Harner *et al. Mini-invasive Surg* 2024;8:1
DOI: 10.20517/2574-1225.2023.46

Mini-invasive Surgery

Review

Open Access

Advanced endolumenal management of acute and chronic leaks after bariatric surgery

Andrew R. Harner[1], Francisco Jr Guerra[1], Shinil K. Shah[1,2], Kulvinder S. Bajwa[1], Peter A. Walker[1], Erik B. Wilson[1], Melissa M. Felinski[1]

[1]Division of Minimally Invasive and Elective General Surgery, Department of Surgery, McGovern Medical School at UT Health, Houston, TX 77030, USA.
[2]Michael E. DeBakey Institute for Comparative Cardiovascular Science and Biomedical Devices, Texas A&M University, College Station, TX 77843, USA.

Correspondence to: Dr. Shinil K. Shah, Division of Minimally Invasive and Elective General Surgery, Department of Surgery McGovern Medical School at UT Health, 6431 Fannin Street, MSB 4.156, Houston, TX 77030, USA. E-mail: shinil.k.shah@uth.tmc.edu

How to cite this article: Harner AR, Guerra F Jr, Shah SK, Bajwa KS, Walker PA, Wilson EB, Felinski MM. Advanced endolumenal management of acute and chronic leaks after bariatric surgery. *Mini-invasive Surg* 2024;8:1. https://dx.doi.org/10.20517/2574-1225.2023.46

Received: 20 Apr 2023 **First Decision:** 27 Nov 2023 **Revised:** 3 Jan 2024 **Accepted:** 16 Jan 2024 **Published:** 22 Jan 2024

Academic Editor: Wah Yang **Copy Editor:** Dong-Li Li **Production Editor:** Dong-Li Li

Abstract
Leaks remain an infrequent yet dreaded complication following bariatric surgery. Effective management includes appropriate classification of leaks and implementation of a multimodality treatment approach that focuses on adequate resuscitation, control of sepsis, and surgical or endoscopic intervention when necessary. Herein, we describe several endoscopic techniques that have demonstrated success in the management of acute and chronic leaks following bariatric surgery. In general, endoscopic interventions can be classified as exclusion techniques (self-expanding endoscopic stents), closure techniques (endoscopic clips, endoscopic suturing, or glues), or drainage techniques (transfistulary stents, endolumenal vacuum therapy, or septotomy). To guide the clinician in the appropriate patient selection for these interventions, we provide a suggested algorithm for the management of patients presenting with acute or chronic leaks following bariatric surgery.

Keywords: Bariatric surgery, sleeve gastrectomy, gastric bypass, leak, endoscopy, endolumenal, treatment

INTRODUCTION

Leaks after bariatric surgery remain an infrequent but highly morbid complication. The incidence of leaks after bariatric surgery continues to decline, with an estimated incidence of 0.7% for sleeve gastrectomy and 0.8% for gastric bypass[1]. Successful management hinges on early recognition, classification, and appropriate treatment of the leak. Because the timing of leak detection determines the optimal management strategy, leaks can be classified temporally as early (those within two weeks postop), intermediate (those from 2-6 weeks postop), or late (greater than six weeks postop). Leaks can be further classified based on their location and the presence or absence of a fluid collection. Additionally, it is important to understand the etiology of a leak. It is generally understood that a leak may be the result of technical factors, tissue trauma, ischemia, increased intraluminal pressure, tension, or a combination of these factors. Key anatomical considerations include appreciation for the relatively higher intraluminal pressure associated with sleeve gastrectomies as opposed to the low pressure system of a gastric bypass. Along these lines, evaluating and treating any narrowing (especially at the incisura) becomes critical in the successful treatment of a proximal sleeve gastrectomy leak.

Various management options exist for the treatment of leaks, and these often involve a combination of procedural interventions and medical management. Medical management involves parenteral hydration, antibiotics, and nutritional support. Patients who present with hemodynamic instability or peritonitis require urgent surgical intervention. In otherwise stable patients, drainage of any fluid collections and repair or diversion of wall defects is the mainstay of treatment and frequently involves multimodality interventions.

Successful management of leaks with endoscopy relies on appropriate patient selection and often necessitates a multidisciplinary approach, including surgery, interventional radiology, and interventional endoscopy. The timing of leaks plays a significant role in the decision to use endoscopy, as early leaks are significantly more responsive to endoscopic management as opposed to late leaks. Along these lines, Christophorou et al. identified several factors that predicted successful healing of gastric sleeve leaks with endoscopy: early leak onset (< 3 days post-surgery), early endoscopic intervention (< 21 days following the index surgery), defect size < 1 cm, and no history of gastric band placement[2].

This article serves as a review of the various endoscopic modalities that can be employed for the treatment of leaks following bariatric surgery. The distinct endoscopic techniques can be broadly classified according to their method of action, including exclusion techniques [self-expanding endoscopic stents (SEES)], closure techniques (endoscopic clips, endoscopic suturing, or glues), and drainage techniques [transfistulary stents, endolumenal vacuum therapy (EVT), or septotomy]. Furthermore, to guide the clinician in the appropriate patient selection for these interventions, we provide a suggested algorithm for the management of patients presenting with acute or chronic leaks following bariatric surgery [Figure 1].

STENTS

SEES are a commonly employed treatment strategy for the management of leaks after bariatric surgery and have shown utility in the treatment of early leaks following sleeve gastrectomy. In meta-analyses, SEES have demonstrated successful leak closure rates ranging from 88%-92%, with reported migration rates ranging from 17%-23%[3,4]. As fistula tracts mature, however, the rate of closure declines over time as fibrosis sets in, with closure rates ranging from 19%-64% for chronic fistula[5,6]. Stents can be either uncovered or covered (partially or fully), metal or plastic, and even specific for bariatric anatomy or combined with a double pigtail drainage catheter for internal drainage[7]. While uncovered stents have minimal migration rates, they do not provide a barrier for diversion of fluids, and they are traumatic on removal. This largely limits their

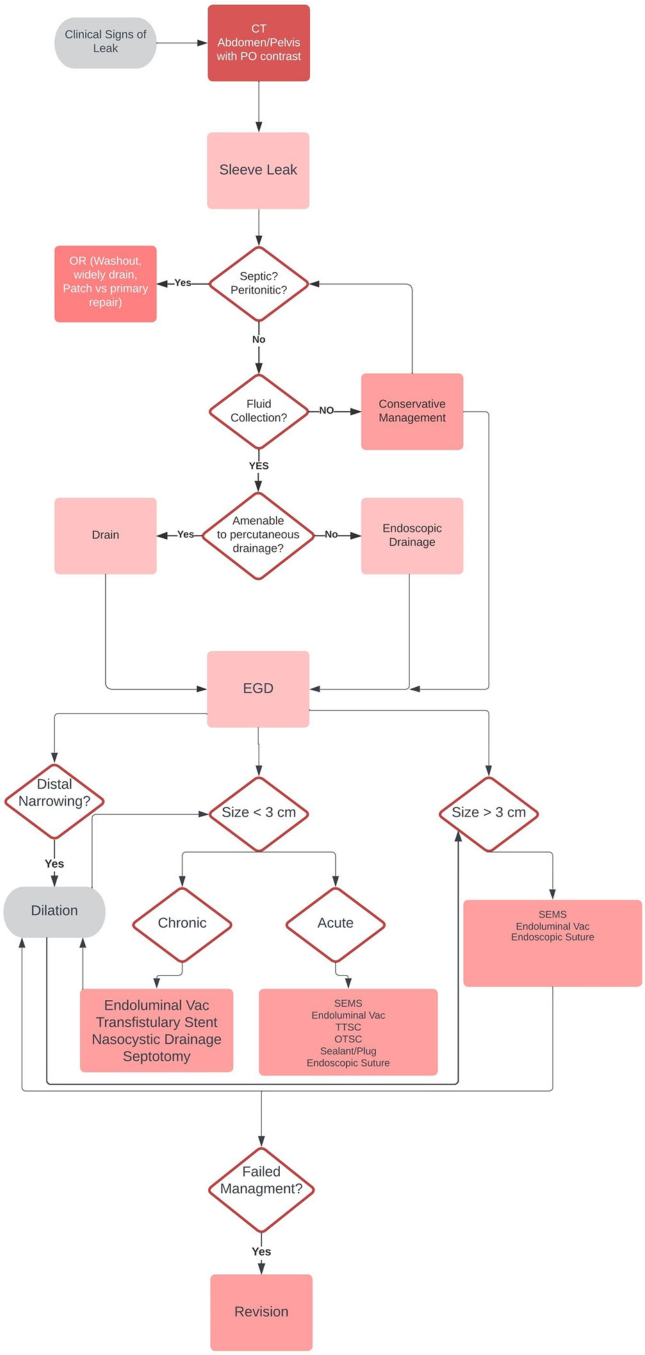

Figure 1. Suggested algorithm for the management of bariatric leaks[9,10]. CT: Computed tomography; PO: per os; OR: operating room; EGD: esophagogastroduodenoscopy; SEMS: self expanding metal stent; TTSC: through the scope clips; OTSC: over the scope clips.

usefulness to malignancies. For leaks after bariatric surgery, partially or fully covered stents are most frequently used. Partially covered stents allow for some tissue ingrowth at exposed areas of the stent and, as a result, tend to result in less migration at the cost of slightly more difficulty in extraction. Despite this, the wide variety of stent options has resulted in significant heterogeneity amongst stent efficacy studies. Consequently, it is difficult to draw conclusions on which type of stents is superior.

In principle, SEES allow for diversion of enteral contents by excluding the site of perforation from the alimentary tract. As a result, the defect is allowed to heal without the constant flow of gastric contents and exposure to increased endolumenal pressure, which may have perpetuated the leak. Additionally, in many cases, patients may start enteral feeds following stent placement, which may promote earlier healing as patients are able to more adequately address their nutritional needs. Longer SEES have the added benefit of addressing any distal points of stricture or obstruction, particularly in patients with sleeve gastrectomy. It is important to note, however, that SEES will not address any fluid collections associated with leaks, and they are, therefore, often used as an adjunct to other treatment modalities such as percutaneous or surgical drainage.

Complications associated with stent placement are usually minimal and limited largely to abdominal discomfort, nausea, vomiting, and reflux. Migration remains a difficult problem with the use of SEES in bariatric surgery as the stents are necessarily at least partially covered and it is difficult to adequately achieve radial tension on the gastric mucosa, even with sleeve anatomy. In addition to the use of partially covered stents, several other methods, such as endoscopic suturing of the proximal stent and the use of clips as anchors, have been described but with variable success[8]. Care should be exercised with stents in patients who have had Roux-en-Y gastric bypass; if stents migrate, they may get lodged in the distal small bowel and can be difficult to remove with endolumenal methods.

The frequency of stent exchanges is not well established and may be dictated most by the patient's clinical course and response to treatment. In general, if the stent is successfully managing the leak and the patient is improving clinically, it may be left in place for weeks at a time (typical duration of no longer than 6-8 weeks). However, it is not possible to determine whether complete closure of the defect has taken place unless the stent is removed and the lumen visualized endoscopically or studied radiographically with enteral contrast. As a result, many would advocate for stent exchange and evaluation at weekly or biweekly intervals to assess for healing and to minimize the difficulty of stent removal that may occur with longer implant times[9].

CLOSURE TECHNIQUES

There are several endoscopic closure techniques, including through the scope clips (TTSC), over the scope clips (OTSC), tissue adhesives, plugs, and suturing devices. The success of each method used depends on the size of the defect and acuity, in addition to user experience and expertise.

Closure techniques - TTSC

TTSC have been used successfully in the treatment of iatrogenic esophageal, gastric, small bowel, and colonic perforations. As such, their utility has translated into the treatment of early sleeve leaks and has shown some success, although there has been limited data in their use for this particular indication. Factors that play a role in their success include defect size, leak acuity, and user experience. Those defects that are smaller than 10 mm in size are more amenable to TTSC use; those between 10 and 30 mm are more amenable to OTSC[10-12]. In addition, such clips can be limited in the amount of closure force applied, making it difficult to close scarred and thickened perforations, hence leading to the preference for their use with more acute leaks[12]. As with any clip, possible complications and limitations include further injury to the tissue, instrument failure or malfunction, clip dislodgement, limited view or maneuverability, tissue quality, and operator experience.

Closure techniques - OTSC

OTSC provide a full thickness closure, acting similarly to a suture. Studies have shown a successful closure in up to 70%-100% of sleeve leaks[4,10,13,14]. In addition, they allow for approximation of tissue in larger defects, particularly those sized 10 to 30 mm. Use of suction or tissue graspers allows for better tissue approximation prior to clipping. OTSC are preferably used in leaks less than seven days old and those with less fibrosis[10]. It can also be used in conjunction with other endolumenal treatments, such as endolumenal stents; this allows for closure and diversion, in addition to enteral feeding. Risk factors for clip failure include poor tissue quality, suboptimal working space, and distal stenosis. Success of OTSC is also improved if performed after abscess drainage[13]. It is important to realize that both TTSC and OTSC add foreign bodies to the field; when they are not successful, they may prevent leak healing secondary to persistent foreign bodies.

Closure techniques - fibrin, cyanoacrylate

Sealants, such as fibrin and cyanoacrylate, also may play an adjunctive role in the treatment of leaks. Fibrin sealants act in a manner that mimics the clotting cascade, ultimately leading to the creation of cross-linking fibrin polymers[10,15]. Multiple sessions may be needed, but success rates have approached 90%-100% (generally with multiple endoscopic methods)[13]. Cyanoacrylate works by sealing quickly once in contact with a basic fluid, such as water or blood[10,15]. The use of sealants can be limited by the size of perforation, length of tract, and persistent infection, at which point sealant plugs should be considered[16]. Be it a sealant or a plug, both methods can be used multiple times to facilitate occlusion of a gastric leak. Importantly, prior to using any sealant, plug, or, as mentioned earlier, clips, any leak should first be contained, as this will be a determining factor in the success of healing the leak.

Closure techniques - endoscopic suturing

The last of the closure techniques aims to maximize efficacy of closure by using actual sutures. Companies, such as Apollo Endosurgery (Austin, TX), have developed endolumenal suturing devices, such as OverStitch, with the goal of replicating intra-abdominal suturing, only now in an intraluminal manner. Limited data exists on endoscopic suturing and its success, with most numbers coming from case series and case studies, ranging up to a 100% success rate. Furthermore, many of these studies are in relation to Roux-en-Y gastric bypass cases. What data does exist has shown that earlier intervention is more likely to lead to closure; leaks closed within 30 days of diagnosis *vs*. those closed after amounted to 44% *vs*. 0% in one study[17-19]. As with clips, endoscopic suturing can be used in conjunction with other modalities, such as stenting. This method requires a large learning curve, which has limited its use for gastric leaks, specifically sleeve leaks. This technique, although it can be used as primary treatment, can also be beneficial in patients who have failed other modalities or in those patients whose leaks are too large to manage with clips, for example, leaks greater than 30 mm in size.

DRAINAGE TECHNIQUES - TRANSFISTULARY STENTING

Transfistulary stenting has been shown to be a viable treatment modality for the treatment of both acute and chronic leaks following bariatric surgery[20]. In principle, fluid collections associated with a gastrointestinal leak can be drained internally via endoscopically placed transfistulary stents. As an added benefit, enteral nutrition is encouraged with transfistulary stenting as the distal migration of food promotes a negative pressure gradient, facilitating internal drainage[21]. There are several varieties of stents used for the purpose of endolumenal drainage, but most are either plastic biliary pigtail stents which typically range in size from 7 to 10 Fr, or larger lumen-apposing metal stents which were originally developed primarily for endoscopic cystgastrostomy for drainage of pancreatic pseudocysts. The stents are typically exchanged or removed every four to six weeks and allow for internal decompression of the fluid collection to allow for fibrosis and shrinking of the cavity[22]. In cases where the fistulous connection is not readily identifiable or easy to access, endoscopic ultrasound can be used as an adjunct to aid in placement[23].

Success rates for transfistulary stenting range from 79%-83%[20,24]. Several factors have been identified as predictive for successful leak closure with transfistulary stenting, including smaller leak size (< 5 cm), contained simple fluid collections, and lack of distal obstruction which would impede decompression through gastric lumen[10]. Complications associated with transfistulary stenting tend to be minimal, with stent migration being the most common and more rarely upper gastrointestinal discomfort, ulceration, or splenic hematoma and abscess formation[20,21,25]. In an effort to minimize stent migration, the use of lumen-apposing metal stents as opposed to pigtail stents or a combined use of SEES in combination with double pigtail stents has been suggested for defects larger than 1 cm[26]. Other complications associated with transfistulary stenting can be minimized by removal of the stent at the earliest clinical sign of leak resolution or with regular four to six week stent exchanges[21]. In chronic leaks, it is important to address distal obstruction (i.e., strictures at the incisura after sleeve gastrectomy).

DRAINAGE TECHNIQUES - EVT (ENDO-SPONGE)

EVT closure devices have emerged as a potential treatment method for leaks after bariatric surgery, and commercial products are available for use in certain markets (Endo-SPONGE, B. Braun, Melsungen Germany)[27]. While well described and studied for the management of leaks related to esophageal surgery, studies in bariatric patients are limited and less well described[28,29]. In principle, EVT acts the same as open vacuum therapy: negative pressure draws effluent and bacteria from the leak cavity, reduces edema, and promotes the formation of granulation tissue[30]. In one study, lumenal occlusive therapy (e.g., covered stents and endoscopic clips) was compared to repeat endoscopic debridement for the treatment of sleeve gastrectomy leaks. In this study, there was no significant difference in the length of stay or need for resection[31]. In another study comparing EVT to surgical revision, covered stent placement, and conservative management, EVT had the best outcomes and lowest mortality[32].

There are several described complications associated with EVT, including hemorrhage from sponge erosion into vasculature, dyspnea from sponge dislodgement into the pharynx, and possibly pancreatitis due to sponge contact[29,30]. Additionally, EVT is an intervention-intensive process compared to other treatment methods, necessitating frequent (every 2-5 days) sponge exchange under endoscopic guidance and general anesthesia[27,30]. This does, however, allow for frequent monitoring of the leak cavity under direct visualization. In one study with a small cohort of nine patients, the mean number of sponge exchanges until leak resolution was 10.5, and the number of days on EVT for individual patients ranged from 4 to 84[27]. EVT tends to be most effective in the acute leak. In chronic leaks, it is often combined with other drainage techniques, such as septotomy (described below), and addressing any distal obstruction.

DRAINAGE TECHNIQUES - SEPTOTOMY

In situations where chronic fibrosis has resulted in septum formation between the gastric lumen and the leak cavity, a septotomy may be performed to help equalize the pressure gradient between the leak cavity and gastric lumen and to facilitate drainage[33,34]. In this method, either an endoscopic needle knife or argon plasma coagulation probe is utilized to perform the septotomy[35]. Though septotomy has shown effectiveness for the treatment of chronic refractory leaks, it should be avoided in the early acute setting, as bleeding and perforation are known risks[36]. As with any method of internal drainage, it is prudent to concurrently address any distal stenosis so as to reduce the intragastric pressure at the site of perforation[37]. This may include, for example, in the case of sleeve gastrectomy addressing strictures or narrowing at the incisura with aggressive dilation (i.e., 30 mm balloon dilation). In one small study, nine patients with leak cavities ranging in size from 3 to 10 cm were all successfully treated with septotomy. The mean operative time was 87.2 min, and the number of procedures required averaged 2.3 (range of 1-4)[35].

CONCLUSION

The management of bariatric leaks is variable among all surgeons. With the growing development of new devices, technology, and equipment, increasing methods are being developed for managing these complications. A multidisciplinary approach is required to maximize treatment success. This includes surgery, interventional radiology, interventional endoscopy, nutritionists/dieticians, and medicine. The algorithm in Figure 1 summarizes a recommended management strategy for acute and chronic leaks after a sleeve gastrectomy. There is no set algorithm that is accepted by all, as each patient is different and presents their own sets of problems, but with a concerted effort amongst all teams, successful resolution of acute and chronic leaks can be achieved in nearly all cases. It may be the case that the majority of these devices and techniques are not performed or available in many centers, but the initial goal should remain consistent across all hospitals, stabilize the patient, achieve source control, and treat any distal obstruction or narrowing.

The first step for any patient who presents with clinical findings suggestive of a leak is to evaluate with advanced imaging, typically a computed tomography (CT) scan with per os (PO) contrast. Those patients with a leak and evidence of sepsis or peritonitis on examination should undergo urgent operative intervention to obtain source control, which may include a combination of washout, drainage, and defect closure or buttressing with healthy surrounding tissue. All patients with a leak, regardless of whether or not they are septic, should be started on antimicrobial therapy and early nutritional support.

Patients who are stable but with the presence of an abdominal fluid collection should be considered for percutaneous drainage. Regardless of the presence of a fluid collection, early endoscopy (preferably by an interventional endoscopist) is recommended to both characterize the exact size and location of the leak and potentially perform therapeutic interventions. In the case of sleeve gastrectomy leaks, identification and treatment of any incisura or other narrowing via balloon dilation is an important consideration to help minimize the intraluminal pressure in an otherwise already high-pressure system.

Larger (> 3 cm) perforations are less amenable to defect closure modalities such as clips and sealants, so we suggest endoscopic suturing, stent placement, a combination of the two, or endoluminal vac therapy. In addition to these therapeutic options, smaller defects (< 3 cm) may be more amenable to endoscopic clip placement (either TTSC or OTSC) and sealants/plugs for defect closure.

Chronic leaks are less amenable to primary closure due to the fibrotic nature of the surrounding tissue, so we suggest that treatment focus on drainage techniques such as septotomy, transfistulary stenting, or endoluminal vac therapy. Ultimately, if these measures fail along with a concerted effort to maximize the patient's nutritional status, then revisional surgery should be considered.

DECLARATIONS

Authors' contributions

Design, data acquisition/interpretation, drafting, revisions: Harner AR, Guerra F Jr
Design, data interpretation, review, and revisions: Shah SK, Felinski MM
Review and revisions: Bajwa KS, Walker PA
Design, review, and revisions: Wilson EB

Availability of data and materials

Not applicable.

Financial support and sponsorship

None.

Conflicts of interest

Harner AR, Guerra F Jr, Bajwa KS, Walker PA, and Felinski MM have no conflicts of interest to disclose.
Shah SK has received grant funding from Activ Surgical.
Wilson EB has received grant funding and/or teaching honoraria from Activ Surgical, Intuitive Surgical, Gore, Ethicon, and Apollo Endosurgery.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

REFERENCES

1. Hutter MM, Schirmer BD, Jones DB, et al. First report from the American College of Surgeons Bariatric Surgery Center Network: laparoscopic sleeve gastrectomy has morbidity and effectiveness positioned between the band and the bypass. *Ann Surg* 2011;254:410-22. DOI PubMed PMC
2. Christophorou D, Valats JC, Funakoshi N, et al. Endoscopic treatment of fistula after sleeve gastrectomy: results of a multicenter retrospective study. *Endoscopy* 2015;47:988-96. DOI
3. Puli SR, Spofford IS, Thompson CC. Use of self-expandable stents in the treatment of bariatric surgery leaks: a systematic review and meta-analysis. *Gastrointest Endosc* 2012;75:287-93. DOI PubMed
4. Rogalski P, Swidnicka-Siergiejko A, Wasielica-Berger J, et al. Endoscopic management of leaks and fistulas after bariatric surgery: a systematic review and meta-analysis. *Surg Endosc* 2021;35:1067-87. DOI PubMed PMC
5. Gonzalez R, Sarr MG, Smith CD, et al. Diagnosis and contemporary management of anastomotic leaks after gastric bypass for obesity. *J Am Coll Surg* 2007;204:47-55. DOI
6. Bege T, Emungania O, Vitton V, et al. An endoscopic strategy for management of anastomotic complications from bariatric surgery: a prospective study. *Gastrointest Endosc* 2011;73:238-44. DOI PubMed
7. Shehab H. Enteral stents in the management of post-bariatric surgery leaks. *Surg Obes Relat Dis* 2018;14:393-403. DOI PubMed
8. Park KH, Lew D, Samaan J, et al. Comparison of no stent fixation, endoscopic suturing, and a novel over-the-scope clip for stent fixation in preventing migration of fully covered self-expanding metal stents: a retrospective comparative study (with video). *Gastrointest Endosc* 2022;96:771-9. DOI
9. Souto-Rodríguez R, Alvarez-Sánchez MV. Endoluminal solutions to bariatric surgery complications: a review with a focus on technical aspects and results. *World J Gastrointest Endosc* 2017;9:105-26. DOI PubMed PMC
10. Gjeorgjievski M, Imam Z, Cappell MS, Jamil LH, Kahaleh M. A comprehensive review of endoscopic management of sleeve gastrectomy leaks. *J Clin Gastroenterol* 2021;55:551-76. DOI PubMed
11. Yılmaz B, Unlu O, Roach EC, et al. Endoscopic clips for the closure of acute iatrogenic perforations: where do we stand? *Dig Endosc* 2015;27:641-8. DOI
12. Manta R, Manno M, Bertani H, et al. Endoscopic treatment of gastrointestinal fistulas using an over-the-scope clip (OTSC) device: case series from a tertiary referral center. *Endoscopy* 2011;43:545-8. DOI
13. Mercky P, Gonzalez JM, Aimore Bonin E, et al. Usefulness of over-the-scope clipping system for closing digestive fistulas. *Dig Endosc* 2015;27:18-24. DOI PubMed
14. Keren D, Eyal O, Sroka G, et al. Over-the-scope clip (OTSC) system for sleeve gastrectomy leaks. *Obes Surg* 2015;25:1358-63. DOI
15. ASGE Technology Committee; Bhat YM, Banerjee S, Barth BA, et al. Tissue adhesives: cyanoacrylate glue and fibrin sealant. *Gastrointest Endosc* 2013;78:209-15. DOI
16. Joo MK. Endoscopic approach for major complications of bariatric surgery. *Clin Endosc* 2017;50:31-41. DOI PubMed PMC
17. Sharaiha RZ, Kumta NA, DeFilippis EM, et al. A large multicenter experience with endoscopic suturing for management of gastrointestinal defects and stent anchorage in 122 patients: a retrospective review. *J Clin Gastroenterol* 2016;50:388-92. DOI
18. Chon SH, Toex U, Plum PS, et al. Efficacy and feasibility of OverStitch suturing of leaks in the upper gastrointestinal tract. *Surg*

Endosc 2020;34:3861-9. DOI PubMed

19. Ge PS, Thompson CC. The use of the overstitch to close perforations and fistulas. *Gastrointest Endosc Clin N Am* 2020;30:147-61. DOI PubMed PMC
20. Bouchard S, Eisendrath P, Toussaint E, et al. Trans-fistulary endoscopic drainage for post-bariatric abdominal collections communicating with the upper gastrointestinal tract. *Endoscopy* 2016;48:809-16. DOI
21. Kumbhari V, Abu Dayyeh BK. Keeping the fistula open: paradigm shift in the management of leaks after bariatric surgery? *Endoscopy* 2016;48:789-91. DOI PubMed
22. Lorenzo D, Guilbaud T, Gonzalez JM, et al. Endoscopic treatment of fistulas after sleeve gastrectomy: a comparison of internal drainage versus closure. *Gastrointest Endosc* 2018;87:429-37. DOI PubMed
23. Machlab S, Pascua-Solé M, Hernández L, et al. Endoscopic ultrasound (EUS)-guided drainage of a postsleeve gastrectomy subphrenic collection using a lumen apposition stent. *Obes Surg* 2020;30:3236-8. DOI PubMed
24. Giuliani A, Romano L, Marchese M, et al. Gastric leak after laparoscopic sleeve gastrectomy: management with endoscopic double pigtail drainage. A systematic review. *Surg Obes Relat Dis* 2019;15:1414-9. DOI PubMed
25. Marchese M, Romano L, Giuliani A, 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;53:367-9. DOI PubMed PMC
26. Rebibo L, Delcenserie R, Brazier F, Yzet T, Regimbeau JM. Treatment of gastric leaks after sleeve gastrectomy. *Endoscopy* 2016;48:590. DOI PubMed
27. Leeds SG, Burdick JS. Management of gastric leaks after sleeve gastrectomy with endoluminal vacuum (E-Vac) therapy. *Surg Obes Relat Dis* 2016;12:1278-85. DOI PubMed
28. Ahrens M, Schulte T, Egberts J, et al. Drainage of esophageal leakage using endoscopic vacuum therapy: a prospective pilot study. *Endoscopy* 2010;42:693-8. DOI
29. Morell B, Murray F, Vetter D, Bueter M, Gubler C. Endoscopic vacuum therapy (EVT) for early infradiaphragmal leakage after bariatric surgery - outcomes of six consecutive cases in a single institution. *Langenbecks Arch Surg* 2019;404:115-21. DOI PubMed
30. Schmidt F, Mennigen R, Vowinkel T, et al. Endoscopic vacuum therapy (EVT) - a new concept for complication management in bariatric surgery. *Obes Surg* 2017;27:2499-505. DOI PubMed
31. Catchlove W, Johari Y, Forrest E, et al. Initial radiologic appearance rather than management strategy predicts the outcomes of sleeve gastrectomy leaks. *Surg Obes Relat Dis* 2022;18:205-16. DOI
32. Schniewind B, Schafmayer C, Voehrs G, et al. Endoscopic endoluminal vacuum therapy is superior to other regimens in managing anastomotic leakage after esophagectomy: a comparative retrospective study. *Surg Endosc* 2013;27:3883-90. DOI
33. Campos JM, Ferreira FC, Teixeira AF, et al. Septotomy and balloon dilation to treat chronic leak after sleeve gastrectomy: technical principles. *Obes Surg* 2016;26:1992-3. DOI PubMed
34. Haito-Chavez Y, Kumbhari V, Ngamruengphong S, et al. Septotomy: an adjunct endoscopic treatment for post-sleeve gastrectomy fistulas. *Gastrointest Endosc* 2016;83:456-7. DOI PubMed
35. Mahadev S, Kumbhari V, Campos JM, et al. Endoscopic septotomy: an effective approach for internal drainage of sleeve gastrectomy-associated collections. *Endoscopy* 2017;49:504-8. DOI
36. Ferraz ÁAB, Feitosa PHF, Santa-Cruz F, et al. Gastric fistula after sleeve gastrectomy: clinical features and treatment options. *Obes Surg* 2021;31:1196-203. DOI
37. Diaz R, Welsh LK, Perez JE, et al. Endoscopic septotomy as a treatment for leaks after sleeve gastrectomy: meeting presentations: Digestive Disease Week 2019. *Endosc Int Open* 2020;8:E70-5. DOI PubMed PMC