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**Minimally invasive management of anastomotic leaks in colorectal surgery**

Sevim Y *et al*. Management of colorectal anastomotic leakage

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**Abstract**

Anastomotic leakage is a feared and unfortunate complication of colorectal surgery. This distressed situation can cause severe morbidity and significantly affects quality of life. Additional interventions may cause more morbidity and mortality. Parenteral nutrition and temporary diverting ostomy are standard treatments of anastomotic leak. However, minimally invasive treatment modalities of anastomotic dehiscence have been widely used recently in line with technological developments. These modalities include laparoscopic repair, endoscopic self-expandable metallic stents, endoscopic clip, over the scope clip, endoanal repair, and endoanal sponge. We mainly aimed in this review to provide an overview of the current knowledge on minimally invasive management of anastomotic leaks.

**Key words:** Anastomotic leak; Colorectal surgery; Minimally invasive surgery

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**Core tip:** Anastomotic leakage is the most feared complication of colorectal surgery, leading to significant patient morbidity and mortality. Its incidence is 3%-6%, even in experienced hands. Despite the high prevalence of this condition, there is no consensus on proper management of anastomotic leaks. In the review, we summarize and discuss the present knowledge on minimally invasive treatment strategies of anastomotic leakage after colorectal surgery.

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**INTRODUCTION**

Anastomotic leak (AL) following colorectal surgery is a feared complication and its incidence is 3%-6%, even in experienced hands[1]. Anastomotic leaks can cause severe morbidity, cost, and affect quality of life. Moreover, major additional interventions may lead to more morbidity and mortality (rates up to 10-20%)[2]. Today, minimally invasive treatment modalities of ALs have been widely used as a result of technological developments. These modalities include laparoscopic repair, endoscopic self-expandable metallic stents (SEMS), endoscopic clip, over the scope clip (OTSC), endoanal repair, and endoanal sponge.

In this review, we summarize and discuss the present knowledge on minimally invasive treatment strategies of anastomotic leakage after colorectal surgery.

**LAPAROSCOPIC REPAIR AND MANAGEMENT**

In the last two decades there have been significant developments in the field of minimally invasive surgical procedures including laparoscopy. Despite these advances in laparoscopic instrumentation and techniques, laparoscopic management following AL after colorectal surgery is still under debate.

A retrospective study by Cucurullo *et al*[3] reported that anastomotic leakage was the most common finding (57.1%) at laparoscopic re-intervention. In this study, 91.7% of cases were managed by anastomotic repair, peritoneal lavage, and temporary diverting ostomy. Only 8.3% of ALs required a Hartmann’s procedure in consequence of gross fecal contamination. Conversion rate was 5.6%, because of extensive colonic ischemia and generalized peritonitis. Lee *et al*[4] also reported 8.2% conversion rate, and all ALs were treated with ileostomy/colostomy with or without anastomotic repair. They compared the results of open and laparoscopic management, and observed significantly shorter hospital stay, lower 30-day postoperative morbidity and complication, and improved stoma closure rate in the laparoscopic group. In other studies by Wind *et al*[5] and Vennix *et al*[6], morbidity rate, hospital stay, ICU admission, and incisional hernia rate were reduced in the laparoscopic re-intervention group. Furthermore, re-laparoscopy can be used a diagnostic tool if clinical concern exists despite an adjunctive diagnostic imaging with reported diagnostic accuracy between 93% and 100%[7].

Laparoscopic re-intervention is a safe, feasible, and effective technique and can be considered as a diagnostic option as well as the first therapeutic approach for evaluating suspected postoperative complications. Today, many studies encourage the use of laparoscopy for the treatment of complications following minimally invasive colorectal surgery in skilled hands.

**ENDOSCOPIC SELF-EXPANDING METALLIC STENT (SEMS), AND OTHER STENTS**

The use of colonic stents has significantly evolved over the last decades as an alternative method of converting emergency surgery for obstructing colorectal cancers to safer definitive elective surgery or as palliative treatment for inoperable malignant colorectal strictures with high success rates[8]. Moreover, the application of colonic stents has gained increasing attention in recent years for postoperative complications following colorectal surgery including ALs, fistulas, and perforations (Figure 1). Especially, smaller ALs not associated with severe sepsis may benefit from colonic stenting after laparoscopic peritoneal lavage and drainage and fashioning of stoma[9]. On the other hand, some authors considered that endoscopic stenting could be utilized in patients with or without a stoma, in combination with percutaneous drainage of infected intraabdominal collections[10].

 Several types of intestinal stent are available, such as self-expanding metal stent (SEMS) (uncovered, partially or fully covered), self-expanding plastic stent (SEPS), and biodegradable (BD) stent. Colonic stent-related complications include stent migration, anorectal pain, incontinence, perforation, rectal bleeding, and stent obstruction[9,11]. The stent can only be placed across an end-to-end anastomosis and the distal end of the stent must be no less than 5 cm proximal to the anal verge[10-12]. Stents placed very distally in the rectum may cause more rectal pain, tenesmus, or fecal incontinence[11-13].

 The risk of stent migration is high in the lower gastrointestinal tract because of the increased intestinal motility and reported in 25% to 40% of patients[14-16]. This rate is less in uncovered or partially covered stents than biodegradable and fully covered stents[9,10,12]. Migration has been also described when large-diameter stents have been used[11,14]. However, the use of partially covered SEMS prevents migration, but allows for tissue in-growth and its removal results technically difficult[11,12]. Use of clips or endoscopic suturing can be an alternative method to anchor the stent in place and reduce migration risk[14] (Figure 1B). Optimal timing of stent removal is controversial. If possible, stents should be removed after adequate healing of the dehiscence is confirmed by endoscopy and resolution of clinical signs and symptoms[16].

 A recent study found that SEMS application was successful in 86% of 22 patients with anastomotic leak following colorectal surgery[13]. In this study, fully covered SEMS were used in 19 patients and uncovered SEMS in 3 patients. Stent migration occurred in only 1 of 22 patients (4.5%); this patient was in covered stent group and stent migrated 6 months after placement. Most of the patients complained of incontinence after placement of the stent, which regressed spontaneously on average 14 wk.

Recent advances and innovations in stent technology have brought up expandable polydioxanone biodegradable stents as an efficacious alternative in the treatment of AL following colorectal surgery. Since the structure of the biodegradable stent does not require any removal procedure, this can decrease mucosal hyperplastic reactions and adverse events associated with stent removal, compared to metal stents[9,10,12,14].

Based on limited data, stent placement appears to be an alternative therapeutic option for selected patients with AL after colorectal surgery when performed by skilled endoscopists. Furthermore, migration is the major problem and the cost of these stents is an important limitation.

**ENDOSCOPIC CLIPS**

Application of clips to approximate the edges of the leaking anastomosis is one of the endoscopic managements. Standard endoclips, which are used to control small perforations and bleeding, may be used for closure of AL, but the usage of these clips with low closure force, especially for more scarred, fibrotic, and irradiated tissues are limited.

First clip was manufactured by the Olympus Corporation from Japan in 1995. Thereafter, a disposable preloaded version of this clip known as Quickclips® (Olympus Ltd., Tokyo, Japan) has gained popularity. Then over-the-scope clips (OTSC) (Ovesco Endoscopy, endoscopy, Tubingen, Germany) were introduced; and in 2011, Cook Medical from US produced instinct endoscopic hemoclip.

OTSC is the most preferred clips in order to control AL. This clip is made of super-elastic nitinol, which is a biocompatible and MRI-safe material, and has the benefit of a larger clip area with increased compression. Firstly, Kirschniak *et al*[7] published their successful results with OTSC used 11 patients which have bleeding or iatrogenic perforation. Application of OTSC for leaks popularized then. Weiland *et al*[18] reported a general success rate of 84.6%. Arezzo *et al*[19] used OTSC for colorectal surgery, performed on 14 patients with leaks not larger than 15 mm in maximum diameter, and without luminal stenosis and abscess. Similarly, their success rate was 86%. Sometimes, first attempt may fail but repeated attempts will be successful in order to close the dehiscence of AL[20].

Favorable results with OTSC may be obtainable without the presence of fibrotic tissue. Closure of chronic leaks and fistulas seem to be considerably challenging and may decrease the success rate[21]. On the other hand, OTSC have meaningful cost benefits compared with ileostomy, and achieve full-thickness wall closure. Moreover, it is useful in shortening the hospital stay and avoiding temporary ileostomy[19]. OTSC can close defects up to 30 mm[22]. Application of multiple clips may be possible for larger defects; however, there is limited experiences on it[23,24].

**ENDOSCOPIC VACUUM-ASSISTED CLOSURE**

Negative pressure wound therapy or vacuum-assisted closure is now a well-established treatment modality for chronic and difficult healing wounds. Recently, this minimally invasive method has been proposed as an effective approach to manage AL after colorectal surgery with success rates ranging from 56.6% to 100%[25-29]. In the original technique, after the presence of the abscess cavity is confirmed by diagnostic colonoscopy, the enteric and purulent contents are aspirated and then irrigated. Last, an open pored, polyurethane sponge with an attached evacuation tube connected to a drainage system is inserted via an introducer sleeve that is fitted over an endoscope and placed through the dehiscence and into the pelvic cavity[10,12,16,25].

The endo-sponge continuously removes secretion, improves microcirculation, and therefore induces granulation formation in the defect. It also facilitates closure of the pelvic cavity by the application of negative pressure of 125 mm Hg[26] (Figure 2). One of the disadvantage of this method is changing the sponge every 2-4 d until the abscess cavity has regressed[25,28,29]. However, this treatment is more effective at shrinking cavities, especially when used within 6 wk after the AL[10,30]. It should be noted that generalized peritonitis is no indication for endo-sponge therapy[12,25,29]; and the overall complication rates are around 20% mainly, consisting of anastomosis stenosis, recidivate abscess, and fistula[26].

 In 2008, a largest series of endoscopic vacuum-assisted closure therapy was reported by Weidenhagen *et al*[25]. In this study, definitive closure of the cavity was achieved in 28 of the 29 patients (96.6%) over a mean treatment period of 34 d (range 4-79 d). In a recent review, Strangio *et al*[26] found that a complete healing of cavity was achieved in near 95% of cases overall, following a median of 30 d of treatment and a median of 11 sessions performed. The authors emphasized that endo-sponge applications might be safely performed in patients with or without a diverting ileostomy. In the series of Weidenhagen *et al*[25], four patients were treated without the construction of a diverting stoma. Similarly, Glitsch*etal*[28] reported on successful endoscopic transanal vacuum-assisted rectal drainage for AL after rectal resection in 16 of 17 patients (94.1%). They also found that the closure time was directly dependent on the cavity size, distance from anastomosis to the anal verge, and the patient’s age. Patients with anastomoses that were 6 cm or less from the anal verge, in elderly patients (aged over 62 years), and the cavity measuring 5 cm × 6 cm or more had considerably longer healing times.

 Endoscopic vacuum-assisted closure therapy seems a safe and useful therapeutic option for the local and minimally invasive management of AL after colorectal surgery with high success rates. However, further prospective clinical studies with randomized data and larger numbers of patients are still needed to clarify the beneficial effects of endo-sponge therapy in patients with anastomotic insufficiency.

**TRANSANAL REPAIR**

Transanal repair is also another preferred method for treatment of delayed AL. Candidates for this method should have a documented persistent sinus or cavity diagnosed by contrast enema, without any evidence of recurrence and co-morbidity. There is primary repair or repair with flap as transanal repair, especially for sinus formation of AL. The flap should be prepared with skin or mucosa, although there is limited supporting data about it in the literature. Endorectal flap advancement is well described in ileorectal anastomotic sinuses. Blumetti *et al*[31] published their 2-centered study in 2012 and reported 6 transanal repairs for 5 patients with 80% success rate.

 In 2015, Brunner *et al*[32] reported two consecutive patients managed by transanal primary repair and irrigation of abdominal cavity for AL after single incision laparoscopic sigmoid resection for stage II/III diverticulitis. They mentioned no residual leaks, no anastomotic strictures, and normal rectal functions.

A summary of some recent successful studies managed minimally invasively after anastomotic leakage and outcomes in SEMS, OTSC, vacuum-assisted closure, and transanal repair at their institutions is shown in Table 1.

**CONCLUSION**

Anastomotic leaks continue to be critical and life-threatening events with considerable morbidity and mortality. Patients with ALs are often critically ill and non-operative management strategies must be preferred first-line approach. Today, minimally invasive treatment options are being a promising alternative to surgical treatment with satisfactory outcomes for the management of ALs. Nevertheless, there is a need for further, large, high quality, randomized, controlled trials on long term outcome, function, and clinical efficacy of these different techniques.

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Figure 1 Self-expanding metal stent for anastomosis leakage. A: Endoscopic image after deployment of the stent; B: Stent with clip (\*) at the proximal end.

Figure 2 Endoscopic appearance of anastomotic leakage. A: Anastomotic leak with cavity before endoscopic vacuum-assisted closure therapy; B: Same cavity covered with granulation tissue (black arrow) three weeks after vacuum therapy was initiated.

Table 1 Results of some recent successful studies managed minimally invasively after acute or chronic anastomotic leak

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Ref.** | **Year** | **Cases** | **Procedure** | **Gender****(F/M)** | **Age****(yr)** | **Previous diagnose or treatment** | **Success*****n* (%)** | **Failure or complications*****n* (%)** | **Follow-up** |
| Lamazza *et al*[13] | 2015 | 22 | SEMS | 11/11 | 68 | Anterior resection (all)Neoadjuvant (21) | 19 (86.4) | Failure: 3 (13.6)Stent migration: 1 (4.5) | 18-42 mo |
| Arezzo *et al*[19] | 2012 | 14 | OTSC | 8/6 | 68.5 | Anterior resection (12)Colostomy closure (1)Right hemicolectomy (1) | 12 (85.7) | 1 patient need further surgery | 4 mo |
| Sulz *et al*[20] | 2014 | 6 | OTSC | 1/5 | 66.5 | Colorectal resection | 5 (83.3) | Failure: 1(Succeeded with 2nd OTSC)  | N/A |
| Weidenhagen *et al*[25] | 2008 | 29 | VAC | 5/24 | 66.7 | Rectal cancer (22)Rectosigmoidal cancer (3)Large rectal adenoma (2)Diverticulitis (1)Endometrial cancer infiltration (1) | 28 (96.6) | 1 (Hartmann’s procedure) | VAC duration: 34.4 ± 19.4 d |
| Blumetti *et al*[31] | 2011 | 5 | Transanal repair | N/A | 52 | Coloanal anastomose (4)Colorectal anastomose (1) | 4 (80) | Failure: 1 (20) | Time to repair:8-15 months |

F/M: Female/male; SEMS: Self-expandable metallic stent; OTSC: Over the scope clip; N/A: Data not available; VAC: Vacuum-assisted closure.