Clinical and Experimental Gastroenterology

Dovepress
Taylor & Francis Group

Open Access Full Text Article

REVIEW

Managing Leaks and Fistulas After Laparoscopic Sleeve Gastrectomy: Challenges and Solutions

Jordan Gipe, Alexandra Z Agathis, SQ Nguyen

Department of Surgery, Mount Sinai Hospital, New York, NY, USA

Correspondence: Jordan Gipe, Department of Surgery Box 1259 The Mount Sinai Hospital, 1 Gustave L. Levy Place, New York, NY, 10029, Tel +1818-935-3352, Email Jordan.Gipe@mountsinai.org

Abstract: Postoperative leaks after sleeve gastrectomy are a troublesome complication that occur in 0.7–5.3% of cases depending on the referenced source. These complications cause significant morbidity for patients requiring prolonged hospitalizations, nutritional support, intravenous antibiotics, and at times additional operations and procedures that risk further downstream complications. The patient presentation varies from relatively benign with minimal or no symptomatology, to the acutely ill with life-threatening sepsis. The management of gastric leak is dependent on a multitude of factors, including the initial presentation as well the surgeon's experience and preference. Here, we will summarize the current literature and discuss the different options that exist for the management of gastric leaks after sleeve gastrectomy including laparoscopic lavage, endoscopic stenting, endoscopic pigtail catheters, endoscopic vacuum therapy, and salvage surgical operations such as fistula jejunostomy and total gastrectomy. The aim is to provide a source for surgeons to reference when they encounter this disease pathology and to shed light on a daunting challenge for the modern bariatric surgeon.

Keywords: sleeve gastrectomy, leak, fistula, management

Introduction & Background

Laparoscopic sleeve gastrectomy (LSG) is the most commonly performed bariatric surgery worldwide, accounting for greater than 69.5% of all bariatric procedures in the US in 2021.[1] Multiple meta-analyses have been performed to evaluate the effectiveness of weight loss and safety.[2–4] In comparison to more complex alternatives like the laparoscopic roux-en-y gastric bypass (RYGB) and duodenal switch (DS), laparoscopic sleeve gastrectomy has demonstrated consistently similar overall weight loss with a lower rate of major complications.[3] Although some meta-analyses have suggested better sustained long-term weight loss with RYGB,[5] there has been notably similar resolution in comorbidities. Furthermore, the differences in long-term outcomes, although statistically significant, may not be clinically relevant given that if initial treatment fails after sleeve gastrectomy, there is still an option for revision surgery and the ability to convert a sleeve to either a duodenal switch or RYGB in the future. For these reasons, the laparoscopic sleeve gastrectomy has gained enormous popularity among patients and bariatric surgeons alike.

While the sleeve gastrectomy is an overall very safe procedure, there is still a risk of postoperative complications. One of the most substantial of these complications is a leak, which often occurs because of increased pressure in the gastric remnant. They are also often related to a failure of the staple line, either as a technical or mechanical error in staple firing or later as the result of local tissue ischemia or the development of hematomas. Other complications include staple line bleeding, portomesenteric vein thrombosis (PMVT), reflux, and strictures. These other complications can also cause significant morbidity in the patient but either occur at very low frequency or have less severe side effects and require fewer interventions to treat than that of a gastric leak. For example, clinically significant staple line bleeding and strictures requiring intervention occur at a rate of <1% in patients undergoing LSG.[3] PMVT can be a potentially fatal complication of LSG but is an extraordinarily rare complication and is commonly quoted as occurring at rates less than 1%.[6]

Received: 8 October 2024
Accepted: 31 December 2024
Published: 7 January 2025

Incidence & Pathophysiology

Leaks occur in 0.7–5.3% of patients undergoing laparoscopic sleeve gastrectomy depending on the referenced study.[2,7] Leaks occur more commonly in LSG than in RYGB despite having no anastomosis; most commonly leak rates for RYGB are cited at around 1%.[8] The vast majority (>85%) of LSG leaks occur near the gastroesophageal junction.[2] This is thought to be due to transmitted intragastric pressure on the superior portion of the sleeve remnant. Additionally, the angle of the last staple load to prevent incorporating the esophagus is also wider which leads to a greater diameter of the proximal sleeve. According to LaPlace's Law, this leads to increased wall tension at the proximal sleeve and is a contributing factor for the breakdown of the staple line at this junction and the formation of a leak. Furthermore, the gastric wall in the upper portion of the stomach is thinner which increases the risk of leak formation when experiencing greater pressure. The GEJ is also an area of reduced blood supply relative to the rest of the stomach, and thus the staple line in this area is at higher risk of ischemia and tissue compromise. Intragastric pressure is elevated relative to the non-sleeve specimen, and much more than in RYGB due to the maintained competence of both the lower esophageal sphincter and the pylorus. Some studies have demonstrated a pressure difference of up to 10mmHg (43±8 vs 34±6) in the sleeve stomach versus in the non-sleeve stomach.[9] This difference in pressure has been cited as a contributing factor for the higher incidence of leak rates in LSG vs other bariatric operations such as DS and RYGB. In addition to leak formation, it is also thought that elevated gastric pressures contribute to the persistence of leaks, making it such a challenging entity to treat. Beyond the acute period in the formation of a leak, the tract begins to fibrose which leads to the development of a fistula between the stomach and the abscess cavity. As will be discussed at length, the treatment of these subacute and chronic leaks focuses on addressing the fistulous connection between the stomach and abscess cavity as well as in reducing back pressure in the sleeve stomach.

Risk Factors

There are both patient specific as well as technical risk factors that contribute to the risk of developing a leak after LSG. The most significant patient risk factor is a history of prior bariatric surgery, which has been quoted as increasing the risk of a leak by 3-fold.[2] These prior surgical interventions included endoscopic sleeves, vertical ring gastroplasty, gastric banding, and primary sleeve. Cornejo et al reviewed patients in the MBSAQIP dataset and compared patients undergoing a re-sleeve gastrectomy to those converted to a RYGB and those undergoing a primary sleeve gastrectomy. They demonstrated significantly higher rates of leaks in the re-sleeve gastrectomy comparatively (1.3% vs 0.5% and 0.1%, respectively).[10] Other research has indicated that patients with extremely high body mass index (BMI > 50 kg/m^2) are at increased risk for leak; however, although statistically significant, the actual difference is quite minimal (2.9% vs 2.4%).[3]

Various technical factors have been studied that may contribute to rates of leak detection after LSG. Many hypotheses as to what technical factors may influence the formation of leaks have been proposed, including the use of staple line reinforcements (oversewing or buttressing the staple line), using different staple heights or stapler manufacturers, omentopexy, bougie size, intraoperative and postoperative leak testing and the various methods by which to test for a leak. Despite an abundance of ongoing research in this area, an exact consensus as to which technical factors limit leak formation remains elusive, and most bariatric surgeons employ a variety of techniques to aid in reducing their individual leak rates.

Bougie Size

One technical risk factor that has been widely agreed upon is the use of a smaller bougie with a size <40 French (2.9% vs 0.6% in some studies).[2,3] The reason for this increased risk is thought to be due to resulting increased pressure in the sleeve remnant, leading to eventual failure of the staple line. Yuval et al demonstrated a relative risk reduction of 66% with utilizing larger bougie sizes (>40 fr) and as such most surgeons now employ this technique.[11] The fear that a larger bougie size may lead to reduced total body weight loss (TBWL) has not been borne out in the research, and no associated decrease in TBWL has been identified in the literature with the use of a larger bougie.[3,11] Severe angulation or twisting of the sleeve causing a functional obstruction has been another proposed risk for leak formation. This has changed practice patterns and often the first firing of the stapler at the angularis incisura is considered the most critical because narrowing at this point can lead to a functional obstruction or increased pressure in the sleeve and potentially increase the risk of a leak forming.[12] It is important to note, however, that different practice patterns exist and some surgeons utilize the distance from the pylorus (2–3cm or 5cm) as their landmark for the first staple firing rather than the anatomic landmark of the angularis incisura. As will be discussed at length later, addressing any distal obstruction either from twisting of the sleeve specimen or narrowing at the angularis is of critical importance when managing a leak.

Staple Line Reinforcement

Staple line reinforcement options are abundant, and many surgeons utilize a variety of these techniques to reduce the risk of bleeding and potentially leaks. Although some have used omentopexy to bolster the staple line with the hopes of reducing leak rates, no appreciable difference has been teased out in the literature.[13,14] A prospective randomized controlled trial was performed in 2010 analyzing the use of staple line reinforcement agents and their effect on outcomes after LSG.[15] Dapri et al demonstrated that there was less bleeding when utilizing staple line reinforcement material when compared to no reinforcement or staple line oversewing, however no statistically significant difference was appreciated in the leak rate among these groups.[15] The types of staple reinforcement used included absorbable suture reinforcement and the use of bioabsorbable polymer materials such as bovine pericardium strips, porcine submucosal intestinal strips or glycolide trimethylene carbonate copolymer stapler reinforced loads. In a meta-analysis article, Gagner et al demonstrated reduction in leak rates with the use of absorbable polymer membrane (APM) staple line reinforcement agents when compared with no reinforcement, oversewing the staple line, and nonabsorbable pericardial strips.[4] The overall leak rate in this paper was 2.1% looking at 8920 patients and with APM reinforcement, that rate was significantly lower at 1.09%.

Staple Height

Staple height is another common factor believed to contribute to leak and bleeding rates after LSG. The teaching is that too short a staple height can lead to malperfusion and ischemia of the staple line, while staple heights that are too tall have limited compression and lead to either poor tissue apposition and increased leak rates or elevated risk of bleeding, which can cause hematomas and contribute to staple line breakdown and eventual leak formation. One study published in 2021 demonstrated lower rates of intraoperative bleeding while using shorter staple heights.[16] Utilizing two separate stapling protocols, the authors determined that areas of higher pressure on the stomach resulted in lower rates of intraoperative bleeding and decreased the need for preventative hemostatic techniques and treatments for postoperative bleeds. However, there is also research to suggest that staple height may not contribute to leak rates. In one single center retrospective analysis of LSG and complications, there was no appreciable difference in leak rates or bleeding rates among patients even when utilizing different staple heights.[17] Although this is the case, in general it is a widely accepted practice to utilize taller stapler heights at the angularis incisure and in the first firings of the gastric body, which tend to have thicker tissue, and to use smaller stapler heights in the later staple firings towards the angle of His where tissue is thinner. This is performed to optimize tissue compression and thus prevent both bleeding and postoperative leaks.

Diagnosis and Management

Clinical Diagnosis

Clinical signs that should alert the surgeon to a possible leak include sustained tachycardia of greater than 120 bpm, fevers, abdominal pain, and at times other nonspecific findings such as cough and pneumonia.[9] In patients with high clinical suspicion for a leak, the diagnostic test of choice is a CT of the abdomen pelvis with IV and oral contrast (if tolerated). Many surgeons often pursue upper gastrointestinal series (UGI), although it has been shown to have high rates of false negative results because many leaks are contained and thus unidentifiable by contrast extravasation.[9]

Routine Leak Testing

The use of intraoperative and postoperative testing to assess for a leak has been controversial. The most common methods for intraoperative leak testing include air leak test, EGD, and methylene blue injection. In 2016, Sethi et al were unable to appreciate any significant difference in leak rate between patients having intraoperative air leak or methylene blue test versus those with no intraoperative testing.[18] Additionally, Bigham et al determined that intraoperative leak testing had very unreliable sensitivity (8.7%) – of the 23 patients who developed a leak, 91% had a negative intraoperative leak test.[19] The lack of sensitivity in pinpointing leaks in a routine intraoperative context is not surprising given that most leaks manifest several days to weeks postoperatively; thus, in the absence of gross technical error, this data suggests a lack of benefit in intraoperative endoscopy in SG. Some groups have made it a common practice to perform postoperative testing for leak, which commonly include an upper GI series on postoperative day 1, however there is no evidence to support this practice. Several single center studies have demonstrated little to no efficacy in routine postoperative leak testing. For example, one study performed on patients undergoing LSG at the Veterans Administration (VA) demonstrated a positive predictive value of 0 with a false positive rate of 1.5%.[20] In the absence of clinical suspicion for a leak, the consensus is that routine postoperative leak testing should be forgone. Some bariatric centers utilize postoperative C-reactive protein (CRP) values as a predictor of leak. In one meta-analysis pooling data from 7 studies that included 1401 patients undergoing either LSG or RYGB, the authors determined that CRP values on postoperative day 1 or 2 may be beneficial in ruling out the presence of a leak or other systemic infectious process.[21]

Timing

A leak after sleeve gastrectomy is often classified by the timing at which it occurs. In general, this is broken down into acute (within 7 days), early (within 1 to 6 weeks), late (after 6 weeks), and chronic (after 12 weeks).[3] Although many factors contribute to the best management of a leak, the timing of a leak can be a useful guide to decision-making regarding operative versus nonoperative management. As a general principle, it is often ideal to return to the operating room if the leak has been detected in the acute postoperative period within 1 week.[9] With earlier leaks, the contamination is often less and thus tissues are healthy enough to undergo further surgical intervention. During this acute period, surgical management options include either stapled exclusion of the leak ("re-sleeve") or a sutured closure of the leak with or without endoscopic stenting.[4,9] It is worth noting, however, that other management options are often employed even in the acute period depending on the viability of the gastric tissue and bariatric center experience including endoluminal vacuum sponge placement and laparoscopic lavage. However, patients most frequently present in a more delayed fashion, typically in the 4–6-week postoperative period.[22] In contrast to acute presentations, once the leak has been present for longer, the friability of tissues from chronic contamination and inflammation makes a durable repair much more challenging. With the persistent inflammation and lack of healing, a fistula often develops between the stomach and the abscess cavity. Thus, treating the subacute presentation is complicated and requires a multidisciplinary approach and often non-operative approaches.

Considerations: Drainage, Diversion, and Nutrition

The most important factors to consider in the management of a leak or fistula with an abscess cavity are obtaining source control with adequate drainage, diversion and decompression of the stomach, closure of the leak area if possible, and obtaining sustainable nutritional access.

After initial supportive care including broad-spectrum antibiotics and nil per os (NPO) status to reduce contamination, the first step in management is to minimize the contamination and obtain adequate source control. This can be performed percutaneously with the placement of CT- or ultrasound-guided drains, endoscopically with the placement of intragastric pigtail catheters, or surgically with an abdominal washout. As discussed earlier, leaks are particularly challenging to manage and heal after sleeve gastrectomy due to the high intraluminal pressure within the remnant stomach with its intact pylorus. Thus, diversion of enteral feeds is a crucial component of the treatment for these patients, and patients often require prolonged durations of NPO status with alternative enteral access. This challenge also necessitates an evaluation of the presence of a downstream partial obstruction, as in the case of a narrowed angularis incisure, which must be addressed at time of treatment to ensure adequate closure of the fistulous tract. There is no good evidence to suggest that one method of drainage and source control is preferred to others. The decision as to which modality is utilized requires clinical judgment and an evaluation of the resources available at one's institution and each method has its advantages and pitfalls. In general, the management of a leak will require a multidisciplinary approach with collaboration between gastroenterology, interventional radiology, and bariatric surgery.

Endoscopic Management: Stenting

Endoscopy is the first-line therapy for most leaks after sleeve gastrectomy. The earliest endoscopic therapy performed for leaks was stenting, which was developed to exclude the fistulous tract and allow it to heal. This initial generation of stents changed the management landscape with their ability to allow patients to eat immediately after placement, with such an initially high success (>80%) rate in treating fistulas.[23]

Despite their early success, these first stents were not specific to the size or contour of sleeve stomachs, and thus did not fit well within the stomach. These stents were shorter than more modern stents and were only partially covered. Due to size mismatching within the sleeve, the stent would often not perfectly exclude a potential fistulous tract, which is most commonly at the GE junction where the gastric sleeve often splays slightly to avoid stapling onto the esophagus. Sizing issues also led to stent migration. In one of the initial series assessing outcomes of stents used to treat complications of sleeve gastrectomy, the authors demonstrated that stent migration occurred frequently (58%) and was at times clinically significant – in a series of 11 patients in whom stent migration occurred, 3 required surgical removal after migrating into the distal small bowel.[23]

Due to this issue, longer stents were developed with the hopes of having better coverage of the fistulous tract and less frequent stent migration. In one of the larger series investigating these newer stents, Garofalo et al found that longer covered stents (240mm) were less prone to stent migration, easier to remove, and boast high rates of success with 10 of 11 patients having closure of the fistula tract within 10 weeks.[24] The advantage of the fully covered stents is that unlike the uncovered stents, they contain a membrane that prevents substantial tissue ingrowth and thus are easier to remove. Longer stents lay across the angularis incisure, effectively reducing a potential obstruction at this point and allowing for decreased back pressure, which, in turn, aids healing. While effective, these stents are difficult to tolerate for patients due to their proximal end sitting at the GE junction. Nearly all patients experience some amount of pain, nausea, and vomiting, resulting in an inability to completely meet their basal nutritional demands and thus require parenteral supplementation during this time. An additional multi-center review of long covered stents for the treatment of leaks after sleeve gastrectomy by de Moura et al demonstrated that the most favorable distal position of a stent is the pre-pyloric location, which is associated with lower rates of stent migration when compared with those terminating past the pylorus.[25] They again revealed that these larger stents are difficult to tolerate, and a clinically significant portion of patients required stent removal due to adverse side effects from stent placement.[25] In Garofalo et al's retrospective analysis of 11 patients undergoing endoscopic stent placement, the average time from treatment initiation to closure of the fistula was 9.9 weeks, and most of these patients required a second endoscopic procedure (most frequently the placement of an additional stent) to achieve successful closure.[24] While useful, stents are rarely utilized as a monotherapy for the treatment of leaks or fistulas and are utilized in conjunction with some form of external or internal drainage of the abscess cavity.

Endoscopic Management: Internal Drainage and Catheters

Endoscopic drainage can be performed with pigtail catheter or by endoscopic internal drainage (EID). The pigtails allow for intraluminal drainage of the abscess cavity and promote tissue healing of the leak or fistulous tract. In one of the largest series analyzing the benefits of this modality, Donatelli et al demonstrated treatment success in 78% of the 64 patients studied.[26] The average number of endoscopic internal drainage procedures performed for these patients was 3.14 and the mean length of healing of the fistulous tract was 57.5 days with a wide variance (some requiring over 200 days of treatment with up to 8 endoscopic procedures). These patients often require a prolonged course of parenteral nutrition, and some require nasojejunal feeding tubes or surgical jejunostomy tubes. However, as opposed to stents which are often challenging for patients to tolerate due to persistent nausea and vomiting, most patients undergoing EID can tolerate an oral diet. In a study evaluating the effectiveness of EID with double pigtail stent placement 9 out of the 12 patients studied were allowed liquid diets within the first week of treatment and were advanced to a soft diet in the 2nd week.[27] Endoscopic drainage is attractive because it also allows for a direct visualization of the fistulous tract, affording the

https://doi.org/10.2147/CEG.S461534

endoscopist the ability to employ other techniques to potentially correct the leak such as over-the-scope clips (OTSC) that can close the tract when possible. Endoscopic drainage also provides access to place stents and feeding tubes. However, endoscopic pigtail placement is not without complications; there have been reports of catheter dislodgement and migration leading to severe side effects and morbidity for patients. In one case study, the catheter required surgical removal after migrating into the spleen.[28] Another well-described complication of these catheters is stenosis of the sleeve, likely caused by the inflammatory response and scar formation that pigtail placement induces.[26] Donatelli et al noted that of their 50 patients successfully treated by EID, 6 later required endoscopic dilation for clinically significant stenotic regions after treatment. They were all successfully treated with balloon dilation.

The treatment algorithm for the use of EID is dependent upon the size of the fistulous tract. In a review of endoscopic treatment methods by Manos et al, they describe a treatment algorithm that entirely excludes the use of stents utilizing multimodal therapies and is dependent on certain characteristics of the leak and associated fistulous tract.[29] For tracts <10mm, pigtail placement alone is often successful in managing the leak. However, for tracts >10mm the ideal treatment is dependent on the timing of presentation. For early leak presentation with fistula tracts >10mm, these patients benefit from some form of lavage and drainage of the abscess either done with naso-cavitary drainage or laparoscopic drainage followed by a septotomy of the tract with pigtail placement to allow for wide internal drainage of the cavity.[29] The septotomy is an incision through the fibrotic rim of the fistulous tract to widen the opening to the abscess cavity and allow for more assured drainage. In the case of naso-cavitary drainage, a naso-gastric feeding tube is placed into the abscess cavity, which allows for regular lavage of the abscess cavity for 10–14 days after which a reevaluation endoscopically with septotomy and pigtail placement can be performed. This treatment algorithm necessitates a dilation of the distal sleeve specimen, especially in the case of known downstream stenosis to relieve the back pressure and assist with closure of the fistulous tract. For patients presenting with large fistulous tracts to the abscess cavity >10mm and later presentation (>1 week after surgery) no naso-cavitary drainage was recommended and instead these patients were treated with pigtail drainage, septotomy, and dilation of the distal sleeve specimen. The authors noted that of the 53 patients treated following this algorithm, only 2 required procedures that deviated from the above algorithm and the other 51 patients achieved complete healing after an average of 3.2 months of treatment and 2.8 endoscopic procedures.[29]

Endoscopic Management: Clipping and Wound Vacuum Therapy

Two additional endoscopic methods that have been described for the management of leaks after sleeve gastrectomy are over-The-scope-clips (OTSC) and endoluminal wound vacuum therapy (E-vac). In one of the largest single center reports of OTSC, the authors Morell et al demonstrated adequate success with OTSC especially for acute leaks (79.6% long-term treatment success) and lower rates of success for more chronic fistulous tracts (55% success).[30] This treatment modality exists within a spectrum of endoscopic closure techniques such as endoscopic suturing and endoclip placement, all of which have been utilized in the literature for the management of leaks. Furthermore, these closure techniques are also not a monotherapy and often require adjuvant therapy including foreign body removal, drain placement, ablation, dilation of a distal obstruction, and feeding access.

The E-vac technique is another viable option for patients with a leak. These patients do often require prolonged hospitalizations with strict NPO guidelines and serial operations to replace the endovac sponge. The basic principle behind the therapy is to place a sponge within the extraluminal cavity, which is then kept to suction to assist with cavity collapse and the closure of the fistulous opening. This sponge is then periodically changed, as frequently as every 4 days, under general anesthesia. In an article describing this methodology by Leeds et al, they present 9 patients who underwent successful treatment with E-vac therapy who required a mean of 10.5 endoscopic exchanges and had an average hospital length of stay of 72.5 days.[31] In the literature reviewed, it seems that E-vac is often reserved as a rescue therapy for those who have previously failed a multitude of alternative endoscopic therapies, although it has demonstrated excellent efficacy in the treatment of leaks.

In the literature to-date, there is no consensus as to which method of endoscopic treatment is best for patients. The decision is largely dependent on the center, surgeon, and endoscopist's experiences. Patients being treated endoscopically require diligent and regular long-term follow-up and at times prolonged hospitalizations with multiple procedures and long durations of enteral supplementation. While potentially burdensome on the patient and healthcare system, the various endoscopic techniques offer less-invasive alternatives to surgical reconstruction or resection, which can be highly morbid.

Operative Management

Surgical management of leaks and chronic fistulas with abscesses are often not first-line treatment, with the exception being acute presentations (<1 week) with minimal peritoneal contamination for whom a re-sleeve or oversewing of the leak can be performed.[4,9] This approach is most successful in patients who had an acute technical or mechanical failure of the staple line after sleeve gastrectomy rather than those with chronic back pressure from a stenotic region. For patients in the acute period who do not have favorable tissue or who are too sick to tolerate prolonged operation, the initial approach to these patients often includes a laparoscopic lavage of the peritoneal cavity paired with endoscopic drainage to reduce peritoneal contamination. Surgical approaches are mostly reserved for those who have failed all other endoscopic and non-operative therapies. Operative interventions as a rescue therapy are generally only considered after 3 to 6 months of treatment failure with other less invasive methods.[32]

The three most described surgical procedures for those meeting criteria are: conversion to roux-en-y gastric bypass, fistula-jejunostomy, and total or near total gastrectomy with esophagojejunostomy. There are numerous case studies demonstrating the efficacy of these surgical approaches in patients that have failed other interventions.[32–36] It is important to note that as endoscopic techniques have advanced, the timing to recommend surgical procedures has been extended with the hopes of successfully treating the leak non-operatively and avoiding a highly morbid surgery. One retrospective review of patients with non-healing gastric leaks after sleeve gastrectomy by Degrandi et al demonstrated good outcomes with conversion to RYGB in 17 patients.[32] One challenge with conversion to the RYGB is that given the proximal sleeve is often the source of the leak, creating a pouch with only healthy tissue while excluding the leak area can risk injury to the esophagus or inclusion of unhealthy friable tissue in the newly created gastric pouch, which increases the risk of a recurrent leak. Degrandi et al demonstrated that although RYGB was technically successful, a significant portion of their patients, 5 of 17, developed a leak postoperatively. These leaks were subsequently managed nonoperatively and ultimately resolved, but the risk of further complications after this salvage procedure is not to be taken lightly. While there is no consensus as to which individual surgical approach is the best, there is agreement that total gastrectomy is reserved for the most treatment-refractory patients who have failed initial surgical operations such as attempts at RYGB or fistula-jejunostomy.

Conclusion

In summary, as the popularity of sleeve gastrectomy grows it is important to understand the treatment of downstream complications from this operation, of which a leak and resulting fistula with abscess remain some of the most significant. In general, it is crucial to keep in mind that there is no one-size fits all approach to the management of this complex issue and successful treatment will inevitably require multidisciplinary approaches that involve endoscopic, radiologic, and surgical personnel. The landscape of endoscopic treatment for leaks has changed most dramatically over the last two decades with stents having fallen slightly out of favor due to their poor tolerance and complications. Replacement therapies include internal pigtail drainage, over-the-scope clip placement, and endoluminal vacuum therapy, which all have variable rates of treatment success but also fewer complications and better tolerance. Surgical approaches to the patient with a leak must be considered only in the most extreme cases and often as a rescue therapy after demonstrated failure of a multitude of alternative therapies. These surgical procedures are highly morbid and fraught with their own sequelae of complications and morbidity, as is the case with complete gastrectomy, conversion to roux-en-y gastric bypass, and fistula-jejunostomy. Successful management requires an in-depth analysis of patient characteristics, leak characteristics, timing, the presence of downstream stenosis, and the prior therapies that have been attempted. While this review has not yielded one algorithmic approach that can unify all existing techniques and tools available, there is a general schema of options based on the timeline (Figure 1). Analogous to multidisciplinary tumor board discussions in surgical oncology, treatment planning should be an organized, collaborative effort amongst surgical, endoscopic, and interventional radiology services. Further research is needed to determine the optimal method for managing these patients, especially in novel and existing endoscopic approaches, which are promising yet relatively untested. Some of these approaches include endoscopic gel forming placement, which have not been tested in humans but show promise in animal models.[37] While the clinical course for these patients is long and arduous, with patience and diligent treatment plans, success is often achieved without requiring morbid surgical approaches.

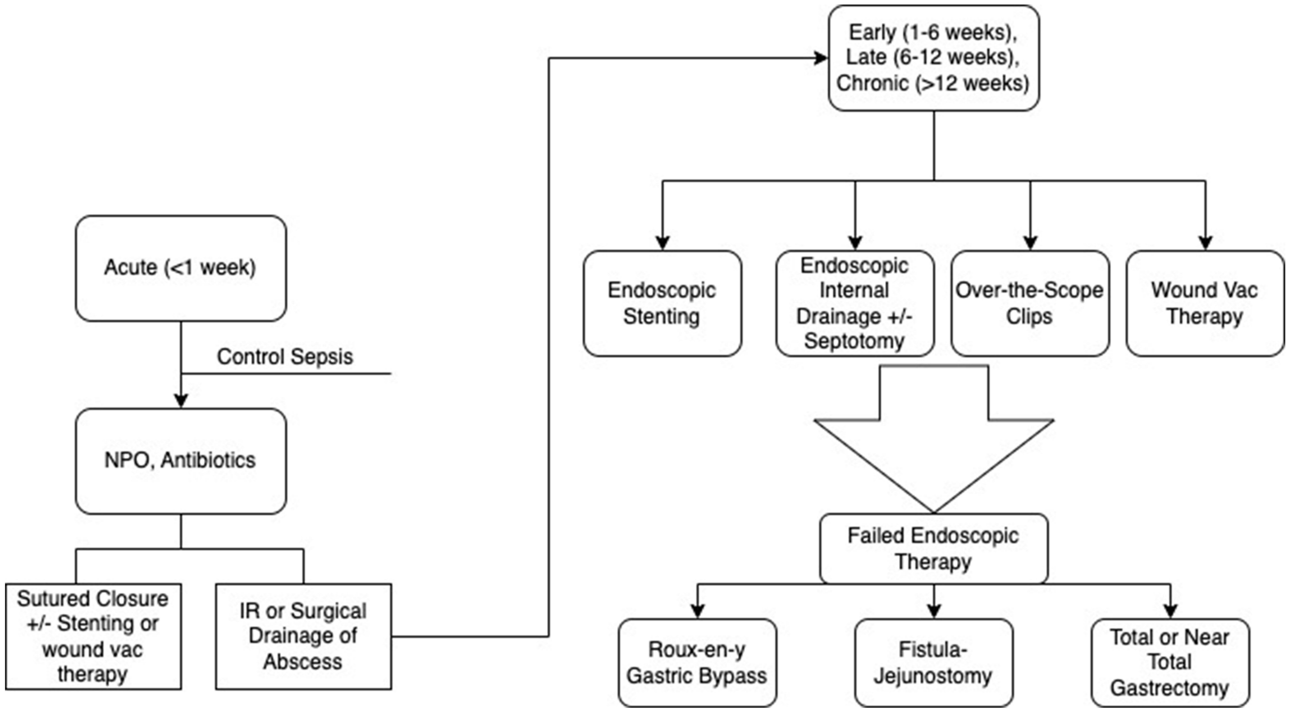

Figure 1 Overall Approach.

Disclosure

The author(s) report no conflicts of interest in this work.

References

1. Aurora AR, Khaitan L, Saber AA. Sleeve gastrectomy and the risk of leak: a systematic analysis of 4888 patients. *Surg Endosc*. 2012;26 (6):1509–1515. doi:10.1007/s00464-011-2085-3
2. Sakran N, Goitein D, Raziel A, et al. Gastric leaks after sleeve gastrectomy: a multicenter experience with 2834 patients. *Surg Endosc*. 2013;27:240–245. doi:10.1007/s00464-012-2426-x
3. Angrisani L, Santonicola A, Iovino P, et al. IFSO worldwide survey 2020–2021: current trends for bariatric and metabolic procedures. *Obes Surg*. 2024;34:1075–1085. doi:10.1007/s11695-024-07118-3
4. Gagner M, Buchwald JN. Comparison of laparoscopic sleeve gastrectomy leak rates in four staple-line reinforcement options: a systematic review. *Surg Obesity Related Dis*. 2014;10(4):713–723. doi:10.1016/j.soard.2014.01.016
5. Lee CM, Cirangle PT, Jossart GH. Vertical gastrectomy for morbid obesity in 216 patients: report of two-year results. *Surg Endosc*. 2007;21:1810–1816. doi:10.1007/s00464-007-9276-y
6. AlSabah SA, AlRuwaished M, Almazeedi S, Al Haddad E, Chouillard E. Portomesenteric vein thrombosis post-laparoscopic sleeve gastrectomy: case series and literature review. *Obes Surg*. 2017;27(9):2360–2369. PMID: 28281234. doi:10.1007/s11695-017-2637-2
7. Alizadeh RF, Li S, Inaba C, et al. Risk factors for gastrointestinal leak after bariatric surgery: MBASQIP analysis. *J Am Coll Surg*. 2018;227 (1):135–141. doi:10.1016/j.jamcollsurg.2018.03.030
8. Shoar S, Saber AA. Long-term and midterm outcomes of laparoscopic sleeve gastrectomy versus Roux-en-Y gastric bypass: a systematic review and meta-analysis of comparative studies. *Surg Obesity Related Dis*. 2017;13(2):170–180. doi:10.1016/j.soard.2016.08.011
9. Praveenraj P, Gomes RM, Kumar S, et al. Management of gastric leaks after laparoscopic sleeve gastrectomy for morbid obesity: a tertiary care experience and design of a management algorithm. *J Minim Access Surg*. 2016;12(4):342–349. doi:10.4103/0972-9941.181285
10. Cornejo J, Zevallos A, Sarmiento J, et al. Increased staple line leak rates following re-sleeve: analysis comparing re-sleeve versus Roux-en-Y gastric bypass conversion and primary sleeve gastrectomy. *Surg Endosc*. 2024;38(9):5368–5376. PMID: 39037465. doi:10.1007/s00464-024-11046-9
11. Yuval JB, Mintz Y, Cohen MJ, Rivkind AI, Elazary R. The effects of bougie caliber on leaks and excess weight loss following laparoscopic sleeve gastrectomy. Is there an ideal bougie size? *Obes Surg*. 2013;23(10):1685–1691. PMID: 23912264. doi:10.1007/s11695-013-1047-3
12. Kim J, Azagury D, Eisenberg D, DeMaria E, Campos GM. ASMBS position statement on prevention, detection, and treatment of gastrointestinal leak after gastric bypass and sleeve gastrectomy, including the roles of imaging, surgical exploration, and nonoperative management. *Surg Obesity Related Dis*. 2015;11(4):739–748. doi:10.1016/j.soard.2015.05.001
13. AlHaddad M, AlAtwan AA, AlKhadher T, AlJewaied A, Qadhi I, AlSabah SK. Omentopexy during laparoscopic sleeve gastrectomy: is it effective in reducing postoperative gastrointestinal symptoms. A retrospective cohort study. *Ann Med Surg*. 2021;65:102369. doi:10.1016/j.amsu.2021.102369

14. Sharma N, Chau WY. Remodifying omentopexy technique used with laparoscopic sleeve gastrectomy: does it change any outcomes? *Obes Surg*. 2020;30(4):1527–1535. doi:10.1007/s11695-019-04357-7
15. Dapri G, Cadière GB, Himpens J. Reinforcing the staple line during laparoscopic sleeve gastrectomy: prospective randomized clinical study comparing three different techniques. *Obes Surg*. 2010;20(4):462–467. doi:10.1007/s11695-009-0047-9
16. Yeo E, Thompson J, Hanseman D, et al. Increased staple loading pressures and reduced staple heights in laparoscopic sleeve gastrectomy reduce intraoperative bleeding. *Surgery*. 2021;169(5):1110–1115. doi:10.1016/j.surg.2020.10.045
17. Ali AB, Morris LM, Hodges J, et al. Postoperative bleeding and leaks in sleeve gastrectomy are independent of both staple height and staple line oversewing. *Surg Endosc*. 2022;36(9):6924–6930. PMID: 35122150. doi:10.1007/s00464-022-09031-1
18. Sethi M, Zagzag J, Patel K, et al. Intraoperative leak testing has no correlation with leak after laparoscopic sleeve gastrectomy. *Surg Endosc*. 2016;30(3):883–891. PMID: 26092015. doi:10.1007/s00464-015-4286-7
19. Bingham J, Kaufman J, Hata K, et al. A multicenter study of routine versus selective intraoperative leak testing for sleeve gastrectomy. *Surg Obes Relat Dis*. 2017;13(9):1469–1475. PMID: 28629729. doi:10.1016/j.soard.2017.05.022
20. Vitello DJ, Vitello JM, Beach-Bachmann J, Bentrem D. Value of routine gastrografin upper gastrointestinal study after sleeve gastrectomy. *JAMA Surg*. 2019;154(2):181–182. doi:10.1001/jamasurg.2018.3197
21. Bona D, Micheletto G, Bonitta G, et al. Does C-reactive protein have a predictive role in the early diagnosis of postoperative complications after bariatric surgery? Systematic review and bayesian meta-analysis. *Obes Surg*. 2019;29:3448–3456. doi:10.1007/s11695-019-04013-0
22. Parmer M, Wang YHW, Hersh EH, Zhang L, Chin E, Nguyen SQ. Management of staple line leaks after laparoscopic sleeve gastrectomy. *JSLS*. 2022;26(3):e2022.00029. PMID: 36071996; PMCID: PMC9439287. doi:10.4293/JSLS.2022.00029
23. Eubanks S, Edwards CA, Fearing NM, et al. Use of endoscopic stents to treat anastomotic complications after bariatric surgery. *Am Coll Surg*. 2008;206(5):935–938. doi:10.1016/j.jamcollsurg.2008.02.016
24. Garofalo F, Noreau-Nguyen M, Denis R, Atlas H, Garneau P, Pescarus R. Evolution of endoscopic treatment of sleeve gastrectomy leaks: from partially covered to long, fully covered stents. *Surg Obesity Related Dis*. 2017;13(6):925–932. doi:10.1016/j.soard.2016.12.019
25. de Moura DTH, de Moura EGH, Neto MG, et al. Outcomes of a novel bariatric stent in the management of sleeve gastrectomy leaks: a multicenter study. *Surg Obesity Related Dis*. 2019;15(8):1241–1251. doi:10.1016/j.soard.2019.05.022
26. Donatelli G, Dumont JL, Cereatti F, et al. Treatment of leaks following sleeve gastrectomy by endoscopic internal drainage (EID). *Obes Surg*. 2015;25:1293–1301. doi:10.1007/s11695-015-1675-x
27. Toh BC, Chong J, Yeung BP, et al. Endoscopic internal drainage with double pigtail stents for upper gastrointestinal anastomotic leaks: suitable for all cases? *Clin Endosc*. 2022;55(3):401–407. doi:10.5946/ce.2021.197
28. Romano L, Giuliani A, Cianca G, et al. A case of intrasplenic displacement of an endoscopic double-pigtail stent as a treatment for laparoscopic sleeve gastrectomy leak. *Int J Surg Case Rep*. 2018;53:367–369. doi:10.1016/j.ijscr.2018.11.008
29. Manos T, Nedelcu M, Nedelcu A, et al. Leak after sleeve gastrectomy: updated algorithm of treatment. *Obes Surg*. 2021;31(11):4861–4867. doi:10.1007/s11695-021-05656-8
30. Morrell DJ, Winder JS, Johri A, et al. Over-The-scope clip management of non-acute, full-thickness gastrointestinal defects. *Surg Endosc*. 2020;34:2690–2702. doi:10.1007/s00464-019-07030-3
31. Leeds SG, Burdick JS. Management of gastric leaks after sleeve gastrectomy with endoluminal vacuum (E-Vac) therapy. *Surg Obesity Related Dis*. 2016;12(7):1278–1285. doi:10.1016/j.soard.2016.01.017
32. Degrandi O, Nedelcu A, Nedelcu M, Simon A, Collet D, Gronnier C. Gastric bypass for the treatment of leak following sleeve gastrectomy. *Obes Surg*. 2021;31(1):79–83. PMID: 32920659. doi:10.1007/s11695-020-04646-6
33. Ramos AC, Ramos MG, Campos JM, Neto MDPG, de Souza Bastos EL. Laparoscopic total gastrectomy as an alternative treatment to post sleeve chronic fistula. *Surg Obesity Related Dis*. 2015;11(3):552–556. doi:10.1016/j.soard.2014.10.021
34. Zhang Y, Wang Y, Bian S, et al. Treatment of leakage following sleeve gastrectomy by laparo-endoscopic gastrostomy (LEG). *Obes Surg*. 2024;34 (8):3105–3110. PMID: 39034373. doi:10.1007/s11695-024-07417-9
35. Amor IB, Debs T, Dalmonte G, et al. Laparoscopic Roux-En-Y Fistulo-Jejunostomy, a preferred technique after failure of endoscopic and radiologic management of fistula post sleeve gastrectomy. *Obes Surg*. 2019;29:749–750. doi:10.1007/s11695-018-03644-z
36. Baltasar A, Bou R, Bengochea M, Serra C, Cipagauta L. Use of a Roux limb to correct esophagogastric junction fistulas after sleeve gastrectomy. *Obes Surg*. 2007;17(10):1408–1410. doi:10.1007/s11695-007-9222-z
37. Watanabe Y, Yamamoto K, Yang Z, et al. Novel endoscopic management of gastroenterological anastomosis leakage by injecting gel-forming solutions: an experimental animal study. *Surg Endosc*. 2023;37:8029–8034. doi:10.1007/s00464-023-10243-2