Original Article

Anastomotic Strictures after Colorectal Surgery: A Single Center Experience

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Key Words
Anastomotic stricture;
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Purpose. Up to 30% of patients develop anastomotic strictures after colorectal surgery. Although many are asymptomatic, these strictures may influence the continuity of the gastrointestinal tract and stoma closure. Currently, the optimal management of strictures remains unclear. Repeat surgical resection and endoscopic intervention may help achieve patency. This study aimed to review cases in our hospital and discuss treatment strategies.

Methods. Eleven patients diagnosed with anastomotic strictures between January 2015 and December 2019 were included in this study. The anastomotic stricture was defined as failure to pass an endoscope through the anastomotic ring during postoperative follow-up. Demographic characteristics, primary surgical outcomes, stricture characteristics, management, and long-term follow-up were analyzed.

Results. The median body mass index of all patients was 23.67. Seven of them had a history of smoking. All patients were diagnosed as anastomotic stricture after operation of left colon cancer. Seven patients previously had a low anterior resection, and four had an anterior resection. Five patients had anastomotic leakage after the initial surgery. All the anastomotic strictures were benign. Four patients received only endoscopic balloon dilation. Three patients received redo surgery. Four patients received multiple modality treatment. The success rates for endoscopic balloon dilation and repeat surgery were 75% and 50%, respectively. Anastomotic stricture failed to be treated in two patients due to pelvic recurrence.

Conclusions. Anastomotic strictures are late complications that are difficult to treat. Optimizing the risk factors and reducing leakage are important to prevent strictures. Endoscopic balloon dilation is an acceptable intervention for benign strictures in select patients.

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Anastomotic stricture (AS) is a late complication that occurs after colorectal surgery. The incidence rate was between 2.5% and 19.5% but could reach to 30% in previous report.[1,2] Although only 5% of patients manifest symptoms related to AS; it may still influence normal bowel movement and impede stoma closure after primary surgery. Reported symptoms included abdominal cramping, constipation, bowel obstruction. The pathogenesis of AS is still uncertain. Both surgical technique and patient's condition can influence AS. Smoking, obesity, stapler use, inadequate tension-free anastomosis may increase incidence of AS.[1,3,4]

Current therapies for AS include redo surgery, en-

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doscopic balloon dilation, and other endoscopic procedures (stenting, electrocautery incision, steroid injection, etc.), but AS recurrence and treatment failure may still occur even after repetitive interventions. Multiple attempt and combination of treatment modality may be need in refractory AS.[5] The purpose of this study was to review our preliminary experience and establish an ideal treatment algorithm for the management of anastomotic strictures.

Materials and Methods

The study was retrospective case series. We enrolled patients diagnosed with AS after colorectal cancer surgery between January 2015 and December 2019 at our hospital. Choosing between open or laparoscopic surgery as well as methods of anastomosis (such as staple or hand-sewn) depend on the condition of the tumor and the surgeon's preference. Patients with locally advanced colorectal cancer, neoadjuvant radiation therapy, severe pelvic adhesions, and poor bowel conditions underwent fecal diversion during their primary surgery. Those who had early anastomotic complications without diversion received a rescue stoma during their hospital course.

Regular follow-up endoscopy was arranged one year after surgery for all patients. Patients with fecal diversion underwent early endoscopy to evaluate stoma closure 3-6 months after primary surgery. AS was defined as the inability to pass the endoscope through the anastomotic ring. Patients who had mild degree stenosis without symptom were excluded. A biopsy was also performed to rule out any malignant changes at the stricture site. Some patients underwent endoscopic balloon dilation or surgical re-anastomosis for strictures, depending on the surgeon's preference. Endoscopic balloon dilation was performed using Micro-Tech (Nanjing) multistage dilation balloons. We measured the length of the anastomotic segment and selected the appropriate balloon size. A guidewire was introduced to pass through the narrow area. The dilation balloon was then introduced along guidewire under endoscopic guidance. We sequentially increased the pressure of the balloon, which lasted for at least 5 min under direct vision. Repeat procedures were arranged every 2-4 weeks with gradual increases in pressure until the endoscope could pass smoothly through the anastomotic ring.

We underwent midline laparotomy if patient received re-do surgery. We checked the abdominal cavity carefully to rule out pelvic recurrence or other lesions that might interfere re-anastomosis. Adhesion lysis was done to mobilize small bowel, sigmoid colon and rectum from pelvis. We repaired serosa tear with 3-0 silk during lysis. Previous anastomotic site was recognized with sigmoidoscope or direct vision. Right angle clamps were applied 2 cm proximal and distal to the anastomotic site. The segment of anastomotic stricture was resected. After we confirmed that medium sizer could pass through proximal colon smoothly, either stapler or hand sewn was used to anastomose the residual colon. Air leak test was done with sigmoidoscope to examinate the completeness of anastomosis. The abdominal cavity was irrigated with copious amount of distilled water. We then placed drainage tube at the pelvis and closed the wound.

Subsequent stoma closure was performed if a stricture-free anastomosis was confirmed during endoscopy. Crossover treatment modalities were arranged if the stricture could not be relieved with repetitive endoscopic interventions or surgery. Demographic data, primary diagnosis, surgical procedures, complications, interval to stricture, treatment for anastomotic stricture, and stricture-free interval were collected.

Results

Eleven patients developed AS after colorectal surgery between January 2015 and December 2019. The incidence rate of AS was < 5% in our hospital between 2015 and 2019. A male predominance was noted (6/11). The median age of the patients was 61 years, and the median body mass index (BMI) was 23.67. Nearly half of the patients (5/11) were overweight with a BMI > 24. More than half of the patients had a history of smoking (7/11). The tumor sites were at the sigmoid colon in four patients, rectosigmoid colon/upper rectum in four patients, and middle/lower rec-

tum in three patients. Among them, only one patient received neoadjuvant concurrent chemoradiotherapy due to mesorectal fascia invasion of the tumor based on preoperative imaging.

Four patients underwent anterior resection (AR), and seven underwent low anterior resection (LAR). Most patients underwent open surgery (10/11). Only one patient underwent hand-sewn anastomosis, while the rest (10/11) underwent anastomosis with circular end-to-end stapling devices. Five patients had fecal diversion during primary surgery due to their suboptimal clinical conditions. Five patients developed a leak after surgery. Four patients underwent emergent reoperation with a diverting stoma. Seven patients received adjuvant chemotherapy postoperatively. In terms of tumor staging, two patients were stage I, four were stage II, four were stage III, and one was stage IV. All of the demographics, treatments, complications, and outcomes of the primary colorectal surgeries performed are summarized in Table 1.

The median follow-up period of all patients was 21 months, and their median interval to AS development was 5 months. Only three patients presented with obstructive symptoms such as abdominal pain, abdominal distension, constipation, or vomiting when AS was confirmed by endoscopies. Benign fibrotic strictures were confirmed using endoscopic biopsy in all patients (11/11). Six patients underwent endoscopic balloon dilation first. Two of six patients failed and one patient received re-do surgery afterward, the other continued endoscopic balloon dilation until December 2019. The other five patients underwent re-do surgery first. Three of five patients failed with surgery and two patients received endoscopic balloon dilation afterwards. Pelvic recurrence was noted intraoperatively in another patient and re-anastomosis could not be performed. There were three patients with cancer recurrence after primary surgery in our series, with one located in the liver and two in the pelvic cavity. The two patients with pelvic recurrence underwent Hartmann's procedure and transverse-loop colostomy.

Reoccurrences of AS were frequent, and most patients required multiple treatment attempts (8/11) with endoscopic interventions, surgical interventions, or multiple treatment modalities. Eight patients were

Table 1. Demographics, treatments, complications, and outcomes of primary colorectal surgery in a hospital between 2015 and 2019

N = 11	
Sex	
Male	6 (54.5%)
Female	5 (45.5%)
Age: median 61 (46-78)	
ASA grade	
1, 2	9 (81.8%)
3, 4	2 (18.2%)
BMI: median 23.67 (18.25-27.57)	
< 18.5	1 (9.1%)
18.5-24	5 (45.5%)
> 24	5 (45.5%)
Alcohol consumption	
Yes	5 (45.5%)
No	6 (54.5%)
Smoking	
Yes	7 (63.6%)
No	4 (36.4%)
Previous abdominal OP	
Yes	5 (45.5%)
No	6 (54.5%)
Primary surgical indication	
Malignancy	11 (100%)
Benign	0 (0%)
TNM stage	
I	2 (18.2%)
II	4 (36.4%)
III	4 (36.4%)
IV	1 (9.1%)
Location	
Sigmoid	4 (36.4%)
R/S, upper rectum	4 (36.4%)
Middle, lower rectum	3 (27.3%)
Neoadjuvant R/T	1 (9.1%)
Surgical approach	
Open surgery	10 (90.9%)
Laparoscopic surgery	1 (9.1%)
Procedure	
Anterior resection	4 (36.4%)
Low anterior resection	7 (63.6%)
Method of anastomosis	
Staple	10 (90.9%)
Hand-sewn	1 (9.1%)
Initial fecal diversion	
Yes	5 (45.5%)
No	6 (54.5%)
Complications	
Anastomotic leak	5 (45.5%)
Liver abscess	1 (9.1%)
Emergent OP with stoma	4 (36.4%)
Mortality	0 (0%)
Adjuvant C/T	
Yes	7 (63.6%)
No	4 (36.4%)

ASA, American Society of Anesthesiologists; BMI, body mass index; OP, operation; R/S, rectosigmoid colon; R/T, radiation therapy; C/T, chemotherapy.

treated with endoscopic interventions with or without redo surgery. Fig. 1 showed the anastomotic ring before and after endoscopic balloon dilation. No procedure-related complications were noted. Among them, six patients achieved successful luminal patency following endoscopic balloon dilation. One of them continued to undergo endoscopic management until December 2019. Endoscopic dilation failed to resolve AS reoccurrence in one patient, but this was successfully managed with redo surgery. One of the six patients with successful endoscopic management received stoma closure afterward, but pelvic cancer recurrence was noted 9 months later. For this patient, a permanent colostomy was also performed due to intestinal obstruction.

On the other hand, six patients underwent redo surgery with or without endoscopic intervention. Among them, three patients improved after redo surgery. However, restrictures were noted in the other three patients. Two of these three patients were treated with endoscopic balloon dilation, regaining luminal patency afterward. The other patient underwent Hartmann's procedure because of severe tissue inflammation and pelvic cancer recurrence.

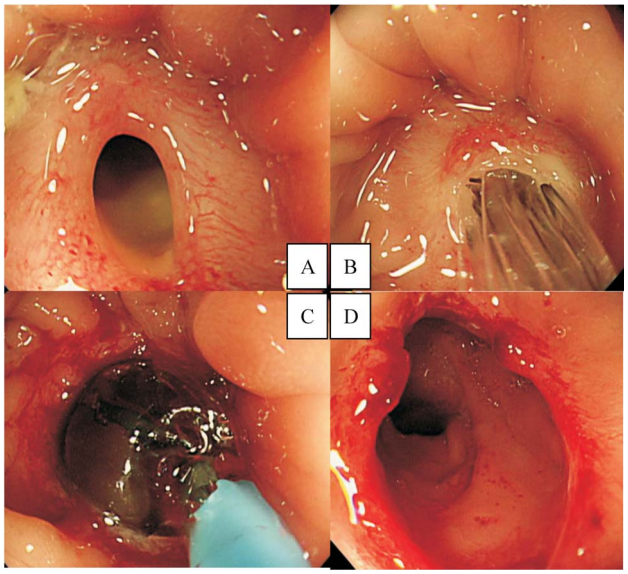

Fig. 1. Anastomotic ring before and after endoscopic balloon dilation. A fibrotic ring was seen by colonoscope and tip of colonoscope could not pass through it (A). Under endoscopic guidance, balloon dilator was inserted through the ring (B). After dilation, the central pathway of fibrotic ring enlarged and colonoscope could pass through it (C and D).

As of December 2019, eight patients have had successful treatments for their AS. Only one patient did not have subsequent stoma closure because of liver cirrhosis and bleeding tendency; therefore, the patient was not suitable for further surgery. The management and outcomes for all of these restrictures are summarized in Table 2. The sequential management procedure of these 11 patients were depicted in Fig. 2.

Discussion

The occurrence of AS after colorectal surgery remains to be a critical issue. Its incidence was previously observed at a median of 5-12 months after surgery.[6] There was a great discrepancy in incidence rate

Table 2. Characteristics, management, and outcomes of anastomotic stricture after primary surgery

Total = 11	
Follow-up duration: median 21 months (range, 7-40 months)	
Interval to stricture: median 5 months (range, 2.5-20.5 months)	
Cancer recurrence	
Yes	3 (27.3%)
No	8 (72.7%)
Obstructive S/S	
Yes	3 (27.3%)
No	8 (72.7%)
Etiology of stricture	
Benign	11 (100%)
Malignant	0 (0%)
Endoscopic features	
Fibrotic ring	11 (100%)
Dehiscence	2 (18.2%)
Treatment	
Endoscopic balloon dilation	4 (36.4%)
Re-do surgery	3 (27.3%)
Mixed	4 (36.4%)
Success of treatment	8 (72.7%)
Endoscopic balloon dilation (total 8)	6 (75%)
Re-do surgery (total 6)	3 (50%)
Stricture free interval: median 9.5 months (range, < 1-17 months)	
Stoma closure (total 7)	6 (85.7%)
Failure of treatment	
Pelvic recurrence	2 (18.2%)
Ongoing treatment	1 (9.1%)

S/S, signs and symptoms.

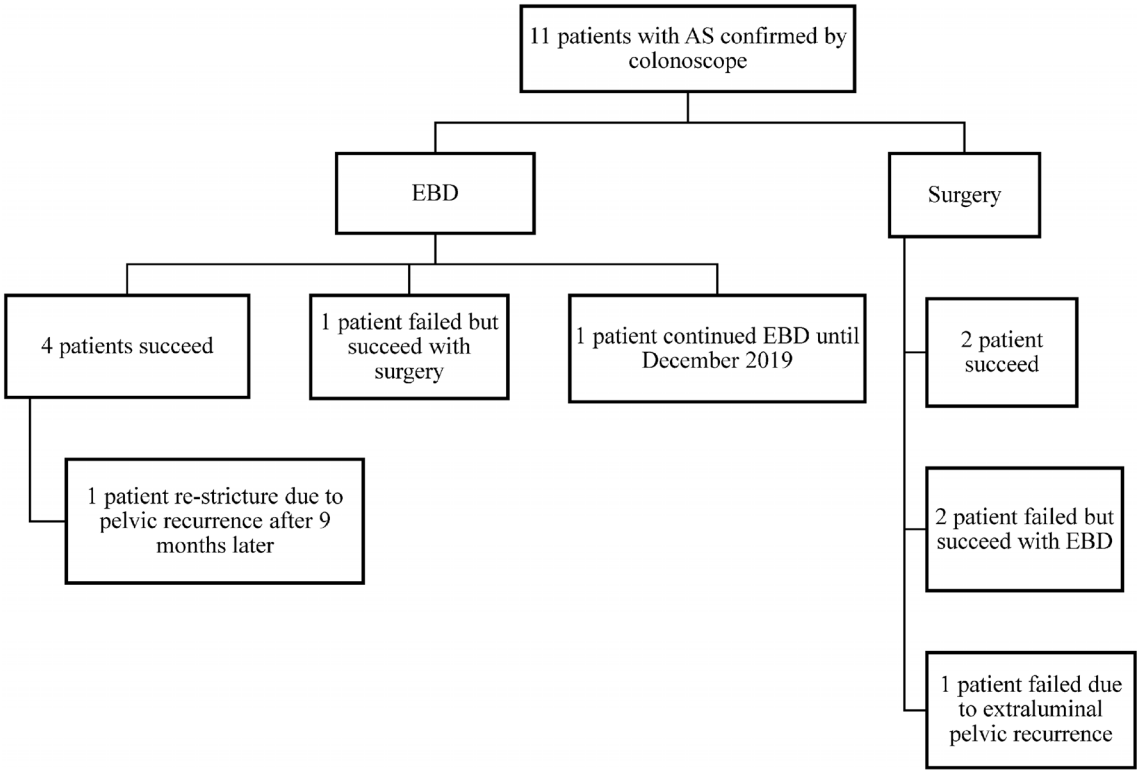

Fig. 2. Sequential management procedures of 11 patients with anastomotic stricture after colorectal surgery. AS, anastomotic stricture; EBD, endoscopic balloon dilation.

ranged from 0 to 30%.[1] The incidence rate the interaction between mucosal repair and intestinal microbiota is complicated, and there is currently little understanding of the normal process of intestinal healing.[7] It is known that local inflammation impairs wound healing by prolonging the inflammatory phase and increasing tissue proteases, which may further lead to wound remodeling and fibrosis.[7] However, the true pathogenesis of AS remains uncertain. Several risk factors of AS have been reported previously, which can be classified into general (such as age, male sex, obesity, comorbidity, smoking, nutrition, corticosteroid therapy) and procedural (such as low anastomosis, stapler use, tension on the anastomosis, blood supply to the anastomosis, radiation therapy).[1,3,4] Considering these, the incidence rate of AS may be reduced if the patient's conditions and surgical technique are optimized perioperatively. Cessation of smoking, nutritional support, fluid-directed therapy, tension-free anastomosis, and sufficient blood supply are important modifiable factors that reduce the incidence of AS.[3] In our series, most patients had a history of smoking and nearly half of patients were overweight before surgery. More cases of anastomotic stricture in LAR were also noted.

Among these factors, the surgical technique appears to be the most significant. More specifically, the balance between ensuring tension-free anastomosis and maintaining vascular supply is important. In colons with less flow or absence of marginal vessels, low ligation of the inferior mesenteric vessels may be appropriate.[1,3] On the other hand, in patients undergoing resection of a long segment or with an extremely short sigmoid colon, it may be preferable to perform high ligation of inferior mesenteric vessels and splenic flexure mobilization to achieve tension-free anastomosis. However, some authors concluded that blood supply was significantly affected by the location of the proximal resection site but not by the choice of high or low ligation.[1] In these situations, intraoperative indocyanine green fluorescence might help demonstrate adequate perfusion over the anastomotic area to avoid vascular compromise during mobiliza-

tion and anastomosis. However, its validity and long-term outcomes remain under investigation.[3] The details of the operations in our series were not available because of the retrospective nature of the study.

When AS occurs, its etiology, length, and location should be evaluated before further management. Biopsy of the stenotic anastomosis should also be routinely performed. Suchan et al. found that tumor recurrence accounted for 10% of AS diagnosed after colorectal resection for malignant disease.[6] It is reported to occur rarely in early strictures (i.e., within 6 months), but the risk of local recurrence increases over time.[9] For malignant strictures, surgical resection and re-anastomosis should be the treatment options for patients with resectable recurrent colorectal cancer.[10] Although there have been no reports on the long-term outcomes of repeat surgery after malignant stricture resection, Genser et al. reported a 70%-88% success rate after redo surgery for either benign or malignant etiology. This success rate could even reach 100% in patients undergoing reoperation for AS. The complication rate after surgery ranged from 26% to 55%, including anastomotic leak, pelvic abscess, and prolonged ileus. The rate of long-term morbidities, such as chronic fistula or recurrent AS, is at 3%-4%.[10] In the presence of unresectable locoregional diseases, proximal fecal diversion may be warranted for palliation. Placing self-expanding metal stents (SEMS) is an alternative treatment option for these situations. In cases of malignant colon obstruction, 80% and 72% of SEMS remain patent after 6 and 12 months, respectively.[11] The overall morbidity and mortality rates of SEMS are 20% and < 1%, respectively. However, in patients with AS affecting a long segment, multiple strictures, extracolonic lesions, complete obstruction, previous irradiation or balloon dilation prior to stent insertion, higher risk of SEMS failure and stent-related complications, such as stent migration and perforation, may be encountered.

Endoscopic balloon dilation is the first-line treatment for benign AS. A previous report showed satisfactory results for the successful management of AS in 59% of patients who underwent resection for cancer and 88% of patients who underwent resection for a benign condition.[5] Despite its simplicity and efficacy, this technique usually requires several treatment sessions and is associated with up to 20% of recurrent benign stenoses.[6,12] The median number of endoscopic balloon dilation required was three in previous research.[6] A relatively narrow stenosis (< 10 mm), short-segment stricture (< 4 cm), and benign AS are considered predictors of successful balloon dilation. In patients with numerous strictures, complete obstruction, fistula within the stricture, active inflammation around the stricture, recent surgery, large angulation, and malignancy, a higher rate of recurrent stricture and treatment failure are expected.[5] Most recurrences occurred within the first two years after balloon dilation.[6] Redo surgery should only be performed after less-invasive techniques have failed or if the patient is not a candidate for endoscopic treatment.[5,10] In our series, all of our patients had benign AS after primary surgery. The success rates after surgery and repeat endoscopic dilation were 50% and 75%, respectively. Two patients initially underwent redo surgery, but re-stricture still occurred. Lumen patency was achieved using endoscopic balloon dilation. None of our patients had perforation, fever, abdominal pain, or changes in bowel habits after endoscopic balloon dilation. Early surgical interventions without prior attempts at endoscopic balloon dilation may not improve the stricture-free interval.

In recent years, endoscopic electrocautery incision (EECI) techniques have been described as alternative therapies for AS. It can be performed alone or combined with other endoscopic modalities (such as steroid injection and endoscopic balloon dilation). Jain et al. reported that the overall success rate for early post-procedure and long-term follow-up after EECI was 98.4% and 93%, respectively.[12] The recurrence rate was 6%, and the complication rate was 3.8%. The high success rate, lower stricture recurrence rate, and lower incidence of complications compared to endoscopic balloon dilation therapy make EECI an attractive option for short, refractory, and benign AS. However, more randomized controlled trials should be conducted to compare endoscopic balloon dilation before it can be considered the standard therapy for managing benign AS after colorectal surgery.

This study has some limitations. This was a sin-

gle-center, retrospective study. The number of participants was small, and long-term follow-up data were lacking. We also noticed substantial variability in the primary surgeries performed as well as the treatment for AS performed by the surgeons. A bigger sample size, a longer follow-up duration, and more standardized protocols may generate more conclusive results in the future.

Conclusions

AS is a common late complication occurring after colorectal surgery, which is difficult to treat. Its associated risk factors include smoking, obesity, and low anterior resection. Optimal correction of risk factors, excellent surgical techniques, and reduced anastomotic leaks are critical in preventing AS after surgery. The management of AS should depend on etiology, length of stricture, and location. Endoscopic balloon dilation is an acceptable intervention for benign strictures in select patients. Redo surgery may be suitable for patients with failure of endoscopic interventions or predictors of poor outcomes under endoscopic interventions.

References

1. Hiranyakas A, Da Silva G, Denoya P, Shawki S, Wexner SD. Colorectal anastomotic stricture: is it associated with inadequate colonic mobilization? *Tech Coloproctol* 2013;17:371-5.
2. Lee SY, Kim CH, Kim YJ, Kim HR. Anastomotic stricture after ultralow anterior resection or intersphincteric resection for very low-lying rectal cancer. *Surg Endosc* 2018;32:660-6.
3. Asari SA, Cho MS, Kim NK. Safe anastomosis in laparoscopic and robotic low anterior resection for rectal cancer: a narrative review and outcomes study from an expert tertiary center. *Eur J Surg Oncol* 2015;41:175-85.
4. Bannura GC, Cumsille MA, Barrera AE, Contreras JP, Melo CL, Soto DC. Predictive factors of stenosis after stapled colorectal anastomosis: prospective analysis of 179 consecutive patients. *World J Surg* 2004;28:921-5.
5. Kwon YH, Jeon SW, Lee YK. Endoscopic management of refractory benign colorectal strictures. *Clin Endosc* 2013;46:472-5.
6. Biraima M, Adamina M, Jost R, Breitenstein S, Soll C. Long-term results of endoscopic balloon dilation for treatment of colorectal anastomotic stenosis. *Surg Endosc* 2016;30:4432-7.
7. Guyton KL, Hyman NH, Alverdy JC. Prevention of perioperative anastomotic healing complications: anastomotic stricture and anastomotic leak. *Adv Surg* 2016;50:129-41.
8. Suchan KL, Muldner A, Manegold BC. Endoscopic treatment of postoperative colorectal anastomotic strictures. *Surg Endosc* 2003;17:1110-3.
9. Schlegel RD, Dehni N, Parc R, Caplin S, Tiret E. Results of reoperations in colorectal anastomotic strictures. *Dis Colon Rectum* 2001;44:1464-8.
10. Genser L, Manceau G, Karoui M, Breton S, Brevart C, Rousseau G, Vaillant JC, Hannoun L. Postoperative and long-term outcomes after redo surgery for failed colorectal or coloanal anastomosis: retrospective analysis of 50 patients and review of the literature. *Dis Colon Rectum* 2013;56:747-55.
11. Tonolini M, Bareggi E, Salerno R. Endoscopic stenting of malignant, benign and iatrogenic colorectal disorders: a primer for radiologists. *Insights Imaging* 2019;10:80.
12. Jain D, Sandhu N, Singhal S. Endoscopic electrocautery incision therapy for benign lower gastrointestinal tract anastomotic strictures. *Ann Gastroenterol* 2017;30:473-85.

原　著

大腸直腸手術後吻合狹窄：單一醫學中心經驗

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高達 30% 病人在大腸直腸手術後發生吻合狹窄，儘管大部分無症狀，吻合狹窄可能影響消化道的連續性及後續造口關閉。最佳處理方式目前仍無定論，反覆的手術切除及內視鏡治療或許可以改善狹窄。我們蒐集 2015 年 1 月至 2019 年 12 月，一共 11 位吻合狹窄的病人，其中 7 位病人接受低前位切除，4 位病人接受前位切除。5 位病人在初次術後發生吻合滲漏。所有吻合狹窄皆為良性，有 4 位病人僅接受內視鏡治療，有 3 位病人僅接受手術切除，4 位病人同時接受內視鏡治療及手術治療。使用內視鏡氣球擴張術及再次手術的治療成功率分別為 75% 及 50%。2 位病人因為骨盆腔腫瘤復發而無法進行吻合狹窄治療。

關鍵詞　吻合狹窄、治療、內視鏡氣球擴張術。