no longer performed because of severe complications)
	Horizontal gastroplasty	

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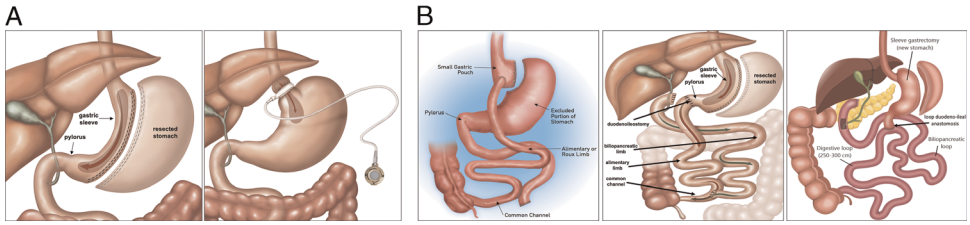

Figure 1. Anatomy of common modern bariatric procedures. (*A*) Current restrictive procedures include the SG (left) and the adjustable gastric band (right). (*B*) Current combined restrictive-malabsorptive procedures include the RYGB (left), DS (center), and single-anastomosis duodenoileal bypass (right) with permission from Ethicon, Inc. (Cincinnati, OH).

too close along the angled incisura or can be due to twisting or torsion of the midbody of the sleeve.[29,32] The altered gastric anatomy and any anatomic abnormalities can be readily assessed by standard endoscopy or a fluoroscopic swallow study, while a computed tomography (CT) swallow is most effective at identifying leaks and any associated abscess cavity.[15]

AGB or "Lap Band"

The AGB, a procedure that was approved by the Food and Drug Administration in 2011, rapidly rose in popularity because of the minimally invasive nature and low early postoperative complication profile but subsequently fell out of favor because of the high failure rates and long-term complications requiring band removal.[33] Although the acute care surgeon is unlikely to be faced with a complication related to a recent AGB placement, they are much more likely to see an AGB patient presenting with a late band-related urgent or emergent complication.[19,20] There are several variants of the AGB, but they all feature a circular prosthetic band with an inflatable balloon placed around the gastric cardia, just below the gastroesophageal junction (Fig. 1*A*). The stomach is then imbricated over the band on the anterior surface of the stomach, typically leaving only the medial section of the band and tubing exposed on the lesser curve. A long tube connects the band to an injection port that is used for inflation or deflation of the band, which is placed in the subcutaneous space of the upper abdomen and sutured to the anterior fascia. Most complications relate to band or tubing erosion, band slippage, or mechanical problems with the band, tubing, or port. Band slippage is the most common issue that would require emergent intervention, as it can result in strangulation and ischemia of the stomach proximal to the band if not rapidly addressed.

DS and Single Anastomosis Duodenoileal Bypass

Duodenal switch is an umbrella term that includes several surgical variations but features a combination of an SG as the restrictive component combined with a Roux-Y intestinal bypass that is much more distal and more malabsorptive compared with the RYGB.[34] A traditional DS entails performing a standard SG and transecting the first part of the duodenum several centimeters distal to the pylorus, followed by a Roux-Y reconstruction with duodenoileostomy and jejunoileostomy anastomoses resulting in a very distal malabsorptive bypass (Fig. 1*B*). As opposed to the RYGB where there is a long unmeasured common channel, the DS features a much shorter common channel that is most commonly 100 to 150 cm in length.[35,36] This procedure thus has similar anatomic features and potential complications to both the SG and the RYGB as described previously. In addition, the presence of the stapled-off duodenal stump creates one additional potential area for staple line bleeding or disruption and duodenal stump leak. The resultant total weight loss, comorbidity improvement/control, and risk of weight regain with the DS appear to be superior to the other bariatric operations.[36] However, the risk of nutritional and malabsorptive complications is higher versus other bariatric procedures because of the much shorter common channel, and these patients are also more prone to dehydration that can exacerbate their acute presentation.[37,38]

Over the past decade, a newer variant of the DS has been gaining popularity as a technically simpler and safer replacement option with less nutritional and malabsorptive complications. The single anastomosis duodenoileal bypass (SADI) with sleeve gastrectomy entails the same SG and proximal duodenal transection as the DS but is then reconstructed with a loop duodenoileostomy rather than a Roux-Y configuration (Fig. 1*B*).[39–41] Because this procedure only involves one anastomosis, it does not carry any of the risks of leak or stricture from the distal anastomosis seen in the DS. However, the loop reconstruction does create the potential for both afferent and efferent loop syndromes similar to those seen after Billroth II reconstruction for peptic ulcer disease. In addition, both the DS and SADI carry a risk of duodenal stump leak from the distal transected end of the first portion of the duodenum. The incidence of severe nutritional deficiencies and malabsorptive syndromes with the SADI appears to be lower than that seen with the DS.[42]

COMMON COMPLICATIONS AND PRACTICAL MANAGEMENT ADVICE

General Approach Principles and Pearls

Table 4 lists the most common and likely bariatric-specific postoperative complications differentiated into early (1–4 weeks) and late (>30 days) from the time of surgery. The most critical piece of history is identifying what prior procedure was performed; this will help guide the workup and areas of main concern on imaging studies. Another essential component of the patient's history to obtain is the frequency, amount, and consistency of emesis. Persistent emesis after any bariatric surgery is highly abnormal, and it should raise a red flag of concern for an acute surgical emergency. Similar to the evaluation and treatment of nonbariatric patients presenting with abdominal complaints, fluid resuscitation should be initiated promptly in bariatric patients. Bariatric patients become easily dehydrated, and this is primarily due to a restrictive mechanism limiting oral intake rather than a malabsorptive mechanism. Furthermore, these

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patients should be given a decreased volume and rate of oral contrast and do not require a "full oral prep" for a diagnostic CT scan.

Patients manifesting with hemodynamic instability or signs of rapid progression of sepsis or clinical deterioration should usually be explored without undue delays or extensive workups. However, in stable patients or those who respond to initial fluid resuscitation, liberal use of imaging (fluoroscopy, CT, endoscopy, or combined) to rule out major life-threatening complications such as a leak, bleeding, or internal hernia is warranted. However, beware of false negative studies, which can miss leaks and internal hernias.[14,15,26] A common mistake in evaluating the patient in the early postoperative period is interpreting concerning imaging findings as normal postoperative variants. Free air and fluid are not normal 1 week or later after surgery and should not be written off as benign findings. Radiologists who are not familiar with bariatric imaging and anatomy may have problems differentiating normal versus abnormal anatomy and findings. Face-to-face discussion and review of the studies are critical to accurate interpretation and diagnosis.

Once the decision has been made to operate, laparoscopy is a valid surgical approach and can be considered in any hemodynamically stable patient, particularly those who had their bariatric procedure performed via minimally invasive surgery techniques.[43–45] Laparoscopy can be both diagnostic and therapeutic in many of these cases and may avoid the added morbidity and complications from a laparotomy incision in a patient with morbid obesity. Of note, laparoscopic entry in bariatric patients often requires avoidance of Palmer's point for Veress or optical trocar entry. This is particularly true in patients with a history of RYGB or SG who present with a leak in the left upper quadrant. The inflammation, fluid, and often dilated viscera in the left upper quadrant may preclude safe and useful entry here. Alternative entry sites include the supraumbilical area and 16 to 20 cm below the xiphoid along the right or left midaxillary lines. Despite the preference for laparoscopy when feasible, open surgical exploration or conversion from laparoscopic to open exploration should be performed in the face of hemodynamic instability, unclear anatomy, or based on the experience and preference of the managing acute care surgeon.[10,13]

GASTRIC BYPASS COMPLICATIONS

Early Complications (≤30 Postoperative Days): Leaks, Bleeding, and Early Small Bowel Obstruction

The top three major concerns early after an RYGB should be leak, leak, and leak. The most common leak location is at the gastrojejunal anastomosis, but any anastomosis or staple line can leak (gastric remnant or jejunojejunostomy).[5,25] Leaks may present as florid peritonitis and sepsis (uncontained) or with subacute symptoms of pain, fever, tachycardia, and nausea with or without emesis (usually contained). Signs of an uncontained leak should prompt immediate surgical exploration; otherwise, radiologic imaging should be rapidly obtained. Most early complications of laparoscopic gastric bypass can be managed laparoscopically in experienced hands but do not hesitate to convert to open as needed. Without signs of an uncontained leak, a contrast swallow study should be obtained. Computed tomography or combined upper gastrointestinal (UGI) fluoroscopy followed by immediate CT has the highest sensitivity.[26] However, these studies are generally reliable only for leaks from the gastrojejunostomy (Fig. 2*A*), and they can easily miss leaks from the jejunojejunostomy or from the gastric remnant, although the prevalence of the latter two are relatively low.[25] Management of contained gastrojejunostomy leaks in stable patients has changed dramatically away from routine operative exploration. Nonoperative management with the use of percutaneous drain placement and endoscopic stent placement has been increasingly used and highly successful.[46,47] Additional options include fibrin glue injection and endoscopic clip or suture closure of the leak, but this should usually be done only by an experienced bariatric surgeon or bariatric endoscopist.[48,49]

After leak, the next concern should be for a small bowel obstruction (SBO).[50,51] Early SBO after laparoscopic gastric bypass is rarely due to adhesions and is more commonly due to one of three reasons: technical error with narrowing or kinking of the jejunojejunostomy, intraluminal obstruction from a formed hematoma, or a port-site hernia.[44,52] Early obstruction of the jejunojejunostomy will cause both proximal dilation and emesis, which are both risk factors for disrupting the gastrojejunostomy

TABLE 4. Bariatric-Specific Complications in the Early and Late Postoperative Periods

	Gastric Bypass	SG	Adjustable Gastric Band
Early (1–4 wk)*	Anastomotic leak	Staple line leak	Dysphagia/reflux
	Gastrointestinal Bleeding	Gastrointestinal bleeding	Band slippage
	Intraluminal clot	Gastric outlet obstruction	Balloon or tubing fracture
	Early stricture	Early stricture	Edema/stenosis at band site
	Surgical site infection**	Surgical site infection**	Surgical site infection**
	Early postop SBO	Early postop SBO	Iatrogenic gastroesophageal injury
Late (>30 d)	Internal hernia	Leak or fistula	Band slippage or erosion
	Stricture	Stricture	Band overinflation
	Marginal ulcer	Gastric outlet obstruction	Port malposition
	Gastrogastric fistula	Portal or mesenteric venous thrombosis	Band/tubing fracture
	Gallstones	Gallstones	Gallstones
	Intussusception	Severe reflux	Intolerance to band inflation

*Additional iatrogenic complications of surgery such as a missed enterotomy should be considered as with any early postoperative patient.
**An intra-abdominal abscess should be assumed to be due to a contained leak if adjacent to an anastomosis or gastric staple line.
Postop, postoperative.

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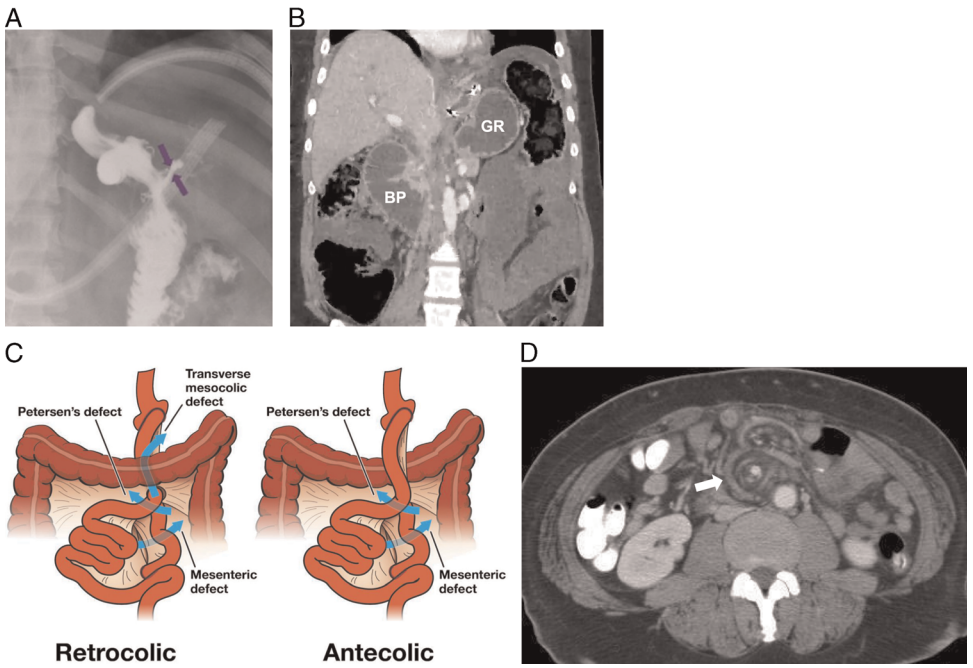

Figure 2. Complications following gastric bypass and SG. (*A*) Upper gastrointestinal fluoroscopy after gastric bypass; arrow, leak at the gastrojejunostomy (with permission from Ross et al., *Abdom Radiol.* 2021;46:3019). (*B*) Computed tomography of SBO after gastric bypass with dilated GR and BP limb. (*C*) Internal hernia locations after gastric bypass; top arrow, Petersen's defect; bottom arrow, mesenteric defect at the jejunojejunostomy (with permission from Altieri et al., *Surg Obes Rel Dis.* 2023;19:763). (*D*) Computed tomography of internal hernia after gastric bypass; arrow, mesenteric "swirl sign" indicating small bowel mesenteric torsion. GR, gastric remnant.

if not promptly treated with surgery or endoscopy. Obstruction at or distal to the jejunojejunostomy will also dilate the BP limb and gastric remnant, which has no outlet for decompression and should be considered a surgical emergency (Fig. 2*B*). Luminal obstruction of the jejunojejunostomy due to a formed hematoma can be a surgical emergency if it causes a complete obstruction, and prompt evacuation surgically or endoscopically should be performed.[53] Although internal hernia should be on the differential diagnosis for any SBO, it is much less common in the early postoperative period.

Late Complications (>30 Postoperative Days): Internal Hernia, Strictures, and Marginal Ulcers

A critical distinction exists between the management of SBOs after gastric bypass versus after other abdominal surgeries. Any true SBO after gastric bypass is presumed to be due to an internal hernia and should not be managed expectantly for two reasons. First, the herniated bowel can rapidly progress to ischemia and necrosis if not promptly reduced. Second, a nasogastric tube will not access or decompress the BP limb and gastric remnant (Fig. 2*B*), which can then dilate and rupture.[23,51]

There are two or three potential spaces for internal hernia formation after a gastric bypass that should be understood before any surgical exploration. These include the mesenteric defect at the jejunojejunostomy, the space between the Roux limb mesentery and transverse colon (the so-called Petersen's defect), and through the mesocolic window if retrocolic routing of the Roux limb was performed at the initial bariatric operation (Fig. 2*C*).[51] Internal hernias most commonly occur through the mesenteric defect at the jejunojejunostomy, while herniation through Petersen's defect is the second most common.[54,55] Any surgical exploration in these patients for an SBO or for acute/chronic abdominal pain complaints should include running the entire length of small bowel and inspection of all potential sites of internal hernia formation.[54,56]

Although there are several CT findings that suggest an internal hernia, none are highly sensitive or specific, and it is important to understand that a normal CT scan does not rule out an internal hernia.[14,15] However, the most reliable sign on CT scan is the mesenteric "swirl sign," which indicates vascular torsion of the herniated intestine (Fig. 2*D*). Other signs or findings that may be present include clustered loops of small bowel in the left upper quadrant, a small bowel loop behind the superior mesenteric artery, and the jejunojejunal anastomosis located to the right of midline (it is normally located to the left of midline).[51,57]

Reduction of internal hernias can be challenging, particularly via laparoscopy. Starting at the gastrojejunostomy and following the small bowel distally will usually lead to the torsed area, but the anatomy may be confusing and attempts at reduction are often unsuccessful.[44,58] If this is encountered, then we recommend shifting to the approach of running the bowel from distal to proximal by starting at the ileocecal valve. As the bowel is run from distal to proximal and pulled to the right side of the patient, the internal hernia will frequently reduce, and normal anatomy and orientation of the jejunojejunostomy will be restored. This will then allow for simple suture closure of the mesenteric defect. We prefer the use of a running closure using a barbed suture, which avoids the need for intracorporeal knot

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tying and provides a secure closure with less suture slippage. However, any available permanent or slow-absorbing suture can be used per surgeon preference.

Following SBO, another late complication of gastric bypass is stricture, which typically take at least 4 to 6 weeks to develop and occurs most commonly at the gastrojejunal anastomosis.[59,60] Progressive intolerance to solids more than liquids and pain with eating are usual presenting signs. Upper endoscopy should be performed, and most strictures respond to serial balloon or bougie dilation.[61] Upper gastrointestinal contrast studies are not reliable and can be read as normal even in the presence of a tight stricture. These rarely require urgent surgical intervention and should be referred to a bariatric specialist for further workup and potential surgical intervention.

Marginal ulceration at the gastrojejunostomy is another late complication of gastric bypass that commonly requires emergent surgical intervention.[62,63] This is typically only seen after gastric bypass and not with other bariatric procedures. The incidence is 2% to 15% and varies by anastomotic techniques and patient populations.[63] Identified causal factors include a larger than normal gastric pouch (increased acid producing cells), stapled anastomoses, nonsteroidal anti-inflammatory medication use, and active smoking.[64] Common symptoms are epigastric pain with eating, but it can also present as a spontaneous perforation with peritonitis and signs of sepsis and thus require intervention by the acute care surgeon. Typical CT scan findings include free air in the upper anterior abdomen, oral contrast extravasation (if given), and free fluid in the upper abdomen (Fig. 3*A*). Most perforated marginal ulcers are on the anterior surface of the gastrojejunal anastomosis and are typically small (less than 1 cm), making them amenable to primary repair or patch (Figs. 3*B–D*). Intraoperative endoscopy or insufflation of air via a nasogastric tube can be useful in identifying the location of perforation (if not readily apparent) and for testing the completeness of the surgical repair. More complicated procedures including resection/revision of the anastomosis are rarely required and should be avoided in the acute setting.[65,66] A closed-suction drain should be left adjacent to the repair, and we recommend early initiation of oral liquid intake (within 24 to 48 hours) along with acid-suppression therapy and smoking cessation if needed. Prolonged nasogastric decompression and withholding or oral intake is not required for the majority of patients who have early diagnosis of the perforation and timely operative repair.

Other Late Complications (>30 Postoperative Days): Choledocholithiasis

Following RYGB, choledocholithiasis cannot be managed with conventional ERCP followed by cholecystectomy since the duodenum has been separated from the functional stomach.[27,28] Management depends on the expertise and comfort of each medical center's gastroenterology, interventional radiology, and surgical team. Gastroenterologists can attempt balloon-assisted ERCP to navigate from the stomach, through the Roux limb, and proximally up the BP limb to access the sphincter of Oddi.[28] Interventional radiologists can use a percutaneous rendezvous technique to access the biliary tree with or without concurrent ERCP. In centers without this expertise or after failure of these attempts, a laparoscopically assisted transgastric ERCP is an excellent option that can readily be performed by any surgeon with basic laparoscopic skills in concert with their interventional gastroenterologist.[67,68] The distal greater curve of the gastric remnant is mobilized, and an anterior 1 to 2 cm gastrotomy is

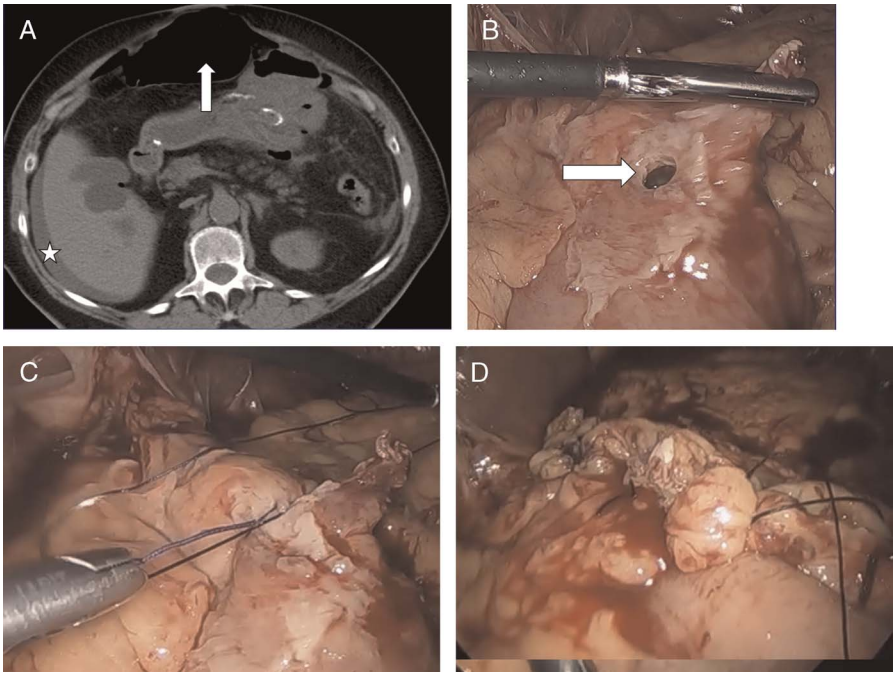

Figure 3. Perforated marginal ulcer after RYGB. (*A*) Computed tomography scan shows free air anterior to the gastrojejunal anastomosis (white arrow) and free fluid (white asterisk). (*B*) Small anterior perforation at the gastrojejunal anastomosis identified on laparoscopic exploration (white arrow). (*C*) Laparoscopic primary suture closure of marginal ulcer perforation. (*D*) Omental patch coverage of perforation repair.

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created to facilitate passage of the endoscope into the remnant (Fig. 4*A*). The stomach adjacent to the gastrotomy can be elevated and stabilized using fixation sutures for passage of the endoscope (Fig. 4*B*), or alternatively, a 15-mm trocar can be directly inserted through the abdominal wall and anterior gastric wall into the gastric lumen. After completion of the procedure, the gastrotomy can be closed with a laparoscopic stapler or with sutures. In less common cases where the need for repeat endoscopic access to the BP limb is anticipated, the gastrotomy site can be converted to a standard Stamm gastrostomy tube. If a patient presents with cholangitis and endoscopy/ERCP is unavailable, open or laparoscopic surgical common bile duct exploration may be required, or placement of an internal-external biliary drain via percutaneous transhepatic cholangiography can be done to temporize the patient until ERCP can be accomplished.[27,28]

SG COMPLICATIONS

Bleeding

Bleeding is one of the most common early acute complications following SG. Patients may present with tachycardia and anemia, with or without hematemesis or melena. The most common sites of bleeding include the sleeve staple line (intraluminally or extraluminally), the divided gastroepiploic perforators or short gastric arteries, and the spleen. Although improvements in laparoscopic staplers and buttressing materials have decreased the frequency of staple line bleeding, it is still one of the most common culprits for postoperative hemorrhage. Most of the staple-line bleeding events will occur extraluminally into the peritoneal cavity and are best approached via laparoscopic or open abdominal exploration if needed. However, it is important to consider the possibility of intraluminal bleeding as the primary source, as the appropriate intervention will typically be urgent endoscopy rather than surgery. Of note, intraluminal bleeding can form a large hematoma with pyloric obstruction, sleeve distension, and resultant proximal staple line blowout that can be catastrophic. Immediate endoscopic and/or surgical exploration with complete clot evacuation in addition to hemorrhage control is warranted in these situations.

For patients with physiologic evidence of ongoing hemorrhage and clear signs of intraperitoneal bleeding (abdominal distension, bloody drain output) or intraluminal bleeding (hematemesis and/or melena), cross-sectional imaging is not necessary and may only delay hemorrhage control. For stable patients and/or those with an unclear source of hemorrhage, cross-sectional imaging can be useful for confirming the diagnosis and directing interventions. Abdominopelvic CT scan or CT angiography can readily identify the presence and location of free fluid, postoperative hematomas, and splenic or other less common sources. In addition, it may allow for visualization of active contrast extravasation at the site of bleeding, but it is not perfectly sensitive and cannot definitively rule out ongoing hemorrhage. Intraluminal bleeding can typically be controlled with endoscopic clip placement or cautery and simultaneously evacuate any formed clot or large hematomas. Extraluminal bleeding can usually be approached laparoscopically unless the patient is hemodynamically unstable. A large-bore suction-irrigator device is optimal to evacuate the typically large amount of clot that is encountered. In many cases, there may be no site of active bleeding identified, and simply evacuating the clot and leaving a closed-suction drain are all that is required. If active bleeding from the staple line or divided perforating arteries is identified, then this is readily controlled with clips, suture ligation, or with the use of an energy device. In cases of bleeding from a splenic capsular tear or laceration, application of topical hemostatic dressings or powder can be attempted if the aforementioned measures have failed. Rarely, a splenectomy may be required.

Leaks

Leaks represent one of the most feared but fortunately uncommon (1–5% incidence) complications following laparoscopic sleeve gastrectomy. Although the laparoscopic sleeve gastrectomy is often touted as a "simpler" procedure compared with gastric bypass, sleeve leaks are frequently more complex and difficult to manage than a leak following gastric bypass. Leaks can occur anywhere along the sleeve staple line, but they are most frequently found at the proximal end at or just below the gastroesophageal junction. This is likely due to poor blood supply in this area, thinner tissue near the esophagus, backpressure from narrowing or twisting of the mid to distal sleeve, or pyloric dysfunction with gastric outlet obstruction. Similar to leaks following RYGB, leaks following SG should be managed with prompt surgical exploration if they are uncontrolled leaks with diffuse peritonitis, sepsis, or instability. Otherwise, patients should undergo prompt initial diagnostic studies including an oral contrast CT or UGI study. Percutaneous drainage can

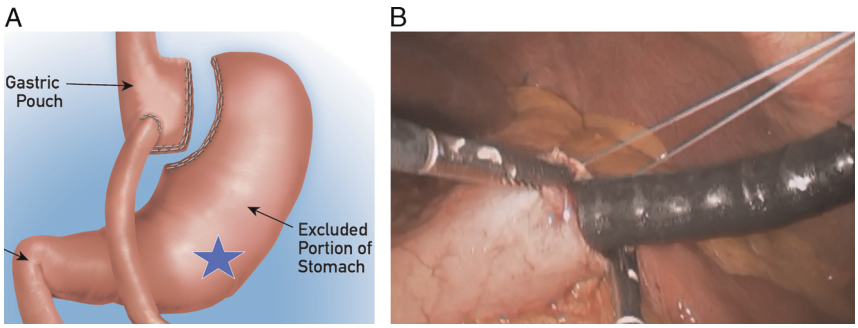

Figure 4. Laparoscopic-assisted transgastric ERCP technique. (*A*) Roux-Y gastric bypass anatomy with usual access point for transgastric ERCP on the distal greater curve of the gastric remnant (blue star). With permission from Ethicon, Inc. (Cincinnati, OH). (*B*) Intraoperative photo with endoscope inserted through a gastrotomy in the distal gastric remnant.

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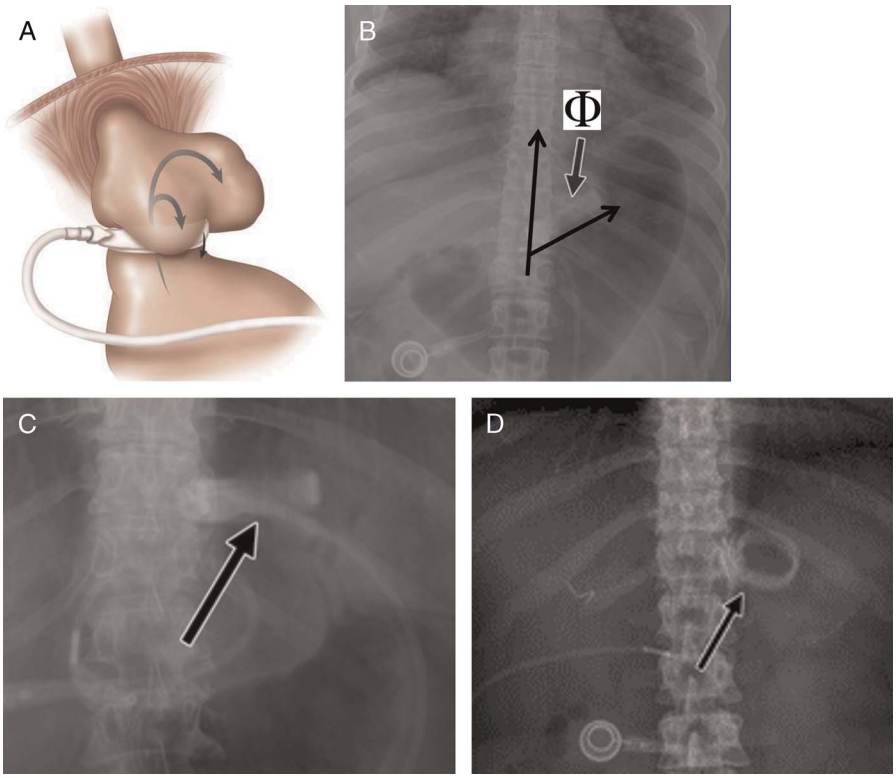

Figure 5. Adjustable gastric band slippage and radiographic assessment. (*A*) Stomach slippage/herniation superiorly through the adjustable gastric band (arrows). With permission from Ethicon, Inc. (Cincinnati, OH). (*B*) Abdominal x-ray showing normal φ angle (45 degrees) of adjustable gastric band. (*C*) Abdominal x-ray showing a slipped adjustable gastric band (black arrow) with the band at a near 90-degree angle (φ angle) with the spine. (*D*) Abdominal x-ray showing the "O sign" (arrow) that also suggests a slipped adjustable gastric band.

be used for stable patients with a contained leak or abscess to control the leak and serve as a bridge to endoscopic or surgical intervention. One of the most important points in managing a sleeve leak is to also evaluate the rest of the sleeve for any anatomic or functional abnormalities that may have caused the leak, such as a sleeve stricture, torsion/twisting of the sleeve, or dysfunction of the gastric outlet/pylorus. If any of these are present, then successful intervention is dependent on addressing both the sleeve leak and the underlying cause.

If operative intervention is required or the leak is discovered intraoperatively, then there are several options available. Attempts at primary repair in the acute phase usually fail, although they may be effective for small pinhole leaks that are identified early. Even with a technically satisfactory primary repair, the assumption should be that it will likely break down, and closed suction drains should be placed at the time of repair. We have used a biliary t-tube in several of these cases to control the leak site and allow for formation of a controlled fistula to the skin. Advantages of this approach include immediate control of the leak, ability to resume oral intake and facilitate hospital discharge, and ability to perform wire-guided instrumentation or drain exchanges via the t-tube as needed. Distal leaks can be managed with resection of the leaking site and conversion to an RYGB if the patient is stable and local tissue conditions permit. Resection is much less straightforward for proximal leaks because they typically require a partial esophagectomy and

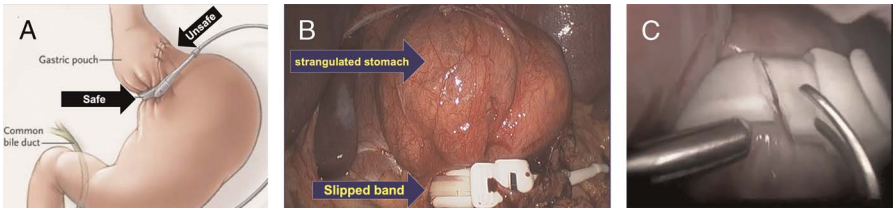

Figure 6. Adjustable gastric band anatomy and removal technique. (*A*) Gastric imbrication typically covers approximately three-quarters of the AGB with the medial/lesser curve area being optimal for safe dissection and mobilization. With permission from Ethicon, Inc. (Cincinnati, OH). (*B*) Intraoperative photograph showing a slipped AGB with inflamed but viable fundus herniated superiorly. (*C*) If manual unbuckling of the band is unable to be achieved, then the band ring can be simply transected with scissors and pulled out of its perigastric tunnel.

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reconstruction with an esophagojejunal anastomosis, but this may be required after failure of less drastic options to control and close the leak.

For patients who do not require immediate operative intervention or have a contained leak, the optimal approach is typically a combination of percutaneous external drain placement and endoscopic or interventional radiologic interventions for the perforation. Endoscopic stenting has been widely used for proximal sleeve leaks, but with lower overall success rates compared with a gastric bypass leak due to the length of the sleeve and difficulty getting proximal and distal seals on the stent. Therefore, these patients should be referred to a very experienced endoscopic surgeon or gastroenterologist. Other advanced endoscopic treatment modalities now include endoscopic clipping or suturing, fibrin glue injection, and endoscopic vacuum therapy, which is analogous to an intraluminal wound vacuum with suction through a nasogastric tube. More recent data are reporting improved success rates (up to 85%) with endoscopic placement of double pigtail stents with or without endoscopic division of the septum between the sleeve and the perforation cavity to maximize internal drainage and closure of the leak site.[30]

AGB OR LAP BAND COMPLICATIONS

Although there are very few centers still placing AGBs, there are many patients who have undergone this procedure and may present with an acute surgical emergency related to the band or complicated by the presence of the band. The two primary reasons why a patient with an AGB would present acutely are band slippage or band erosion. In cases of band slippage, the band slips distally, and excess mobile fundus and gastric body are herniated proximally up through the band (Fig. 5*A*). This can cause gastric obstructive symptoms and even gastric strangulation and necrosis if left untreated. Patients will usually present with acute intolerance to oral intake, persistent emesis, acute onset of acid reflux, and even difficulty with oral secretions. Alternatively, the patient may present with these complaints shortly after a band adjustment where the band was inflated to increase food restriction. It is important to ask about the exact type/brand of AGB that was placed, their history of band fills or any recent band manipulation, and the total fill volume currently in their AGB (if known).

Diagnosis of a slipped AGB can frequently be made via simple assessment of two factors on an anteroposterior upper abdominal x-ray: (1) the appearance or shape of the band and (2) measurement of the angle of the band relative to the spine. This φ angle is the angle formed by a straight line through the long axis of the band and a vertical line through the spinal column (Fig. 5*B*). Normal AGB positioning creates an angle of approximately 45 degrees, and anything greater than 58 degrees indicates slippage (Fig. 5*C*). In addition, a normal AGB looks like a solid hockey puck viewed from the side, but a slipped band will often change to a circular shape with a dark lumen (the "O sign") (Fig. 5*D*). One or both of these findings should prompt immediate further evaluation or interventions for slippage. A contrast swallow or CT scan can be helpful in equivocal cases or to delineate the degree of slippage and gastric herniation. These studies can also help determine if the stomach has ischemic changes or perforation.

The first intervention that should be performed in these patients is aspiration of all fluid from the band to deflate the balloon and relieve the obstructive symptoms. The band port is similar in function and design to a port-a-cath and can be accessed with a 20- to 22-gauge needle after identifying the center of the port via abdominal wall palpation. In most cases, this will result in immediate relief of symptoms and obviate the need for urgent surgical intervention, even in the presence of a slipped band. However, if this does not relieve symptoms or there is clinical or imaging concerns for compromised stomach, then emergent laparoscopic exploration and band removal is indicated. Laparoscopic AGB removal is a relatively simple procedure, but there are several key technical points and dangers that must be appreciated. Although many illustrations of the AGB make it appear as if it is simply a free-floating band placed around the proximal stomach (Fig. 1*A*), in actuality, the stomach is commonly imbricated over the lateral three-quarters of the band, leaving only the band buckle freely exposed as shown in Figure 6*A*. The presence of any band slippage or gastric herniation and the status of the herniated gastric tissue should be assessed and noted (Fig. 6*B*), and careful inspection performed after the band has been removed to identify any ischemic areas or iatrogenic injuries. Safe mobilization and dissection are then performed starting on the lesser curve side and dividing any adhesions over the exposed part of the band and buckle, while more lateral dissection should be avoided because of risk of

TABLE 5. Options and Technical Tips for Surgical Enteral Access in Bariatric Patients

	Type of Access Procedure and Technical Tips/Considerations
SG	**1. Feeding jejunostomy** • Standard laparoscopic, open, or percutaneous technique • Placement in proximal jejunum similar to nonbariatric patients 2. Gastrostomy tube • Should typically be avoided because of sleeve anatomy • Some case series of percutaneous g-tube placement after SG
GB	**1. Remnant gastrostomy tube** • Gastric remnant is ideal site for both decompression and feeding • Feeds will be absorbed normally (bypasses the bypass) • May require mobilization of Roux limb and more lateral placement on distal greater curve of stomach to reach abdominal wall 2. Feeding jejunostomy • Avoid placing in Roux limb; place in distal BP limb or proximal common channel
AGB	**1. Standard gastrostomy or jejunostomy tube techniques, usually accompanied by AGB removal**
DS	**1. Feeding jejunostomy** • Standard laparoscopic, open, or percutaneous technique • Placement in proximal jejunum (BP limb) similar to nonbariatric patients 2. Gastrostomy tube • As outlined previously for SG
SADI	**1. Feeding jejunostomy** • Standard laparoscopic, open, or percutaneous technique • Placement in proximal jejunum (afferent limb) similar to nonbariatric patients, or efferent limb distal to the duodenal-ileal anastomosis if proximal feeding contraindicated 2. Gastrostomy tube • As outlined previously for SG

Preferred option for feeding access for each procedure is highlighted in bold font.
GB, gastric bypass.

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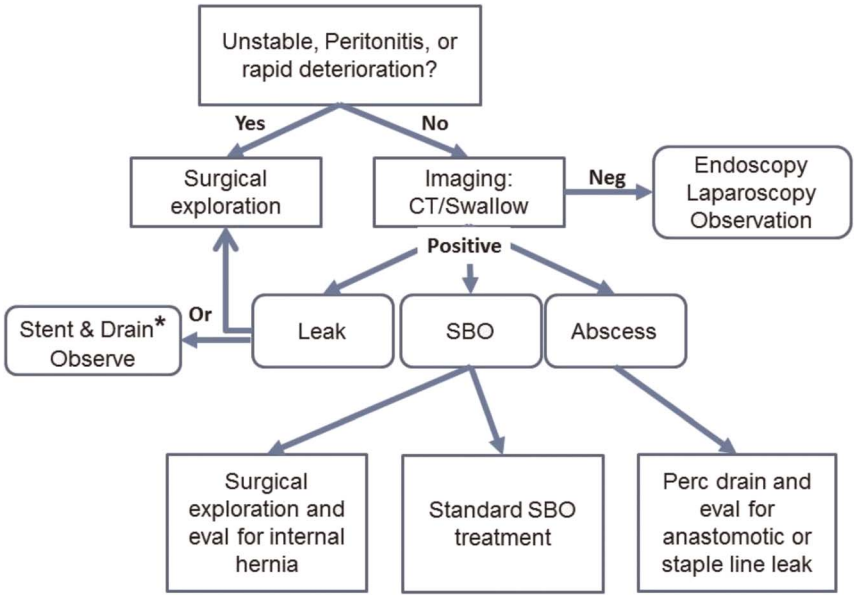

Figure 7. A simplified algorithm for the evaluation and initial management of acute abdominal complaints in the postbariatric surgery patient. Perc, percutaneous.

gastric injury (Fig. 6*A*). Only enough mobilization to expose the band buckle and 1 to 2 cm of the ring of the band is required. Once that is exposed, the band can be manually unbuckled or can simply be divided with laparoscopic scissors (Fig. 6*C*) and then pulled out of the perigastric tunnel. Care should be taken that all of the band tubing is removed with the band and, similarly, that the subcutaneous port is removed via direct cut-down on the abdominal wall. Although some authors also recommend excision of the capsule of scar tissue around the stomach at the site of the AGB, we have found this to not be necessary and likely only increases the risk of an iatrogenic injury particularly in the emergent setting.

DS AND SADI COMPLICATIONS

As previously mentioned and shown in Figure 1*B*, the DS and SADI combine an SG with the addition of a Roux-Y (DS) or loop (SADI) duodenoileostomy that provides significantly more malabsorption than a gastric bypass. Common complications following DS and SADI are similar to those following gastric bypass and sleeve, which have already been discussed. Anastomotic leak rates range from 1% to 5%, with management similar to the aforementioned description for RYGB, with the exception that stent placement is more difficult compared with RYGB because of the SG anatomy. One additional unique, and fortunately very uncommon, complication after DS or SADI is breakdown and leakage from the duodenal stump. This must be considered in addition to the other potential leak sites for any patient presenting with signs of sepsis, peritonitis, or contained air/fluid collections around the duodenal stump. Leakage of duodenal stump contents including bile and pancreatic enzymes tends to produce a significant inflammatory response and systemic signs and, in most cases, should be managed with prompt operative exploration. Management will be dictated by the size of the leak, the quality of the duodenal tissue, and the local inflammatory reaction. Small leaks from the staple line are often amenable to primary suture repair or mobilization of the duodenal stump with stapled resection of the leaking end. Larger leaks and leaks with severe local inflammation may preclude simpler methods of closure, and the focus should be on adequate wide local drainage to control the leak and create an enterocutaneous fistula tract. Tube duodenostomy either directly into the leak site or introduced retrograde via a distal duodenotomy may have a role in highly select cases but rarely provide definitive control of the leakage.

Duodenal switch and SADI also have a higher risk of malabsorptive complications compared with the other common bariatric procedures. These include dehydration, protein-calorie malnutrition, fat malabsorption, and vitamin and mineral deficiencies with particular concern for the fat-soluble vitamins (vitamins A, D, E, and K). These are rarely emergencies that require surgical intervention but can often be present in addition to an urgent or emergent surgical complication. The initial evaluation in these patients should include nutritional laboratory studies for thiamine, folate, an iron panel, vitamin B12, and the fat soluble vitamins as indicated based on the presentation and symptoms. Oral pancreatic enzyme replacement can help mitigate and partially reverse the malabsorptive component of the DS or SADI, but supplemental nutrition therapy with enteral or parenteral feeding should be initiated if there are signs of existing malnutrition. Partial reversal of the malabsorptive component can be accomplished by one of several techniques that results in lengthening of the common channel to provide greater total absorptive surface for ingested nutrients, but this should usually be referred to an experienced bariatric surgeon whenever possible.

SURGICAL ACCESS FOR ENTERAL NUTRITION OR DECOMPRESSION

An additional consideration in the management of any bariatric patient with an urgent or emergent presentation, or

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who undergoes emergency surgery, is whether there is a need or indication for placement of a surgical feeding tube for nutrition and/or decompression. Although the majority of patients can be managed with nasoenteric tubes for feeding or decompression, there is a small population that will require surgical placement of a tube in the gastrointestinal tract. These typically include patients who will need longer-term feeding access or who fail attempts at nasoenteric access, those with anatomy that precludes nasoenteric access, or those with a severe complication who will require prolonged enteral feeding or tube decompression of a critical anatomic area. Table 5 shows the various options for each type of bariatric surgical procedure and key technical points. For patients with a prior RYGB, placement of a large-bore gastrostomy tube in the excluded stomach (gastric remnant) is the preferred approach.[69] This can allow for decompression of the remnant that cannot be accessed via the nasoenteric route and provides a route for administering enteral nutrition that will undergo normal absorption. The location for placement is similar to that shown in Figure 4*A* for transgastric ERCP, although more lateral placement and additional mobilization of the greater curve and Roux limb may be required to reach the abdominal wall.[69] Surgical gastrostomy tubes are generally avoided in patients with gastric sleeve anatomy (SG, DS, and SADI), and a feeding jejunostomy is usually preferred in this setting.

EMERGING BARIATRIC PROCEDURES AND THERAPIES

The majority of this review and practical guide has focused on the more common bariatric surgical procedures being performed currently and over the past decade and most likely to present with some condition requiring management by the ACS team. However, the field of bariatric and metabolic surgery and medicine is rapidly evolving, with many novel procedures, techniques, and therapies that may be unfamiliar to most surgeons. The two most recent Food and Drug Administration–approved procedures that are being increasingly performed are intragastric balloons and endoscopic gastric plication (also called "endoscopic sleeve gastroplasty").[70–73] The primary complications with these that may require urgent surgical evaluation are gastric perforation, gastric bleeding, and obstructive symptoms. Emergent endoscopic evaluation or exploratory surgery may be required to control bleeding or gastrointestinal perforation, and either transfer to a bariatric center or consultation with a bariatric endoscopist or surgeon should be done as early as possible. The other obesity treatment that is rapidly gaining traction is pharmacotherapy, either as standalone treatment or as adjuvant therapy following bariatric surgery. Although previous results with various antiobesity medications have been largely disappointing, much better weight loss and comorbidity control are being seen with newer agents mainly from the glucagon-like peptide-1 agonist family.[74,75] Although these agents are not likely to cause an emergent surgical presentation, they do significantly delay gastric emptying and likely increase aspiration risk perioperatively.[76,77] Increased attention to adequate gastric decompression and aspiration precautions during rapid sequence intubation should be maintained for any patient taking these medications.

CONCLUSION

Patients with a history of a recent or remote bariatric surgical procedure are at risk for a variety of acute care surgical emergencies that are related to their bariatric procedure or that necessitate additional considerations and management decisions compared with a nonbariatric patient. These cases are likely to become increasingly common as the annual volumes of bariatric surgical procedures continues to increase in the United States and worldwide. The acute care surgeon may be required to perform the initial diagnostic workup and interventions, or even the definitive surgical management in select cases, and thus must be familiar with the relevant anatomy, physiology, and optimal management approach. Figure 7 shows a global simplified algorithm for the initial diagnostic evaluation and interventions in the postbariatric patient with acute abdominal complaints, with additional procedure-specific details as provided in the individual sections previously. Close coordination with local or regional bariatric surgical expertise is also strongly advised, with transfer to a bariatric center of excellence whenever feasible and particularly for patients with more complex anatomy or surgical disease. This is also a continuously evolving field as new medical, endoscopic, and surgical bariatric procedures are being introduced at a rapid pace, but adherence to the basic principles as outlined previously should continue to be universally applicable.

AUTHORSHIP

M.J.M., A.P., and A.B. contributed in the conception and design. M.J.M., V.C., A.P., and A.B. contributed in the acquisition of data. K.S., A.B.D., J.D.N., V.C., and S.A.A. contributed in the analysis and interpretation of data. M.J.M., V.C., and M.J.M. contributed in the drafting of the manuscript. K.S., A.B.D., J.D.N., S.A.A., A.B., A.P., and M.J.M. contributed in the critical revision of the manuscript. M.J.M. and K.S. contributed in the administrative, technical, or material support. M.J.M. and K.S. contributed in the supervision.
All authors have seen and approved the final manuscript as submitted. The first author (M.J.M.) had full access to all data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

DISCLOSURE

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