8 Role of Endoscopy, Stenting, and Other Nonoperative Interventions in the Management of Bariatric Complications: A US Perspective

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Obesity is a national and global epidemic, with over 2/3 of US adults classified as overweight and obese and 1/3 classified as morbidly obese [1]. Surgical treatment of obesity is the most sustainable method to induce substantial durable weight loss in this population [2]. Bariatric surgery is now an established surgical discipline in the USA, and the opportunity for partnering health care providers including non-bariatric general surgeons, emergency physicians, nurse practitioners, and primary care physicians to care for patients who have had bariatric surgery is increasingly common. Sleeve gastrectomy and Roux-en-Y gastric bypass are the more common bariatric surgical procedures performed in the USA with adjustable gastric banding and duodenal switch comprising the remaining small percentage of operations (Fig. 8.1a–d). These procedures are highly effective for weight loss and are enjoying an increasingly safe track record, but still carry a morbidity rate of 3–20 % and a mortality rate of 0.1–0.5 % [3, 4]. Historically, complications of bariatric surgery required operative therapy. However, the role of endoscopy is emerging as a more common approach to managing many of these complications nonoperatively.

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8.1 Forensic Endoscopy

For many patients who have undergone bariatric surgery in the distant past, determining the baseline-altered anatomy before venturing into the realm of diagnosing the acute concern is paramount. Due to economic, familial, and professional circumstances, many well-intended patients are unable to maintain close connection with their bariatric providers. Some patients develop surgically related complications long after their index procedure has been completed. Most hospitals purge their systems of operative reports and other pertinent medical information 10 years after care has concluded. This places increased importance on the reliability of the

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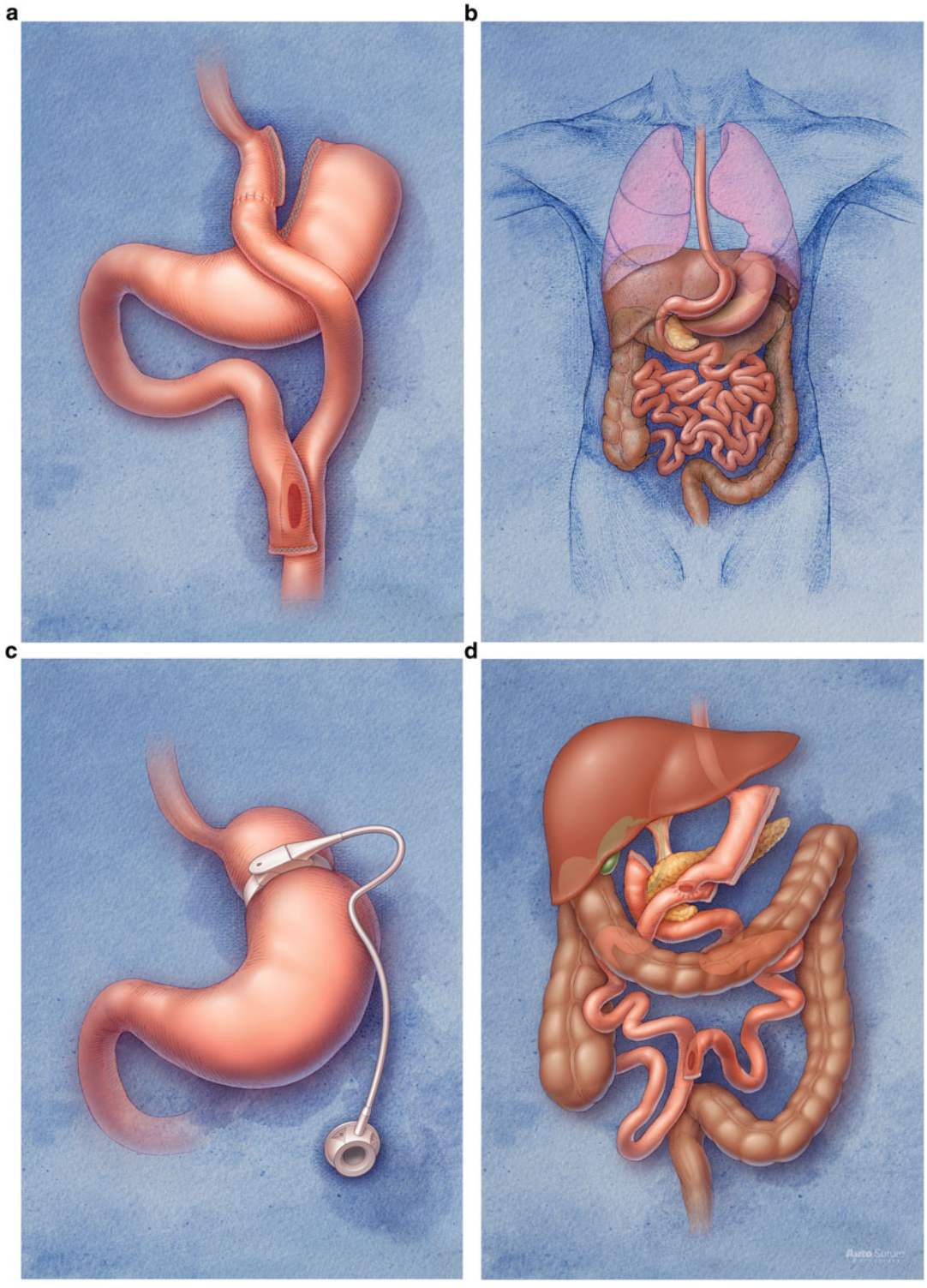

Fig. 8.1 Bariatric surgical anatomy: (**a**) Roux-en-Y gastric bypass, (**b**) sleeve gastrectomy, (**c**) adjustable gastric band, (**d**) duodenal switch (All rights reserved. Used with the permission of Medtronic)

patient's personal account of his or her surgical history. Although well intended, many are not able to muster more detail than the fact that he or she had gastric surgery. In these circumstances a diagnostic or forensic endoscopy by the physician and radiographic studies, most commonly upper gastrointestinal swallow studies and computerized tomography, are used to determine the likely index operation, what has recently changed resulting in the specific presenting complaint, and what can be done to reinstitute functional gastrointestinal anatomy in order to resolve the patient's concern.

For individuals who have a known recent surgical history and for those for which forensic endoscopy and radiography have provided a blueprint of the concern at hand an endoscopic approach to definitive management is often a reasonable nonoperative option.

8.1.1 Leaks

Anastomotic (and long staple line) leak is one of the most feared complications of any gastrointestinal surgery. Gastric bypass and duodenal switch procedures incorporate two anastomoses at risk for postoperative leak (Fig. 8.1a, d). The gastrojejunostomy and duodenojejunostomy in particular can be under tension and have subsequent ischemia, leading to leak. Leak rates of these proximal anastomoses are typically higher than the distal enteroenterostomies and are less likely to be under tension. From an endoscopic perspective, this is fortunate since the distal anastomoses are more difficult to access. Sleeve gastrectomy entails removal of the greater curvature of the stomach, leaving behind a tubularized stomach with intact pylorus. This leaves a high-pressure system with a long staple line when compared to the other stapled procedures. Leaks along the sleeve staple line can become chronic and very slow to heal. Two areas particularly prone to being troublesome include the very proximal stomach at the angle of His which is at risk for leakage, and the distal stomach alongside the incisura which is at risk for functional obstruction due to folding resulting in upstream pressurization. Leaks typically manifest with tachycardia, fatigue, malaise, shortness of breath, and hypotension. An upper GI fluoroscopy study can help elucidate the site of the leak. However, a negative upper GI study does not completely rule out a leak, and if there is clinical concern for a leak it is appropriate to investigate further endoscopically or operatively.

Endoscopically placed stents (either tubular or pigtail) can be helpful in the immediate postoperative period. When used in an acute setting, stents can be highly effective as a solo treatment of leak [5]. Even in cases where another therapy is required, use of a tubular exclusion stent can allow patients to continue to take oral nutrition. In some settings, percutaneous drainage of intra-abdominal abscess or laparoscopic drainage of extralumenal fluid may speed the rate of healing a leak [6, 7]. The use of pigtail stents facilitates internal drainage of a leak-related abscess in the same fashion as the management scheme used for pancreatic pseudocysts with formation of a cyst-gastrostomy. Use of pigtail stents is rarely associated with migration or erosion; however distal enteral access is usually needed for nutritional support to avoid ongoing outflow through the leak from proximal enteral intake.

Stents are not risk free. Tubular stents used to treat leaks and nonmalignant strictures in the USA are for the most part being used in an off-label (although often effective) manner. They are not perfectly designed to complete the task for which they are often being used. Tubular stent migration is a common nuisance, seen in nearly 50% of stent placements [7]. Inserting a second "nested" stent into the first creating a longer effective stent with distal abutment in the antrum can decrease the migration rate, and increase coverage of a sleeve staple line to ensure coverage of an entire staple line if necessary. Stents can also be sutured into place to decrease migration, either using an endoscopic suturing device or with laparoscopic assistance [8].

Other morbidities related to tubular stents include erosion and fistula formation due to the radial pressure applied by the stent. Radial pressure is crucial to maintain stent position and

exclude the leak. These rates increase as stent duration increases, and it is advised to leave stents in no longer than 28 days before removal or exchange [9]. Use of tubular stents for short durations can be very useful, but the total duration of stent use should be limited to 2–3 months due to the potential concerns of erosion, stenosis, and fistula formation noted earlier [10].

When a leak persists over the course of weeks and becomes chronic, tubular stents are less likely to facilitate a nonoperative durable solution. In a study of stents placed for chronic leak, only 19% had a successful closure with stent alone [7]. Thus, in this population, stents are likely most effective as a bridge therapy to definitive surgical closure. In this setting, they can help with control of sepsis and allow patients to resume enteral nutrition. Use of downstream jejunal feeding access, which can be placed percutaneously with endoscopic guidance, can also avoid parenteral nutrition in many circumstances.

Endoscopic clips are also useful to manage small leaks. Typically these work best if the leak is discovered in the early postoperative period. Clips are available in several types. Through-the-scope clips are available from multiple manufacturers. They are small, and can close mucosal defects; however they do not ordinarily provide full-thickness approximation of tissue. Over-the-scope clips, although more cumbersome and bulky, can provide full-thickness approximation of gastric tissue, and thus are the most helpful type of clip for treatment of leak.

Leak algorithm: Assess stability of patient and acute/chronic nature of leak. If acute and small, endoscopic closure with through-the-scope or over-the-scope clip can be performed. If acute and large, tubular stent with external drainage and distal enteral access should be performed. If chronic and small, pigtail stent ± distal enteral access can be performed. An over-the-scope clip can be attempted if tissue is pliable. If chronic and large either type of stent can be used for local control (alternate is using endoscopic/surgically placed endolumenal/external drain to create a controlled fistula). Distal enteral access is advised and plans should be made for surgical revision if the leak fails to close (Videos 8.1, 8.2, and 8.3).

8.1.2 Hemorrhage

Hemorrhage from staple lines and anastomotic sites is often intralumenal and well suited to endoscopic hemostasis. Acute bleeding manifests in the first 72 h after surgery with tachycardia, palor, fatigue, malaise, and/or a drop in hemoglobin. Many of the staple lines are easily accessible endoscopically. Epinephrine injection, argon plasma coagulation, heater probe cautery, endoscopic suturing, and endoscopic clipping are all potentially useful adjuncts to treat staple line bleeding. Through-the-scope clip application is particularly useful for fresh anastomoses, as it avoids thermal damage that may further compromise staple line healing.

Through-the-scope clips are effective for both gastrojejunostomy and sleeve gastrectomy bleeding. Over-the-scope clips are capable of compressing larger areas of tissue and thus larger vessels. Bleeding from the enteroenterostomy of a Roux-en-Y gastric bypass or duodenal switch is far enough downstream that it is unlikely to be managed endoscopically. Luckily, bleeding at that site is fairly rare and can often be managed expectantly or in severe cases with laparoscopic oversewing of the staple line.

Intraperitoneal bleeding can occur from staple lines, as well as from the short gastric vessels and mesentery and solid organs which can be inadvertently damaged during surgery (particularly the spleen and liver). These areas are less amenable to endoscopic hemostasis and require formal surgical treatment.

Bleeding algorithm: Assess stability of patient and acute/chronic nature of hemorrhage. If patient is vomiting blood the site is endolumenal and proximal for which endoscopy is ideal. Therapeutic endoscope with large suction channel is helpful for removing clot enabling precise placement of endoscopic clip or suture to achieve hemostasis. If patient is passing blood per rectum with no proximal symptoms the site is likely distal requiring laparoscopic assessment and potentially oversewing the staple line. If patient has no gastrointestinal symptoms but has decreasing hemoglobin/hematocrit and symptoms of shock, the site is likely extralumenal and requires surgical treatment.

Table 8.1 Risk factors for marginal ulceration after gastric bypass

Ischemia (technical, smoking, diabetes)
Acid production in pouch
Foreign body
Gastro-gastric fistula
Helicobacter pylori
Nonsteroidal anti-inflammatory drugs

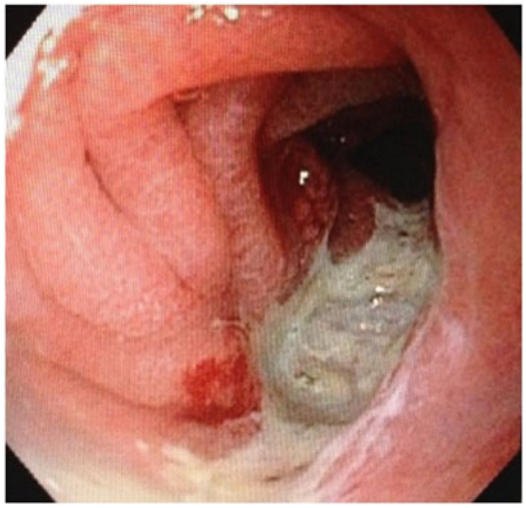

Fig. 8.2 Marginal ulcer

8.1.3 Marginal Ulceration

The anatomy of a Roux-en-Y gastric bypass can lead to a marginal ulceration. Marginal ulceration can occur in up to 16% of patients [11]. This ulcer, often seen in the jejunum just distal to the gastrojejunal anastomosis, can be multifactorial, Table 8.1 (Fig. 8.2). Ischemia is one common cause. Operative ischemia and microvascular ischemia are both culprits. Smoking in particular has been shown to cause microvascular ischemia that can lead to marginal ulceration, and patients who have had a gastric bypass are discouraged from smoking. The cardia cells in the gastric pouch are capable of acid production, and if an ulcer develops a trial of antisecretory therapy is appropriate to eliminate acid production that might cause the ulceration to develop or propagate. Foreign material can be a nidus for marginal ulceration, and the use of absorbable suture is helpful in avoiding this complication. If there is permanent suture present at the anastomosis, it can be removed endoscopically as long as there has been adequate time for anastomotic healing (typically 6 weeks, but can vary depending on each individual situation). *Helicobacter pylori* infection is another cause for ulceration, and all patients should be screened and treated for *Helicobacter pylori* preoperatively to avoid this. Nonsteroidal anti-inflammatory drugs can also exacerbate marginal ulcers, and patients should avoid their use if they have other risk factors for marginal ulceration.

Marginal ulcers can be difficult to manage. Medical therapy is an appropriate first line, but is not always effective. Smoking cessation, proton pump inhibitor therapy, and a coating agent such as sucralfate should be considered early in the treatment of marginal ulcers. Recurrence is also fairly common, particularly when risk factors are not adequately addressed [12]. Endoscopic therapies, such as oversewing or clipping, are useful strategies for treating marginal ulcers [13].

In rare cases, ulcers can perforate. This may require surgical therapy, but if detected early with minimal enteric spillage, this situation may also be palliated effectively with either a tubular stent placement or over-the-scope clip or suturing device for source control and broad-spectrum antibiotics. If not endoscopically amenable, then addressing the issue in the operating room may be required to obtain adequate control and closure. Ulcers can also present with GI bleeding, and can be managed endoscopically via the bleeding algorithm.

In some cases, endoscopic therapy can be used as a bridge to definitive therapy. Some cases of marginal ulceration clearly require surgical revision of the proximal anastomosis. This is more difficult in a setting of acute bleeding or perforation. Temporarily managing these issues endoscopically to allow resolution of acute inflammation can often turn a difficult laparoscopic operation into a relatively manageable one, or turn a scenario requiring open surgery into one where a laparoscopic approach can be used.

8.1.4 Strictures

Anastomotic stricture is a rare but troubling complication of bariatric surgery. Strictures after gastrojejunostomy can cause dysphagia, vomiting, and unwanted, accelerated weight loss. This is typically a chronic problem. Ischemia, from surgical technique or microvascular causes (smoking, diabetes), and chronic ulceration are common culprits. Once the root cause has been resolved these strictures can often be treated endoscopically with dilation. Dilation over a wire and using a through-the-scope balloon are effective. Steroid injection of the anastomosis can also help soften the stricture and increase success of dilation. Occasionally, serial dilation every couple of weeks for a period of time is necessary. When endoscopic management of strictures fails, operative revision of the anastomosis or stricturoplasty is appropriate.

The enteroenterostomy, when strictured, is more difficult to manage endoscopically due to its location. A stricture in this location often requires surgical revision.

8.1.5 Erosion

First with the vertical banded gastroplasty, and more recently with the adjustable gastric band, erosion of foreign material into the proximal stomach can create problems after bariatric surgery (Fig. 8.3). Common presenting symptoms include dysphagia, epigastric pain, and cellulitis of the port due to enteral bacteria traveling along the band's tubing. Endoscopy and upper GI contrast study can demonstrate erosion, and occasionally the eroded object is visible in the lumen during endoscopy. When that is the case, it is feasible to attempt removal endoscopically, understanding that laparoscopic assistance might become necessary. These patients ultimately may require conversion to another bariatric operation (often a Roux-en-Y gastric bypass), but removal of the offending foreign body endoscopically can spare the patient one or more operations.

Erosion of the staple line through to the gastric remnant after gastric bypass is another potential

Fig. 8.3 Eroded band

morbidity of bariatric surgery. When carried full thickness and into the remnant stomach, this can create a gastro-gastric fistula. These can create morbidity including dysphagia, additional acid secretion into the pouch and subsequent marginal ulcerations, and postprandial epigastric pain as well as weight regain due to reestablishment of the native flow of enteral contents through the bypassed portion of the GI tract. Endoscopic treatment with suture closure and fibrin injection of these has been attempted with some success [14].

8.1.6 Fistulas

Fistulization between the gastric pouch and gastric remnant can occur after gastric bypass. This was more common due to staple line failure when the pouch was created with a nondividing stapler, which has fallen out of favor. Other causes include incomplete division of fundus during gastric bypass, pouch staple line leak with abscess formation and decompression into the remnant, and marginal ulcer that erodes into the gastric remnant [15]. Fistulas can present with symptoms similar to marginal ulcer, or with weight regain and lack of satiety. Endoscopy

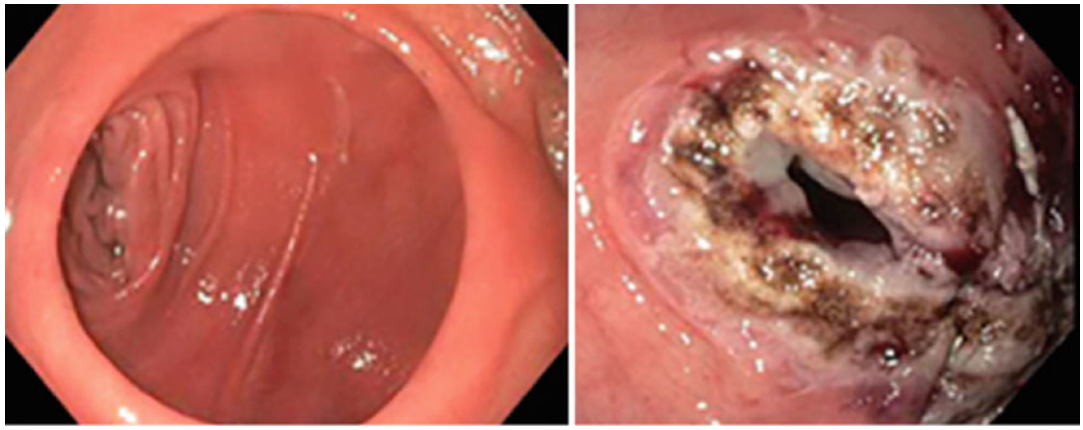

Fig. 8.4 Stoma dilation: pre- and post-endoscopic plication

is the best initial diagnostic test to evaluate for fistula along with an upper GI fluoroscopy study. If a fistula is present, there are multiple options for repair. Surgical repair is most definitive, but carries higher morbidity rates. For small fistulas of a less than 5 mm in size, endoscopic closure with over-the-scope clip or suturing is a useful technique to achieve closure [14]. While this does have some rate of recurrence, in some patients it can improve symptoms sufficiently as an outpatient procedure to avoid a more complex surgical approach with a prolonged convalescence (Video 8.4).

8.1.7 Weight Regain/Stoma Dilation

Bariatric surgery is the most effective long-term form of weight loss, but there is still a subset of patients who regain weight after surgery. One of the etiologies of this is pouch and stoma accommodation/dilation. Surgical revision is one option, but can be difficult, can recur, and carries a significant amount of revision-based morbidity [16]. Endoscopic pouch plication and stoma reduction are alternative options that are less morbid in a subset of patients (Fig. 8.4) [14, 17]. Durability of the associated new weight loss has not been adequately substantiated and compliance with lifestyle modification and the support programs associated with nationally accredited bariatric centers likely play a large role in long-term success.

8.2 Conclusion

Bariatric surgical patients have become a mainstay in the general population. Historically their care was delegated only to the surgeons dedicated to the practice of bariatric surgery. As patients travel and find themselves in areas without formal bariatric coverage it has become common for non-bariatric general surgeons, emergency physicians, nurse practitioners, and primary care physicians to care for these patients and their sometimes unique postsurgical issues. Historically, complications of bariatric surgery required operative therapy. However, the role of endoscopy is emerging as a more common approach to managing many of these complications nonoperatively. It is strongly encouraged that physicians who will be caring for these patients develop an endoscopic acumen in order to facilitate the diagnosis and initial if not definitive management regimens for endoscopically approachable complications following bariatric surgery.

8.3 Self-Assessment Questions

Correct answer in bold.

1. The most appropriate device for obtaining full-thickness tissue in order to close an small acutely detected leak is:
   (a) Argon plasma coagulation

(b) Through-the-scope clip
(c) **Over-the-scope clip**
(d) Pigtail stent

2. Patients suffering from anastomotic leak often present first with:
   (a) Early satiety
   (b) Pruritus
   (c) Low abdominal pain
   (d) **Tachycardia**
3. Gastro-gastric fistula commonly presents with :
   (a) Hematemesis
   (b) **Epigastric pain/heartburn**
   (c) Accelerated weight loss
   (d) Diarrhea

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