Evaluation of efficacy of endoscopic incision method in postoperative benign anastomotic strictures of gastrointestinal system

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Abstract

Introduction: Postoperative benign anastomotic strictures (POBAS) which develop after surgical resections of the gastrointestinal system (GIS) present with symptoms depending on location of the stricture. Diagnosis is confirmed by endoscopic and radiological methods. Although bougie or balloon dilatation is preferred in management, the endoscopic incision method (EIM) is also used with considerable success. In this trial, we aimed to evaluate EIM, which is one of the endoscopic dilatation techniques used in postoperative anastomotic stricture of GIS.

Material and methods: A total of 20 POBAS patients, 12 men and 8 women, subjected to EIM intervention for strictures, were enrolled in the trial. The number of patients with upper GIS strictures was 6 (30%), while the number of cases with lower GIS strictures was 14 (70%).

Results: Dilatation of the stricture was achieved in 15 (75%) patients with one treatment session, while more than one session of EIM was needed in 5 (25%) cases. Mean duration of follow-up of patients was 10.65 ±5.86 (0–25) months. Procedure-related complications developed in 8 patients. Among them, 7 were minor complications and improved without any treatment. In only 1 (5%) patient, perforation was observed as a major complication. Following EIM, recurrence of POBAS was observed in 5 (25%) patients. The following parameters were found to have an impact on successful outcome in EIM: presence or absence of a tortuous lumen in POBAS (p = 0.035) and length of stricture (p = 0.02), complications during the procedure (if any), and presence of single or multiple strictures.

Conclusions: Endoscopic incision method may be regarded as a favorable approach among first choice treatment alternatives in uncomplicated anastomotic strictures of GIS, or it may be used as an adjunctive dilatation method.

Key words: anastomosis, stricture, endoscopic incision.

Introduction

In gastrointestinal system (GIS) diseases which require surgical intervention, surgical resection preserving continuity of the gastrointestinal tract is the preferred treatment method [1]. However, the main cause of morbidity in this method is postoperative anastomotic strictures. Among endoscopic methods, bougie and balloon dilatation are the most frequently preferred techniques; however, techniques such as corticosteroid injection, placement of stents, endoscopic incision method (EIM)

and injection of mitomycin C are also used with considerable success. Surgical intervention is required in a group of patients comprising 5–15% of all cases. However, adjunctive surgical resection is problematic in all cases in terms of technical implementation [2–7]. Literature data on bougie and balloon dilatation in anastomotic strictures of the GIS are more comprehensive as compared to other endoscopic dilatation techniques, but EIM was reported in a limited number of cases [8–22].

Operative GIS anastomoses have four major complications: anastomotic leak, fistula, bleeding and anastomotic stricture. In the literature, incidence of postoperative benign anastomotic strictures (POBAS) is reported as 5–46% for the upper GIS and 1.3–18% for the lower GIS [23–28]. Postoperative benign anastomotic strictures may be due to various causes: inflammatory pseudotumors following postoperative complications, secondary to use of a circular stapler, ischemia of the upper portion of the gastric tract, and secondary fibrosis due to radiotherapy [2, 29]. Inflammation and fibrosis are the main outcomes in all cases of benign strictures. Although these complications are usually seen during the first months after surgery, an active fibrotic process may be prolonged, and it may also be seen after a few years following the operation [30]. Choice of treatment in initial stages is endoscopic methods such as bougie or balloon dilatation. Available data indicate that balloon and bougie dilatations are similar in terms of efficacy [31].

The success rate of dilatation treatments in anastomotic strictures varies between 70% and 90%. Unfortunately, these treatment approaches carry a considerable risk of recurrence, and hence repetitive treatment sessions are required in patients. In various trials, the mean number of dilatation sessions per patient varies between 2 and 9 [2, 23, 25, 32–34]. Cases which require more than four dilatation sessions are defined as "persistent strictures", and various endoscopic treatment methods were reported to yield varying success rates. However, experience with this method, namely EIM, is limited to small patient series or case reports. In a group of cases comprising 5–15% of patients where these treatment approaches are not sufficient, surgical intervention is required [2–7, 35].

In recent years, outcomes of randomized and prospective studies conducted on endoscopic incisions indicate that EIM is at least as effective as balloon and bougie dilatation in > 1 cm complex strictures, while it is more effective than these methods in simple strictures shorter than 1 cm; the procedure is determined to be as safe as balloon and bougie dilatation in both simple and complex anastomotic strictures [36, 37].

In this study, we aimed to evaluate complications, recurrence rate and utility of EIM, a less commonly used endoscopic dilatation technique, in POBAS of GIS.

Material and methods

Patients referring to the Department of Gastroenterology Endoscopy Unit of Ankara Numune Education and Research Hospital for endoscopic evaluation due to various symptoms during January 2009-April 2011, diagnosed as postoperative anastomotic stricture in the GIS based on endoscopic evaluation, with no history of previous endoscopic dilatation and subjected to EIM intervention in our center for strictures, were enrolled in the trial. Inclusion criteria were patients who had anastomotic stenosis after a gastrointestinal operation due to benign or malignant lesions. Exclusion criteria were patients who had contraindications for endoscopy (such as heart failure, respiratory failure, coagulation disorders) and malignant pathology of anastomotic stricture, and previous intervention of stricture dilatation with any method. The following parameters were assessed: age, gender, cause(s) of surgical intervention, type of surgery, method of surgical intervention, presence or absence of postoperative complications, type of postoperative complications, time frame between the operation and development of anastomotic stricture, symptoms due to anastomotic stricture, localization, length and diameter of anastomotic stricture, endoscopic findings accompanying stricture, adjunctive endoscopic treatment methods in addition to endoscopic incision (if any), complications associated with the procedure and number of required endoscopic treatment sessions.

Benign character of the stricture was confirmed both prior to EIM and after the procedure by endoscopic and radiological examination; in patients suspected to have malignancies (such as ulcer, ulcerovegetative mass or polyp, mucosal irregularity), additional histopathological evaluation was carried out. Length and diameter of the stricture was assessed by endoscopy; since the diameter of the utilized endoscope (Fujinon EG 530 WR videogastroscope (Fujinon, Omiya, Japan; diameter 9.4 mm, working channel 2.8 mm)) and colonoscope (Fujinon EC 530 WL videocolonoscope; Fujinon, Omiya, Japan; diameter 12,8 mm, working channel 3.8 mm) or dimensions of the needle-tipped sphincterotome (Olympus, Japan, KD-441Q Needle Knife) (diameter of external sheet 1.7 mm, length of knife 5 mm) were known, dimensions of the stricture were calculated based on these values. In cases where endoscopic evaluation was not possible, assessment was performed by barium radiography.

The procedure was explained to each patient and informed consent was taken. The local Ethical Committee approved the study.

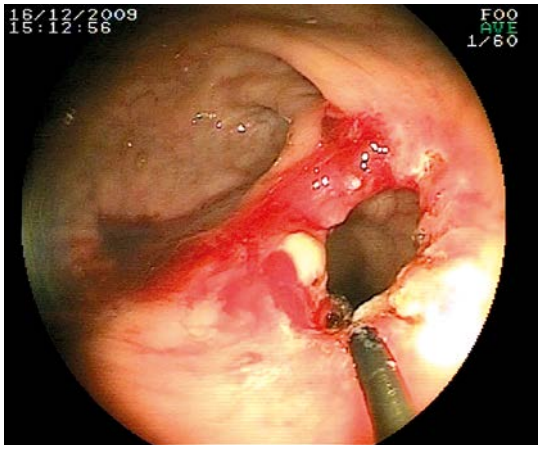

Figure 1. Endoscopic appearance of intervention with EIM on benign anastomotic stricture in lower GIS

Table I. Basic characteristics of patients (n = 20) and operation

Parameter	Result
Gender, *n* (%):	
Male	12 (60)
Female	8 (40)
Age, mean ± SD (range) [years]:	
Male	53.83 ±15.20 (27–75)
Female	49.12 ±18.50 (21–68)
Total	51.95 ±16.29 (21–75)
Cause of operation, *n* (%):	
Esophageal carcinoma	2 (10)
Gastric carcinoma	4 (20)
Sigmoid carcinoma	6 (30)
Rectum carcinoma	7 (35)
Traumatic rectum perforation	1 (5)
Type of operation, *n* (%):	
Emergency	2 (10)
Elective	18 (90)
Mode of operation, *n* (%):	
Subtotal esophagectomy	2 (10)
Total gastrectomy	4 (20)
Resection of sigmoid + right hemicolectomy	1 (5)
Left hemicolectomy	3 (15)
Resection of sigmoid	4 (20)
Low-anterior resection	6 (30)
Postoperative complications, *n* (%):	
No complications	13 (65)
Infection	4 (20)
Leak, infection	2 (10)
Leak, infection, bleeding	1 (5)

Endoscopic incision method

Following necessary preparations, the tip of the endoscope was placed proximally to the stricture area and the needle-tipped sphincterotome was advanced through the working channel to the anastomotic line and placed under direct vision, as applied in sphincterotomy (Figure 1). The bimodal electrocautery current was adjusted to blend 2 mode, and software controlled incision was performed. Electrocautery devices were adjusted according to treatment of normal sized and small polyps. Effective incision power was set at 120 W per 50 s, while coagulation power was 45 W per 750 ms. With the needle-tipped sphincterotome, linear incisions parallel to the gastrointestinal tract were performed on scar tissue in the stricture area. Depth, number and length of the incisions were adjusted so as to dilate the lumen of the stricture, based on the form and length of the stricture. The procedure was terminated upon ready passage of the endoscope through the stricture. Patients were monitored for 3 h after the procedure and were discharged based on absence of bleeding, pain, fever and symptoms associated with other complications.

Statistical analysis

The program SPSS for Windows 18 was used for data analysis. Compliance of continuous variables with normal distribution was assessed by the Kolmogorov-Smirnov test. Continuous numeric variables were indicated as mean ± standard deviation or median (minimum-maximum), while nominal variables were presented as the number of cases and percentage (%). Normally distributed variables were evaluated by unpaired Student's *t* test, and non-normally distributed variables were assessed by the non-parametric Mann-Whitney *U* test. Nominal variables were evaluated by the χ^2 test. Results with p values < 0.05 were regarded as statistically significant. Correlation of data was assessed by the Spearman rank correlation method, and $p < 0.05$ was regarded as statistically significant.

Results

A total of 20 patients, 12 (60%) men and 8 (40%) women, were enrolled in the trial. Mean age was 51.95 ±16.29 (21–75) years; it was 53.83 ±15.20 (27–75) years in male patients and 49.12 ±18.50 (21–68) years in female patients. A history of surgical intervention was found in only 1 patient due to extra-malignant causes (traumatic rectum perforation). Basic characteristics of patients are summarized in Table I.

Elective surgery was performed in 18 cases (in 2 patients it was not performed). One of the emer-

gency operations was performed for traumatic rectum perforation, while the other patient was operated on for acute abdomen and diagnosed malignancy in the rectum. Various resection procedures and end-to-end anastomosis operations (subtotal esophagectomy, total gastrectomy, right and left hemicolectomy, resection of sigmoid, low anterior resection of rectum) were performed in different patients. No operation-related complications were seen in 13 (65%) patients while infection at incision site was observed in 4 (20%) patients, leak from site of anastomosis and infection at incision site in 2 (10%) patients and leak from site of anastomosis + infection at incision site + bleeding from incision site was seen in 1 (5%) patient in the postoperative stage. Surgical operations and features of postoperative complications are summarized in Table I.

The number of patients with upper GIS strictures was 6 (30%) while the number of lower GIS strictures was 14 (70%). Type of stricture was simple in 2 (10%) patients, and 18 patients had complex strictures (90%). Mean diameter of POBAS was measured as 4.6 ±1.95 (2–9) mm and mean length of POBAS was 19.3 ±11.99 (5–40) mm; mean duration for development of POBAS was 6.85 ±4.31 (1–17) months. Fistula was found to coexist with POBAS in colon diverticula in 1 patient and in the area of the long segment anastomotic stricture in another patient. The POBAS was determined as a single stricture in 15 (75%) patients, while POBAS with multiple strictures was found in 5 (25%) patients. The lumen of POBAS showed a smooth surface in 14 (70%) patients, while a tortuous lumen was observed in 6 (30%) patients. All 6 (30%) patients with upper GIS strictures referred with symptoms of dysphagia; in patients with lower GIS POBAS, 2 (10%) cases reported constipation, 4 (20%) patients reported constipation and abdominal pain, 2 (10%) patients referred with constipation and flatulence and 6 (30%) patients reported constipation, abdominal pain and flatulence. Features of postoperative benign anastomotic strictures are shown in Table II.

Correlation between time to development of POBAS and length and diameter of stricture was statistically insignificant (p = 0.613/p = 0.483). Upper GIS strictures were statistically significantly shorter than lower GIS strictures (p = 0.007). However, no statistically significant difference was found between upper and lower GIS strictures in terms of stricture diameter (p = 0.120).

Mean duration of follow-up of patients was 10.65 ±5.86 (0–25) months. A single treatment session provided dilatation of stricture in 15 (75%) patients; two sessions in 3 (15%) patients and three sessions in 2 (10%) patients were required for dilatation. Procedure-related complications were observed in a total of 8 patients. Seven of these complications were minor events and improved without any treatment (minor bleeding in 5 (25%) patients, pain in 2 (10%) patients). Major complication was observed in only 1 (5%) patient in the form of perforation. In the case with perforation, barium radiography was performed prior to the procedure due to a history of recurrent surgical interventions (3) and radiotherapy. However, no additional pathological finding was seen in radiography, apart from the stricture. During EIM, a second stricture area in the form of multiple pinholes was observed after dilatation of the first stricture. A suspicion of fistula was raised due to absence of feces in the proximity of the stricture, endoscopic appearance and localization; therefore a guide wire was passed through this area. The procedure was terminated due to presentation of a guide wire in the vaginal area, and the patient was referred for emergency surgery. Rectovaginal fistula in this area was also confirmed during the operation.

Table II. Features of postoperative benign anastomotic strictures (n = 20)

Parameter	Result
Localization of POBAS, *n* (%):	
Upper GIS	6 (30)
Lower GIS	14 (70)
Nature of POBAS, *n* (%):	
Simple	2 (10)
Complex	18 (90)
Diameter of POBAS, mean ± SD (range) [mm]	4.6 ±1.95 (2–9)
Length of POBAS, mean ± SD (range) [mm]	19.3 ±11.99 (5–40)
Presence of fistula co-existing with POBAS, *n* (%)	1 (5)
Presence of diverticula co-existing with POBAS, *n* (%)	1 (5)
Presence of single or multiple stricture (s) in POBAS, *n* (%)	15 (75)/5(25)
Smooth or tortuous lumen in POBAS, *n* (%)	14 (70)/6(30)
Duration to development of POBAS, mean ± SD (range) [months]	6.85 ±4.31 (1–17)
Symptoms of POBAS, *n* (%):	
Dysphagia	6 (30)
Constipation	2 (10)
Constipation, abdominal pain	4 (20)
Constipation, flatulence	2 (10)
Constipation, abdominal pain, flatulence	6 (30)

Recurrence of POBAS following EIM was observed in 5 (25%) patients. Mean duration to recurrence of POBAS was 3.2 ±1.30 (2–5) weeks. No statistical assessment could be performed between patients with upper and lower GIS strictures in terms of duration without any recurrence after dilatation with EIM because the number of patients was not sufficient. No statistically significant correlation was found between diameter and length of POBAS and successful outcome of the procedure (p = 0.761/p = 0.224). The correlation between number of procedural sessions and length of stricture plus presence or absence of a tortuous lumen was statistically significant (p = 0.035/p = 0.02), while there was no significant correlation between number of sessions and stricture diameter (p = 0.59). No significant correlation was found between number of sessions and presence of single or multiple strictures and length of stricture (p = 0.13/p = 0.10). This finding was due to the low number of patients with multiple strictures. Properties of the endoscopic incision method are shown in Table III.

In multivariate analysis, parameters with an impact on success of the procedure were specified as presence of single or multiple strictures in POBAS, smooth or tortuous lumen and presence or absence of complications during the procedure.

Table III. Properties of endoscopic incision method (n = 20)

Parameter	Result
Duration of follow-up after EIM, mean ± SD (range) [months]	10.65 ±5.86 (0–25)
EIM-associated complications, *n* (%):	
No complications	12 (60)
Minor bleeding	5 (25)
Pain	2 (10)
Perforation	1 (5)
Total morbidity due to EIM, *n* (%)	8 (40)
Total mortality due to EIM, *n* (%)	0 (0)
Methods used for dilatation, *n* (%):	
Only EIM	12 (60)
EIM and TTS balloon	5 (25)
EIM and intralesional steroids	1 (5)
EIM, intralesional steroids + TTS balloon	2 (10)
Number of EIM sessions, mean ± SD (range)	1.35 ±0.67 (1–3)
Number of patients with recurrence of POBAS, *n* (%)	5 (25)
Duration to recurrence of POBAS, mean ± SD (range) [weeks]	3.2 ±1.30 (2–5)

Discussion

Since longitudinal dilatation methods may cause massive trauma in the intestinal wall, balloon dilatation which exerts radial pressure is the preferred method [38, 39]. However, even balloon dilatation may frequently cause mucosal fissures and carry a risk of perforation in the intestinal wall at the weakest point of the stricture ring. This may be prevented by implementation of linear incisions in the strongest portion of the scar tissue under endoscopic direct vision, as applied in sphincterectomy. Additionally, early endoscopic intervention prevents poor outcome of severe fibrosis and persistent stenosis while providing ready passage of contents in the gastrointestinal tract.

In the current trial, one endoscopic incision session was found to be sufficient in patients with anastomotic strictures shorter than 1 cm, while more than one session was required in some patients with anatomical strictures longer than 1 cm, and these findings were in compliance with literature data. In endoscopic evaluation performed prior to the endoscopic incision session, no active inflammation findings were found in inspection of epithelial tissue in the anastomotic area in any of the patients; however, inflammation may be present in deep layers of anastomosis in patients with long segment strictures, and this is not detected in endoscopic evaluation. It was previously shown that in patients with long segment strictures, postoperative complications such as postoperative leak, fistula and infection at the site of anastomosis were common and these postoperative complications were associated with poor vascularization [24, 40].

Poor vascularization and extensive inflammation in deep layers of anastomosis may cause development of fibrotic tissue and lead to resistance against treatment with EIM. In addition, this may explain the observation that treatment with EIM is less successful in long segment strictures as compared to short segment strictures.

In the literature, mild bleeding associated with endoscopic incision was reported in a small number of cases, and bleeding was taken under control in all cases with endoscopic methods [8, 17]. The higher proportion of cases with mild bleeding in our trial, as compared to the literature, may be due to negligence of these cases in previous series, since these were mild and reversible cases, or it may be related to the fact that all patients in the current trial are complicated cases, presenting with strictures with especially very short diameters.

Rates of perforation in dilatation methods are reported as 0.1–0.4%, and it is caused by mucosal tears [25, 31, 33, 41, 42]. Detailed evaluation

of the stricture area is required prior to EIM. No further evaluation is required in cases where the distal region of the constricted lumen is readily seen in endoscopic evaluation in short segment strictures. On the other hand, in cases where the distal lumen is not readily visualized or cases of suspected complex strictures and in patients with a history of more than one or complicated surgical operations, the stricture site should be evaluated with various methods such as barium radiography, computed tomography, magnetic resoanance imaging and endoscopic ultrasound, and detailed anatomy should be exposed. In our series, a history of recurrent surgical intervention (three) and radiotherapy was present in the case with perforation; therefore, barium radiography was performed prior to the procedure, and no pathology was found in radiography apart from the stricture. During EIM, a second area of stricture with the size of a pinhole was detected, after dilatation of the first stricture. Fistula was suspected during incision of this area; therefore the procedure was terminated and the area was confirmed as a rectovaginal fistula by surgical operation. Due to the low number of cases and application of the procedure by experienced endoscopists in all cases, the low rate of complications in previously published EIM series may not be regarded as a reliable finding.

Success of treatment and rate of recurrence of stricture is associated with length of the strictured segment. In order to evaluate efficacy of EIM in long segment strictures, trials should be conducted on a considerably greater number of patients with long segment strictures. However, in a great majority of patients with short segment anastomotic strictures with a length of less than 1 cm, treatment with even one session provided a symptom-free life span of more than 12 months [43]. This finding indicates that duration of efficacy in EIM in short segment strictures is longer than bougie and balloon dilatation [44]. Low recurrence rates following EIM may be explained by absence of additional synthesis of collagen fibers after endoscopic incision in animal studies [45].

In several cases, fibrotic stricture is considerably rigid; this causes a nonfunctional outcome in balloon dilatation technique or the requirement of more than one treatment session; EIM may be performed in such cases [17, 46]. In recent years, a trial published by Truong *et al.* showed that combined use of EIM and the consecutive balloon dilatation technique provided long-term clinical efficacy with minimum complications [37].

Novel methods have been used in colorectal strictures in recent years (e.g. placement of self-expendable metal stent); acute and chronic complications (bleeding, perforation, migration of stent) as well as high cost may limit the use of these methods [47, 48].

Endoscopic incision method has certain advantages in treatment of anastomotic GIS strictures as a low-cost, safe and effective method as compared to other procedures. In a trial conducted by Truong *et al.* dilatation with EIM was performed in a total of 36 patients with lower GIS POBAS. Complex stricture was found in 15 of 36 (41%) patients, and the procedure was unsuccessful in only 1 patient. Cause of failure of the procedure was associated with the long segment property of the stricture. However, no information is available on structural features of the stricture, namely tortuosity and presence of single or multiple strictures [37]. In the current trial, complex strictures were found in 18 of 20 (90%) patients, while the procedure failed in only 2 patients. In these patients, complex and long segment strictures were present, while strictures were tortuous and multiple in both patients. We suggest that in patients with lower GIS POBAS, exposing the parameters related to unfavorable outcomes of the procedure, namely presence of multiple strictures and structural features of stricture such as tortuous lumen, as specified in our trial, is significant in terms of a successful outcome of the procedure and in prevention of procedure-related complications. Common dilatation methods such as balloon or bougie increase the perforation risk from the weak side of the anastomotic area because of invasion of force without control transversely and longitudinally. In EIM, incision of thickened mucosal collagen fibers decreases the risk of perforation in additional balloon dilatation when needed, and provide an advantage of using lower balloon pressure [46, 49, 50].

The main limitation of the present study is the low number of cases, as in other EIM studies in the literature, because the frequency of symptomatic benign anastomotic stricture is not high. Another limitation is the lack of analysis of upper and lower GIS cases separately, again due to the low number of cases. On the other hand, our study includes more complicated cases than other EIM studies in the literature, with a higher number of cases. In the study of Truong *et al.*, EIM was not successful in 15 of 36 (41%) patients, and they did not explain the structural features of the stricture, such as tortuosity of the lumen and presence of multiple strictures in the segment [37]. Similarly, medical literature generally focuses on the length of the strictured segment, but our study revealed the importance of tortuosity and other structural features of the stricture. Also our study revealed that besides length of the stricture, luminal tortuosity and the presence of multiple strictures are also important factors that affect success of EIM in GIS POBAS.

Endoscopic incision method is a cheaper method with a low risk of perforation and longer duration of lumen aperture in short segmental stric-

tures, compared to classical dilatation methods [44]. Furthermore, it can also be combined with other dilatation methods. The main disadvantages are the need for endoscopic experience of the gastroenterologist, and low success rates in long segments.

In conclusion, the place of EIM in treatment algorithms of GIS strictures will change as the experience is increased in implementation of the procedure. In postoperative anastomotic GIS strictures, and especially in simple-short anastomotic strictures, this method may be regarded as a good alternative among first choice treatments, or it may be used as an adjunctive dilatation method.

Conflict of interest

The authors declare no conflict of interest.

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