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# Endoscopy-Guided Balloon Dilation of Benign Anastomotic Strictures after Radical Gastrectomy for Gastric Cancer

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**Background/Aims:** The aim of this study was to evaluate the outcome of endoscopic dilation for benign anastomotic stricture after radical gastrectomy in gastric cancer patients. **Methods:** Gastric cancer patients who underwent endoscopic balloon dilation for benign anastomosis stricture after radical gastrectomy during a 6-year period were reviewed retrospectively. **Results:** Twenty-one patients developed benign strictures at the site of anastomosis. The majority of strictures occurred within 1 year after surgery (95.2%). The median duration to stenosis after surgery was 1.70 months (range, 0.17 to 23.97 months). The success rate of the first endoscopic dilation was 61.9%. Between the restenosis group (n=8) and the no restenosis group (n=13), there were no significant differences in the body mass index (22.82 kg/$m^2$ vs 22.46 kg/$m^2$), interval to symptom onset (73.9 days vs 109.3 days), interval to treatment (84.6 days vs 115.6 days), maximal balloon diameter (14.12 mm vs 15.62 mm), number of balloon dilation sessions (1.75 vs 1.31), location of gastric cancer or type of surgery. One patient required surgery because of stricture refractory to repeated dilation. **Conclusions:** Endoscopic dilation is a highly effective treatment for benign anastomotic strictures after radical gastrectomy for gastric cancer and should be considered a primary intervention prior to proceeding with surgical revision. **(Gut Liver 2014;8:394-399)**

**Key Words:** Stomach neoplasms; Anastomotic stricture; Radical gastrectomy; Endoscopic dilation

## INTRODUCTION

Anastomotic stricture is a complication of upper gastrointestinal surgery. Balloon dilation (BD) has been shown to be a safe and effective nonsurgical method to manage anastomotic strictures. Endoscopically guided BD has been described in patients with esophageal anastomotic stricture,[1-3] gastrojejunal anastomotic stricture after Roux-en-Y gastric bypass,[4] and colorectal anastomotic stricture.[5,6] One study reported the management of benign anastomotic strictures after total gastrectomy by fluoroscopically guided BD without the use of an endoscope.[7] To our knowledge, however, few reports have focused on the efficacy of endoscopic BD for benign anastomotic stricture after radical gastrectomy in gastric cancer patients.

The purpose of this study was to retrospectively investigate the results of endoscopic BD for benign anastomotic stricture after radical gastrectomy in gastric cancer patients.

## MATERIALS AND METHODS

### 1. Patients

We performed a retrospective review of prospectively collected data on 7,011 patients who underwent radical gastrectomy for gastric cancer, 21 of whom had endoscopically guided BD at Severance Hospital, Yonsei University College of Medicine, Seoul, Korea from January 2006 to March 2012. Exclusion criteria included a previous history of other cancers, prior abdominal surgery, and other malignant stricture. We also excluded those with malignant stricture at the site of anastomosis, and those with benign stricture without endoscopically guided BD.

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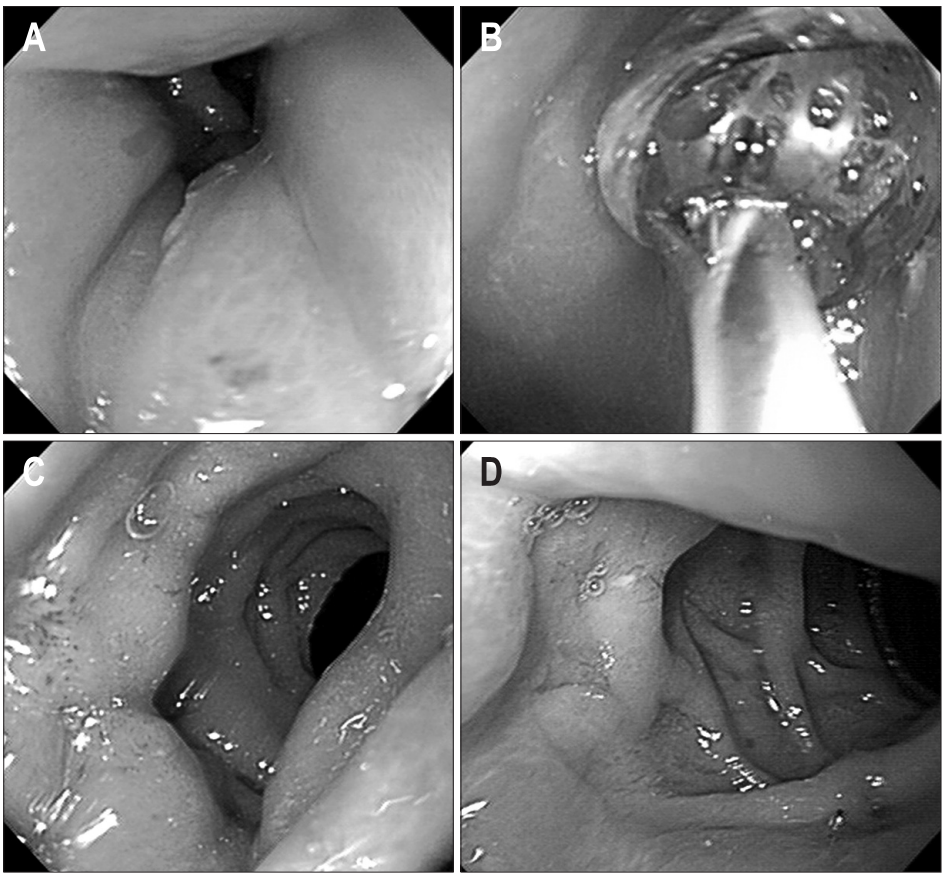


**Fig. 1.** Endoscopic images of the through-the-scope balloon dilation procedure. (A) Anastomosis stricture after subtotal gastrectomy (Billroth I), approximately 5 mm in diameter. (B) Balloon dilation procedure. (C) Relieved stricture just after dilation. (D) Maintained luminal diameter without recurrence of stricture 11 months after operation.

The Institutional Review Board of Yonsei University Hospital approved the study protocol, which was conducted in accordance with the Declaration of Helsinki.

#### 2. Diagnosis of benign stricture

A gastroduodenoscope (GIF Q240 or H260; Olympus Optical Co., Ltd., Tokyo, Japan) with an outer diameter of 10.2 or 9.8 mm was used to perform routine upper endoscopy 3 months after gastrectomy and whenever a patient presented with dysphagia. An anastomotic stricture was defined as a narrowing that did not allow passage, or showed significant resistance to passage of the gastroduodenoscope in symptomatic patients. Severe stricture was defined as a narrowing that allow passage for liquid only.

#### 3. Endoscopic balloon dilation technique

Dilations were performed by one of three experienced endoscopists who each have performed over 1,000 endoscopies annually. Through-the-scope (TTS)-BD was performed with the patient under conscious sedation and under direct endoscopic visual control with fluoroscopic monitoring. Disposable TTS-BD catheters whose diameter was between 6 to 20 mm were used (Controlled Radial Expansion Balloon Dilator; Boston Scientific, Cork, Ireland). The size of the stricture was estimated with biopsy forceps that measured 7.3 or 4.8 mm (FB-24 K-1 or FB-25 K-1; Olympus Optical Co., Ltd., respectively) when fully opened.

A catheter with an adequate balloon size was selected and passed it into the stricture through the working channel (3.7 mm in diameter) of the endoscope (GIF 2T240; Olympus Optical Co., Ltd.). BD was usually begun with a diameter that was 2 to 3 mm larger than the estimated stricture diameter. After placing the balloon through the stricture, the balloon was inflated with a water/contrast mixture (1:1) to the recommended pressure for 60 seconds and then deflated it for 60 seconds before the next inflation (Fig. 1). The balloon diameter was progressively increased by 1 to 1.5 mm up to 13.5 to 20 mm in one or two sessions. Occurrence of perforations was checked by chest radiography. The patient fasted for 12 hours after the procedure. The success of the procedure was defined as restoration of the patient's ability to take solid food.

#### 4. Follow-up

Follow-up interviews and physical examinations were done at 2 weeks after BD, and then every 3 months (advanced gastric cancer cases) or 6 months (early gastric cancer cases); endoscopy was performed at 9 months and annually thereafter. If dysphagia recurred, restenosis was suspected and esophagogastroduodenoscopy was performed to confirm it. When restenosis did occur, TTS-BD was repeated. During follow-up, the patients were divided into two groups: 1) patients with symptoms sug-

gestive of stricture recurrence who subsequently underwent BD for restenosis of anastomotic strictures (the restenosis group) and 2) patients who had no further signs or symptoms of restenosis (the no restenosis group).

### 5. Statistical analysis

Continuous variables are expressed as the mean±SD. Continuous variables were analyzed using the Student t-test or univariate analysis of variance, and categorical variables were analyzed using the chi-square test. Two-tailed p-values less than 0.05 were considered statistically significant. Statistical analysis was carried out using SPSS version 18.0 software (IBM Co., Armonk, NY, USA).

## RESULTS

Twenty-one patients underwent BD, and median follow-up duration was 22.83 months (range, 1.87 to 79.60 months). Table 1 shows the characteristics of the patients who underwent endoscopic BD. The maximal diameter of the balloon catheters was 10 to 20 mm. No major complications, such as massive bleeding or perforation, occurred in this study.

Fig. 2 shows the cumulative percentage of patients with benign stricture after radical gastrectomy: 21 of the total 7,011 patients (0.30%). The majority of benign strictures occurred within 1 year after surgery (20 of 21 patients, 95.2%). Median duration to stenosis after surgery was 1.70 months (range, 0.17 to 23.97 months).

Number of BD session was as follows: a single dilation on 13 patients (61.9%), a second dilation on four patients (19.0%), a third dilation on three patients (14.3%), and a fourth dilation on one patient (4.8%). The success rate of the first BD was 61.9% (13 of 21 patients), and 61.9% of patients were on regular follow-up after the first dilation without recurrence. The only patient who underwent a fourth dilation required total gastrectomy due to refractory anastomostic stricture. Fig. 3 shows the cumulative percentage of patients with restenosis after the first endoscopic BD. The majority of restenosis occurred within 1 month after the first BD (seven of eight patients, 87.5%). Median duration to restenosis was 0.32 months (range, 0.03 to 3.97 months).

The patients were divided into two groups according to the presence of restenosis after the first BD (Table 2). There were no significant differences in body mass index (22.82 kg/$m^2$ vs 22.46 kg/$m^2$, p=0.911), interval to symptoms (73.87 days vs 109.30 days, p=0.635), interval to treatment (84.63 days vs 115.62 days, p=0.684), maximal balloon diameter (14.12 mm vs 15.62 mm, p=0.135), number of BD sessions (1.75 vs 1.31, p=0.103), location of gastric cancer (p=1.000), and type of surgery (p=1.000) between patients in the restenosis group (n=8) and those in the no restenosis group (n=13). There were significant difference in maximal diameter before ballooning (5.31 vs 4.38, p=0.039).

## DISCUSSION

Symptomatic anastomotic stricture is a relatively common finding after gastric surgery, occurring in up to 16.0% of patients as gastrojejunal anastomotic strictures.[4,8-10] The rate of benign anastomotic stricture in this study is quite low (21/7,011, or 0.3%), because the patients with benign anastomotic stricture who did not undergo endoscopic treatment were excluded. When considering laparoscopic surgery, laparoscopy-assisted total gastrectomy is a technically feasible procedure compared with laparoscopy-assisted distal gastrectomy. However, the postoperative complication rate of laparoscopy-assisted total gastrectomy is higher than that of laparoscopy-assisted distal gastrectomy, especially with regard to anastomotic stricture.[9] These strictures must be aggressively investigated and appropriately treated. The cause of the stricture after radical gastrectomy is not well understood, but ischemia (i.e., caused by a stapler), tension on the anastomosis, edema, or a foreign-body reaction are recognized factors.[11]

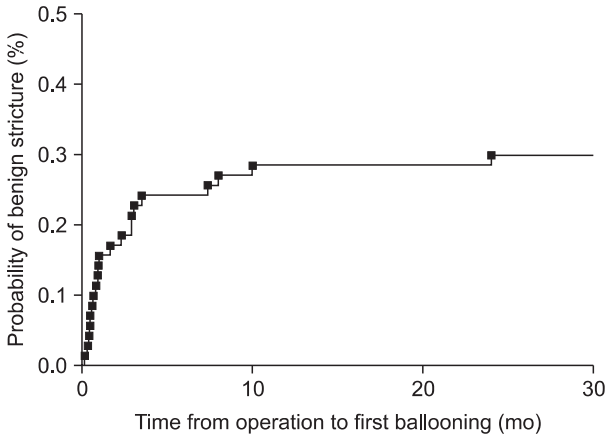


**Fig. 2.** Estimated cumulative percentage of patients with benign stricture after operation.

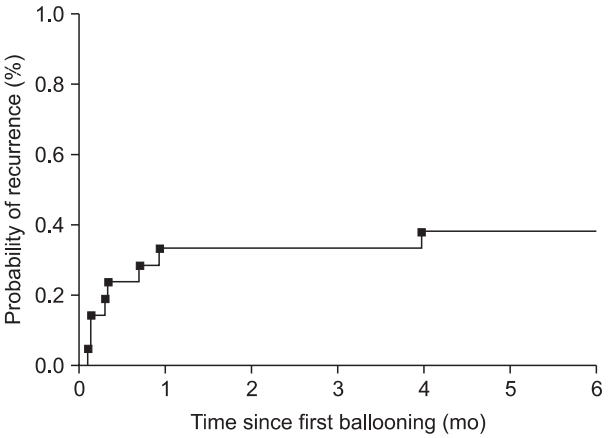


**Fig. 3.** Estimated cumulative probability of patients with recurrence after the first endoscopic balloon dilation.

**Table 1.** Characteristics of Patients with Endoscopic Balloon Dilation

| Patient no. | Age, yr | Sex | Stage of stomach cancer | AGC vs EGC | Location of stomach cancer | Surgery | Pathologic type of stomach cancer | Symptoms | Interval to symptoms after operation, day | Interval to treatment after operation, day | Maximal diameter before ballooning, mm | Maximal ballon diameter, mm | No. of sessions at 1st ballooning | 2nd ballooning | 3rd ballooning | 4th ballooning | Operation | Complication |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 48 | M | Ia | EGC | Body | Billroth II | AWD | Nausea/vomiting | 11 | 15 | 5 | 15 | 1 | | | | | None |
| 2 | 61 | M | Ia | EGC | Antrum | Billroth II | AMD | Nausea/vomiting | 85 | 88 | 4 | 15 | 2 | Y | Y | Y | Y | None |
| 3 | 65 | M | II | AGC (BIII) | Fundus | TG | AMD | Nausea/vomiting | 11 | 14 | 6 | 15 | 2 | | | | | None |
| 4 | 26 | M | IV | AGC (BIII) | Fundus | TG | APD | Nausea/vomiting | 9 | 25 | 4 | 12 | 1 | | | | | None |
| 5 | 65 | M | Ia | EGC | Fundus | TG | AWD | Nausea/vomiting | 5 | 30 | 5 | 15 | 1 | | | | | None |
| 6 | 38 | M | Ia | EGC | Antrum | Billroth II | AWD | Nausea/vomiting | 3 | 5 | 6 | 15 | 1 | | | | | None |
| 7 | 69 | F | Ia | EGC | Fundus | TG | AMD | None | 45 | 50 | 6 | 10 | 1 | Y | Y | | | None |
| 8 | 48 | F | Ia | EGC | Body | TG | SRC | Abdominal pain | 25 | 29 | 5 | 15 | 1 | Y | | | | None |
| 9 | 31 | M | IIIa | AGC (BIV) | Antrum | Billroth II | APD | Nausea/vomiting | 90 | 105 | 5 | 15 | 2 | | | | | None |
| 10 | 73 | M | Ib | AGC (BIII) | Antrum | Billroth I | AMD | Abdominal pain | 7 | 10 | 7 | 18 | 1 | | | | | None |
| 11 | 50 | F | Ia | EGC | Body | Billroth I | AMD | Nausea/vomiting | 5 | 12 | 6 | 15 | 1 | | | | | None |
| 12 | 79 | F | Ia | EGC | Antrum | Billroth I | APD | Nausea/vomiting | 15 | 18 | 5 | 16 | 2 | | | | | None |
| 13 | 63 | M | Ib | AGC (BIII) | Fundus | TG | APD | Nausea/vomiting | 40 | 70 | 4 | 15 | 2 | Y | | | | None |
| 14 | 61 | M | Ib | AGC (BIII) | Antrum | Billroth I | AWD | Nausea/vomiting | 80 | 88 | 3 | 13 | 2 | Y | Y | | | None |
| 15 | 54 | M | Ia | EGC | Body | TG | APD | Dysphagia | 700 | 720 | 5 | 18 | 1 | | | | | None |
| 16 | 82 | M | IV | AGC (BIII) | Fundus | TG | APD | Nausea/vomiting | 290 | 300 | 6 | 15 | 2 | | | | | None |
| 17 | 52 | F | IV | AGC (BIII) | Body | TG | APD | Nausea/vomiting | 215 | 221 | 4 | 14 | 1 | | | | | None |
| 18 | 28 | F | IV | AGC (BIV) | Body | TG | SRC | Nausea/vomiting | 220 | 240 | 5 | 16 | 1 | Y | | | | None |
| 19 | 45 | F | IV | AGC (BIII) | Body | TG | SRC | Dysphagia | 60 | 28 | 5 | 20 | 1 | | | | | None |
| 20 | 50 | M | IIIa | AGC (BIII) | Body | TG | APD | Abdominal pain | 83 | 92 | 5 | 17 | 2 | Y | | | | None |
| 21 | 50 | F | Ia | EGC | Antrum | Billroth I | AMD | Abdominal pain | 13 | 20 | 3 | 12 | 3 | Y | Y | | | None |

AGC, advanced gastric cancer; EGC, early gastric cancer; AWD, adenocarcinoma well differentiated; AMD, adenocarcinoma moderate differentiated; BIII, Borrmann type III; BIV, Borrmann type IV; TG, total gastrectomy; APD, adenocarcinoma poorly differentiated; SRC, signet ring cell carcinoma.

**Table 2.** Characteristics of Patients at the Initial Balloon Dilation

| Characteristic | No restenosis group (n=13) | Restenosis group (n=8) | p-value* |
|---|---|---|---|
| Age, yr | 54.46±17.6 | 53.75±12.8 | 0.922 |
| Sex | | | |
| Male | 9 (69.2) | 4 (50.0) | 0.646 |
| Female | 4 (30.8) | 4 (50.0) | |
| Weight, kg | 61.69±12.5 | 62.38±14.8 | 0.911 |
| Height, cm | 166.08±9.8 | 164.88±6.6 | 0.764 |
| Body mass index, kg/m$^2$ | 22.46±4.6 | 22.82±4.4 | 0.858 |
| Maximal diameter before ballooning, mm | 5.31±0.9 | 4.38±1.1 | 0.039 |
| Interval to symptoms after operation, day | 109.30±199.4 | 73.87±65.1 | 0.635 |
| Interval to treatment after operation, day | 115.62±203.7 | 84.63±68.6 | 0.684 |
| From operation to initial balloon dilation according to 90 days | | | |
| Less than 90 | 9 (69.2) | 6 (75.0) | 1.000 |
| Over 90 | 4 (30.8) | 2 (25.0) | |
| Location of stomach cancer | | | |
| Cardia | 4 (30.8) | 2 (25.0) | 1.000 |
| Funds | 0 | 0 | |
| Body | 5 (38.5) | 3 (37.5) | |
| Antrum | 4 (30.8) | 3 (37.5) | |
| Surgery | | | |
| TG | 7 (53.8) | 5 (62.5) | 1.000 |
| Billroth I | 3 (23.1) | 2 (25.0) | |
| Billroth II | 3 (23.1) | 1 (12.5) | |
| Initial ballooning | | | |
| Maximal balloon diameter, mm | 15.62±2.0 | 14.12±2.3 | 0.135 |
| No. of sessions | 1.31±0.5 | 1.75±0.7 | 0.103 |

Data are presented as mean±SD or number (%).
TG, total gastrectomy.
*Calculated by independent samples t-tests or chi-square tests.

TTS-BD has been advocated as an effective therapy for the stenosis, but the data are scarce and relate only to esophageal, colorectal, and gastroenteric anastomotic strictures after gastric bypass surgery. In one cohort study of 14 patients with laparoscopic gastric bypass, 58% of patients achieved long-term resolution of symptoms using a 15-mm hydrostatic balloon.[12] Cho *et al.*[7] reported long-term follow-up results of benign anastomotic strictures after total gastrectomy that was managed with fluoroscopically guided BD. Overall clinical success was achieved without major complications in 91% of the patients, after a mean of 1.3 sessions. Most of the patients with overall clinical success needed only a single dilation session and no patients needed surgical correction.[7]

TTS-BD was found to be sufficiently safe for treatment of gastrojejunal anastomotic stricture after Roux-en-Y gastric bypass in ambulatory settings.[13] In that study, all dilations were effectively accomplished in ambulatory settings with no required hospital stay for 98% of the patients; a low rate of repeated dilations means reduced surgical costs for patients. TTS-BD is also effective and safe for benign colorectal anastomotic stricture, which occurs in approximately 20% of patients after low anterior resection.[5,6] There was no relationship found between the number of dilation sessions and recurrence in those studies. In patients with cervical esophagogastrostomy, TTS-BD was performed for the management of benign anastomotic stricture. Complete relief of dysphagia was obtained in 20 of the 24 patients.[2]

The cause of restenosis after TTS-BD during radical gastrectomy is not well understood. Chung *et al.*[1] reported that certain factors influence restenosis in esophageal anastomotic stricture. Approximately 83.3% (10/12) of cases required repeated dilation within 4 months. Duration of less than 90 days from surgery to initial intervention and stricture diameter less than 13 mm after the initial intervention were independent clinical findings for repeated dilation. The patients undergoing BD earlier than 90 days after surgery require careful observation for restenosis. Postdilator diameter greater than 13 mm is needed to avoid restenosis. However, in our study, there were no significant differences in the duration from surgery to initial intervention or in postdilator diameter, as shown in Table 2.

In addition, maximal diameter before ballooning was smaller in restenosis group than that in no restenosis group (5.31 vs 4.38, p=0.039). But its causal relationship was not clear. Enough dilatation was likely to not have been done in more stenotic group because of the risk of bleeding or perforation.

Maximal dilation size must still be determined. In our series, one patient had 20-mm BD without complications. One study reported that fluoroscopically guided BD was effective and safe for use in the management of benign anastomotic stricture after total gastrectomy. A luminal diameter of 20 mm appears to be optimal for prevention of recurrent symptoms with the fewest complications.[7] In addition, another report demonstrated that TTS-BD to 15 mm was a safe and effective treatment for benign esophagojejunostomy strictures following total gastrectomy. Restenosis was not common and could be resolved by one or two further TTS-BD sessions.[3,4]

The limitations of this study are its retrospective design, which could involve selection bias, and its small, nonrandomized format. Because we used a very limited definition for anastomotic stricture, patients with only severe strictures were included. Therefore, this excludes symptomatic patients with mild to moderate strictures and probably biases the data and results. A larger, prospective, randomized trial is needed to con-

firm our data. Then, it would be possible to clarify what factors influence BD failure. Since the data in this study were collected at a single, third-degree referral center, the application of these results may be limited. However, our good outcomes suggest that TTS-BD can relieve benign anastomotic stricture after radical gastrectomy in gastric cancer patients. Although 38.1% of patients had restenosis after the first endoscopic BD, most were successfully treated by repeated BD. As we mentioned earlier, the majority of benign strictures occurred within 1 year after surgery, and restenosis occurred within 1 month after the first BD. Therefore, close observation is recommended for patients with symptoms suggestive of stricture after radical gastrectomy.

In conclusion, endoscopic BD is an effective treatment for benign anastomotic strictures after radical gastrectomy for gastric cancer and should be considered a primary intervention prior to proceeding with surgical revision.

## CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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