Benign Strictures of the Esophagus and Gastric Outlet: Interventional Management

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Benign strictures of the esophagus and gastric outlet are difficult to manage conservatively and they usually require intervention to relieve dysphagia or to treat the stricture-related complications. In this article, authors review the non-surgical options that are used to treat benign strictures of the esophagus and gastric outlet, including balloon dilation, temporary stent placement, intralesional steroid injection and incisional therapy.

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It is not uncommon to encounter benign strictures of the esophagus and gastric outlet in clinical practice (1–4). Any benign process that obstructs the esophagus or stomach, or that induces inflammatory or fibrotic changes in the esophagus or stomach can result in esophageal strictures and gastric outlet obstruction (1–8). These benign strictures can have a major negative impact on a patient's well-being, and the complications include malnutrition, aspiration, pain and respiratory failure (9–11). These strictures are difficult to manage conservatively and they usually require intervention to relieve the dysphagia or to treat the stricture-related complications (12–14). Although the surgical procedures are potentially curative, they are associated with high rates of morbidity and mortality (15–17).

Several non-surgical, minimally invasive options are available to treat benign strictures of the esophagus and gastric outlet. These procedures, which can be performed endoscopically or fluoroscopically, include balloon dilation, temporary stent placement, intralesional steroid injection and incisional therapy. This article reviews the use of these options to treat benign strictures of the esophagus and gastric outlet.

Benign Esophageal Strictures

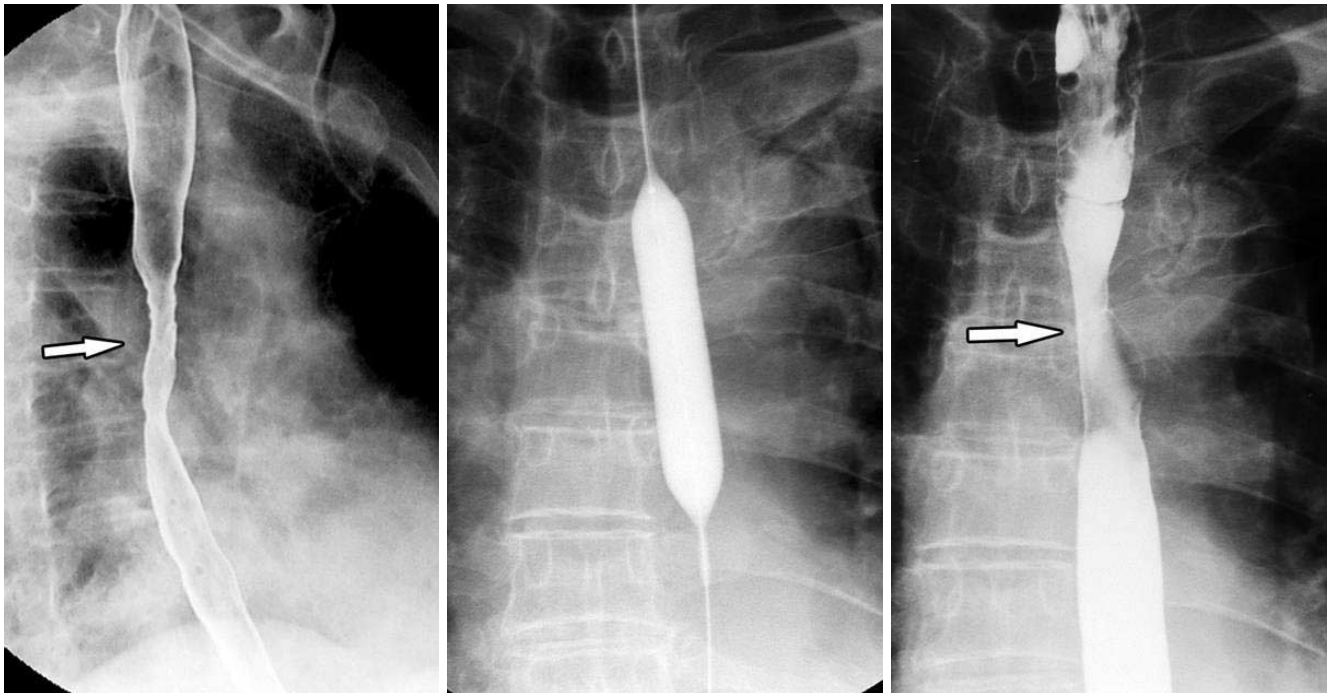
Benign esophageal strictures are sequelae of deep esophageal injuries, and these injuries may be due to peptic ulcer disease, surgery, radiation therapy, Schatzki's ring, esophageal webs and corrosive injury (6). These injuries stimulate the overproduction of fibrotic tissue and this leads to the formation of benign esophageal strictures (18). These strictures can be divided into two categories, 1) simple and 2) complex, based on their length, shape and diameter. Simple esophageal strictures are defined as those that are focal and straight, with most having a diameter that allows the passage of an endoscope of normal diameter (3). Simple strictures are usually caused by peptic ulcer disease, Schatzki's ring or a web (3, 19). Complex esophageal strictures are defined as those that are long (> 2 cm), tortuous or that have a diameter that prevents passage of an endoscope of normal diameter (3). The most common causes of complex strictures

include corrosive injury, radiation, anastomotic stricture and severe peptic injury (6, 14, 20, 21).

Balloon Dilation

Balloon dilation under endoscopic or fluoroscopic guidance is regarded as a safe, effective initial option for treating benign esophageal strictures (1, 3, 4, 12, 14, 15, 19, 22). Balloon dilation is thought to widen the luminal diameter of the esophagus by circumferential stretching and/or splitting of the stricture (1, 3). Under endoscopic or fluoroscopic guidance, the middle portion of the balloon is positioned at the narrowest part of the stricture and then it is inflated with water or contrast medium until the waist deformity created by the stricture disappears from the balloon contour or until the patient develops severe pain (1, 4). Elimination of the waist is an indicator of successful dilation. The balloon's diameter should be progressively increased, with starting by performing dilation with a small balloon and progressing to larger sizes to minimize the chance of perforation (4). The first balloon is often 10–15 mm in diameter; if dilation with this sized balloon is easily accomplished and the patient well tolerates the procedure, then the diameter of the balloon catheter is increased up to 20–25 mm. If at any point the patient complains of intolerable pain or if a persistent waist remains in the balloon even at the maximal inflation pressure (i.e., 6 atm), then the dilation should be stopped (23). Fluoroscopy allows complete visual control and so it may help minimize the risk of perforation due to inappropriate advancement of instruments and misplacement of the balloon, which can be caused by sliding during inflation, and especially when treating complex strictures (1, 4).

Simple esophageal strictures generally respond well to balloon dilation. Most patients with simple esophageal strictures require 1–3 dilations to relieve their symptoms, although 25–35% of patients require repeated dilations (13). Yet complex esophageal strictures are more difficult to treat, and they require at least three dilation sessions to relieve the obstructive symptoms, and complex esophageal strictures are associated with high rates of recurrence and perforation (6, 14). For example, 43–46% of patients require repeated balloon dilations for esophageal strictures induced by radiation injury (20, 24) (Fig. 1). Although they are minor complications, type 1 (intramural) and type 2 (transmural without mediastinal spillage) esophageal ruptures were observed after 12 of 25 (48%) balloon dilations for esophageal strictures caused by radiation injury (20). Moreover, 62% (73 of 117) of patients with



A B C

Fig. 1. Radiation-induced esophageal stricture.
A. Esophagogram shows 5-cm long stricture (arrow) in mid-esophageal area.
B. Dilation of stricture using 15-mm-diameter balloon under fluoroscopic guidance. Because dilation was not easily accomplished, caliber of balloon catheter was not increased to 20 mm.
C. Esophagogram one month after balloon dilation shows improvement of stricture (arrow). Patient's symptoms were also resolved, but symptoms recurred two months later.

corrosive esophageal strictures required repeated balloon dilations owing to recurrence. In addition, esophageal ruptures occurred after 52 of 390 balloon dilations (13%), including 35 type 1, 14 type 2 and three type 3 (transmural with mediastinal spillage) ruptures.

The patients with type 1 and type 2 esophageal ruptures can be managed conservatively. Those patients with type 2 esophageal rupture and who experience persistent extraluminal leakage, even after conservative treatment, can be treated by insertion of a covered stent to prevent leakage (25). Surgery is indicated for the patients with type 3 esophageal rupture and for patients with progressive clinical deterioration (26).

Refractory benign esophageal strictures are defined as those that cannot be dilated to an adequate diameter, those that recur within a short time interval or those that require continuous dilation (27). These resistant strictures may seriously affect a patient's quality of life owing to complications such as aspiration, malnutrition, pain and esophageal perforation (10). Among the methods used to treat refractory benign esophageal strictures are intralesional steroid injection, temporary stenting and incisional therapy.

Intralesional Steroid Injection

The intralesional injection of corticosteroids has been reported to soften scars and keloids (28, 29) owing to the local inhibition of inflammatory responses, which results in the reduction of fibrotic tissue (30). Intralesional steroid injections have been increasingly used over the past decade to treat refractory benign esophageal strictures (30–32). This approach usually involves endoscopic intralesional injections of triamcinolone acetonide (40 mg/mL, diluted 1:1 with saline solution) into all four quadrants of the strictures, and this is most often done in combination with balloon dilation (30–32). The combination of intralesional steroid injection and balloon dilation has been shown to increase the intervals between dilations and to decrease their frequency (30–32). However, this therapy seems to be inadequate to treat long strictures. Furthermore, the optimal injection technique and the frequency and dose of triamcinolone injections have not yet been established (1).

Stent Placement

Stent placement is a commonly used, minimally invasive method to treatment unresectable malignant strictures and fistulas (33, 34). However, permanent stenting of benign esophageal strictures in patients with a relatively long life expectancy has not yet reached widespread acceptance owing to the late adverse events of stent placement, including the development of new strictures caused by stent-induced granulation tissue, stent migration and esophageal ulceration (35, 36). However, temporary placement of retrievable, fully covered stents made of plastic or metal has become a new strategy for treating refractory benign esophageal strictures (10, 11, 37–39) (Fig. 2). The therapeutic concept of temporary stenting is quite attractive because a stent has a persistent dilation effect after placement and it can be removed after the stricture heals or when new strictures or other stent-related complications occur. The early experience of temporary stenting for refractory benign esophageal stricture was favorable (18, 37). In one series (37), 17 of 21 patients (81%) showed improvement of dysphagia after a median of 21 months with no complications. In another series (18), 12 of 15 patients (80%) showed improvement of dysphagia after a median of 22.7 months. However, five patients (33%) showed recurrent symptoms, four due to formation of granulation tissue and one due to stent migration (18).

Yet more recent studies have found that the rates of long-term resolution of dysphagia after temporary stenting were unsatisfactory, with high rates of complications (10, 11, 38). For example, one study (11) found that only 31% of patients showed long-term relief of symptoms, whereas the rates of complications were high, including the rates of stent migration (62%), pain (27%) and stent-induced formation of granulation tissue (17%). Another study (38) found that only 30% of patients (intention to treat) were dysphagia-free after a median follow-up of 12.3 months, with high rates of complications, including stent migration (22%), severe chest pain (11%), bleeding (8%), perforation (6%), gastroesophageal reflux (6%), impaction (6%) and new fistula (3%), and one patient died of massive bleeding.

A third study (10) also showed that temporary metallic stenting for refractory benign esophageal strictures achieved discouraging results. During a mean follow-up period of 38 months, only 31% of patients showed long-term relief of obstructive symptoms. The most common complications were granulation tissue formation (31%), severe pain (24%) and stent migration (25%). The rates of maintained patency after temporary metallic stenting at 1, 3 and 6 months and 1, 2 and 4 years were 58%, 43%, 38%, 33%, 26% and 21%, respectively (10). An increased stricture length was found to be a significant predictor of stricture recurrence (10).

Temporary stenting does have several benefits. For example, temporary stent placement should be considered during the early chronic stage (3 weeks to 6 months after ingestion of a corrosive agent) for patients with corrosive strictures because these patients are highly prone to

recurrence and rupture after dilation (6). In addition, temporary stent placement can serve as an effective bridge to surgery for patients who require a considerable time before surgery. Furthermore, stent placement may be the only option for patients with severe stenosis that prevents adequate balloon dilation.

Efforts are underway to decrease the rates of stent-related complications, including formation of granulation tissue and stent migration. An *in vivo* animal study showed that compared with conventional metallic stents, drug-eluting (paclitaxel) stents induced little tissue reaction around the esophageal mucosa, and the drug-eluting (paclitaxel) stents were easily separated from esophageal tissue, which allows easy retrievability (40). In addition, a new esophageal stent has been developed with an anti-migration design, a double-layer configuration (inner

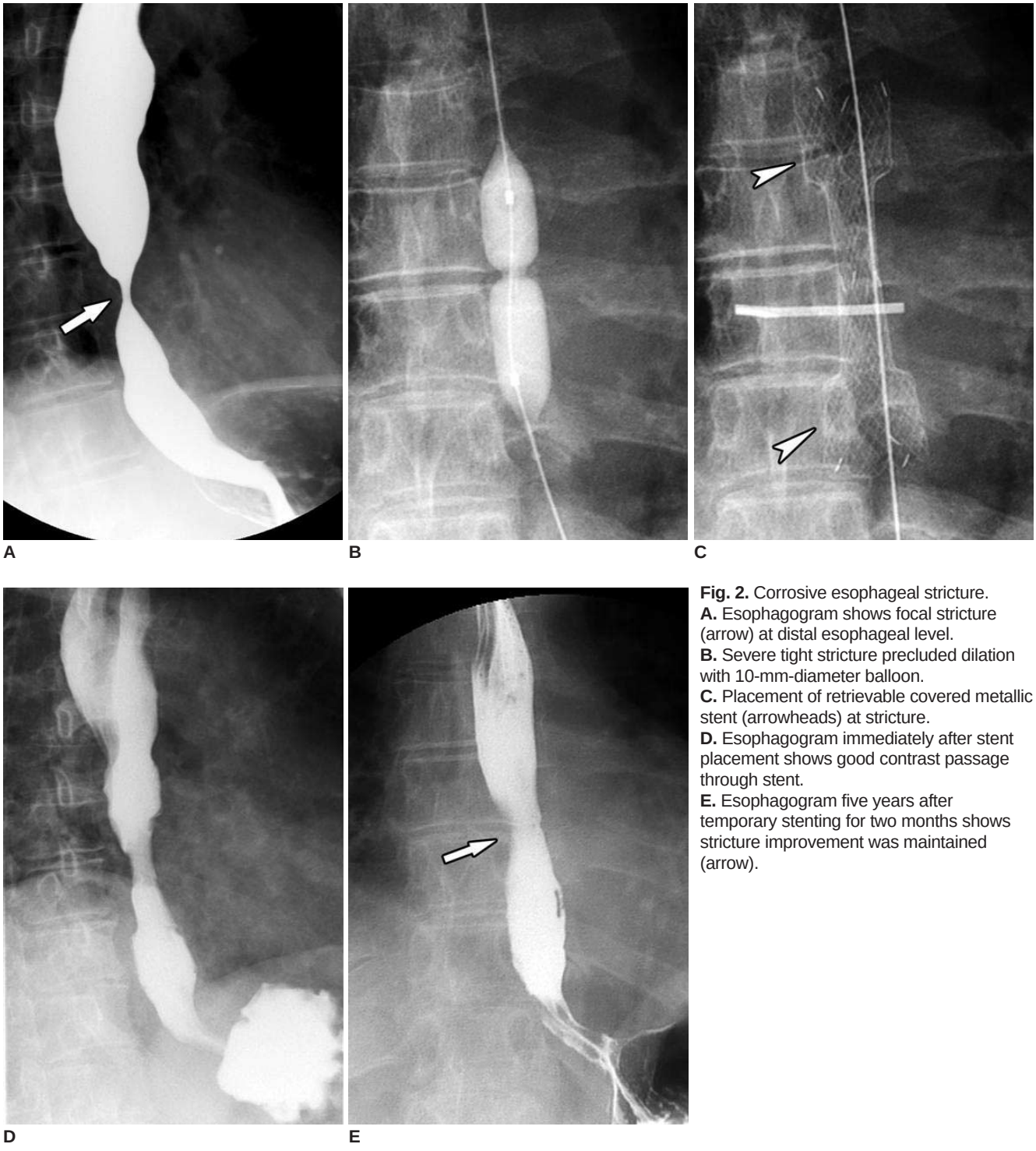


Fig. 2. Corrosive esophageal stricture.
A. Esophagogram shows focal stricture (arrow) at distal esophageal level.
B. Severe tight stricture precluded dilation with 10-mm-diameter balloon.
C. Placement of retrievable covered metallic stent (arrowheads) at stricture.
D. Esophagogram immediately after stent placement shows good contrast passage through stent.
E. Esophagogram five years after temporary stenting for two months shows stricture improvement was maintained (arrow).

covered and outer uncovered parts) and an outer uncovered nitinol wire tube, which allows the stent to fix itself in the esophageal wall (41). These new stents provided good symptom relief with low rates of recurrent dysphagia and stent migration (41). Because recurrent dysphagia is often due to the formulation of granulation tissue and stent migration, drug-eluting or anti-migration stents may be a good alternative in the management of refractory benign esophageal strictures.

In summary, temporary stenting for refractory benign esophageal strictures may be effective during the period of stent placement. Yet following stent removal, the symptom-free period rapidly decreases over time, and particularly in patients with long strictures. Temporary stenting is associated with high complication rates and so it should only be considered in carefully selected patients.

Incisional Therapy

Incisional therapy using electrocautery, with or without argon plasma coagulation or endoscopic scissors, has been successful in patients with Schatzki's rings or circular anastomotic strictures that are refractory to dilations (42–44). For instance, evaluation of the efficacy of electrocautery needle-knife treatment in 20 patients with refractory anastomotic strictures of the esophagus showed that 12 patients with strictures < 1 cm remained dysphagia-free

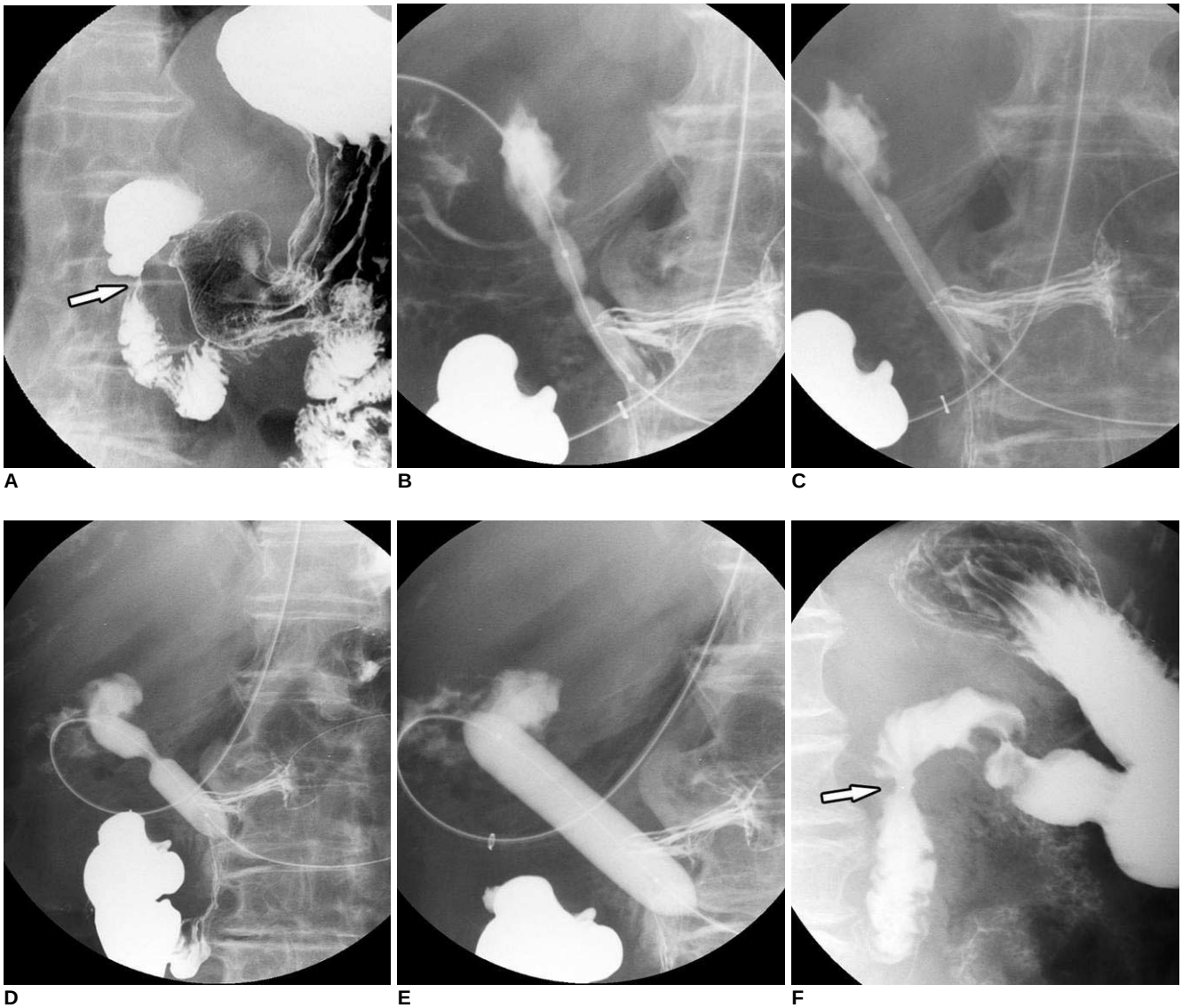


Fig. 3. Peptic ulcer-induced duodenal stricture.
A. Upper gastrointestinal series shows peptic ulcer-induced stricture (arrow) in second portion of duodenum.
B-E. Under fluoroscopic guidance, stricture was initially dilated with 8-mm-diameter balloon. Because dilation was easily achieved, caliber of balloon catheter was increased to 15 mm.
F. Upper gastrointestinal series one year after balloon dilation shows improvement of luminal diameter (arrow).

for 12 months after a single treatment (42). In contrast, dysphagia recurred in eight patients who had long-segment strictures (1.5–5 cm), and these patients required a mean of three treatments (42).

Incisional therapy has been also used as the primary treatment for patients with Schatzki's rings and anastomotic strictures after gastroesophageal surgery (8, 9). For example, a randomized, prospective trial that compared electrosurgical incision combined with acid suppression treatment and bougie dilation combined with acid suppression treatment in 25 patients with symptomatic Schatzki's rings found that the symptom-free period was significantly longer in the incision group than in the bougie dilation group (7.99 vs. 5.86 months, $p = 0.03$) and that the addition of acid suppression treatment reduced the gastroesophageal reflux-related symptoms, regardless of the primary treatment (8).

In summary, incisional therapy may be a good alternative for the treatment of resistant or non-resistant anastomotic strictures of the esophagus and Schatzki's ring. However, incisional therapy is not appropriate for patients with long esophageal strictures.

Benign Gastric Outlet Strictures

Benign strictures of the gastric outlet are not uncommon in clinical practice and these may have several etiologies, including anastomotic strictures after gastric surgery, peptic ulcer, corrosive injury, strictures secondary to intervention, and rarely, Crohn's disease (2, 4, 5, 7, 15, 16, 45). These strictures may result in prolonged vomiting and nutritional deficiencies (46). Surgical revision is indicated for the patients with benign gastric outlet strictures and who do not respond to conservative medical treatment (47, 48). However, surgery is associated with high rates of morbidity and mortality, and particularly in patients with high risk factors, including an advanced age, a poor nutritional status or combined disease (49).

Balloon Dilation

Endoscopically or fluoroscopically guided balloon dilation is a safe and effective alternative to surgery for patients with benign strictures of the gastric outlet (2, 4, 5, 7, 15, 16, 45). It is considered to be a more rapid treatment and more cost effective than surgery.

Balloon dilation has been widely used for treating patients with peptic ulcer-related gastric outlet obstruction (Fig. 3), but the long-term outcomes were found to widely vary, from 16–100% (50–53). Yet more recently, balloon dilation combined with antisecretory therapy and removal of the etiologic factors (e.g., Helicobacter pylori) was shown to achieve long-term resolution of symptoms in 85–100% of patients with peptic ulcer-related gastric outlet obstruction (2, 54).

Benign anastomotic strictures occur in 3–13% of patients after gastric surgery, and usually within the first three months (7, 55). Obesity has become a major health problem, leading to an increase in performing restrictive gastric surgery for morbidly obese patients worldwide. Several studies have assessed the efficacy of balloon dilation for treating benign gastric outlet stricture after restrictive surgery for morbid obesity (7, 16, 55, 56). For example, one or two endoscopic balloon dilations resulted in symptom resolution without any major complications in 93% (40 of 43) of patients with gastrojejunostomy strictures after Roux-en-Y gastric bypass for obesity during the first year. In addition, fluoroscopically guided balloon dilation relieved the obstructive symptoms in 50% (12 of 24) of the patients who had gastric outlet strictures after surgery for morbid obesity after a mean follow-up of 29 months (16). Fluoroscopically guided balloon dilation also led to symptom resolution in 16 of 17 (84%) patients who were treated for benign strictures that were caused by Billroth I (gastroduodenostomy) or Billroth II (gastrojejunostomy) reconstruction for malignancy or gastric ulcer, with no major complications, over a mean of 14 months (57). An interval of two or three weeks has been suggested as the minimum 'safe' time between surgery and dilation of an anastomotic stricture (21, 58).

Gastric outlet stricture can also result from the ingestion of caustic substances. However, only six of 17 (35%) patients with caustic strictures responded to balloon dilation, compared with a 70% response rate for the patients with peptic strictures (52). Furthermore, the patients with caustic strictures required more dilations than those with peptic ulcer-related strictures (53). Yet more recently, repeated balloon dilations (mean: 5.8 sessions) were found to achieve long-term resolution (symptom free for 18 to 58 months) in 95% (39 of 41) of the patients with short-segment (< 2.5 cm), caustic-induced gastric outlet strictures (5).

Strictures occurring at the gastric outlet should be sufficiently dilated to prevent symptoms of obstruction, but not so much as to increase the risk of perforation. Thus, it is important to determine the optimal diameter of dilation. The optimal diameter may depend on the type of stricture (i.e., anastomotic vs. non-anastomotic stricture). For anastomotic strictures, a diameter of 20 mm may prevent symptoms of obstruction with no major complications (57). Yet for non-anastomotic strictures, a maximal diameter of 15 mm may be sufficient to relieve obstructive symptoms (2, 5). Balloons of larger diameter (> 15 mm)

may increase the risk of perforation during the treatment of non-anastomotic strictures. For example, dilation with 20-mm balloons caused perforations in two of three patients with peptic pyloric strictures (51), and dilations to 18 mm caused perforations in two patients with peptic pyloroduodenal strictures (59). Following laparotomy, 21% of the patients with gastric outlet strictures and who were dilated to 20 mm experienced perforations, compared with none of those patients whose strictures were dilated to 15 mm (60–62).

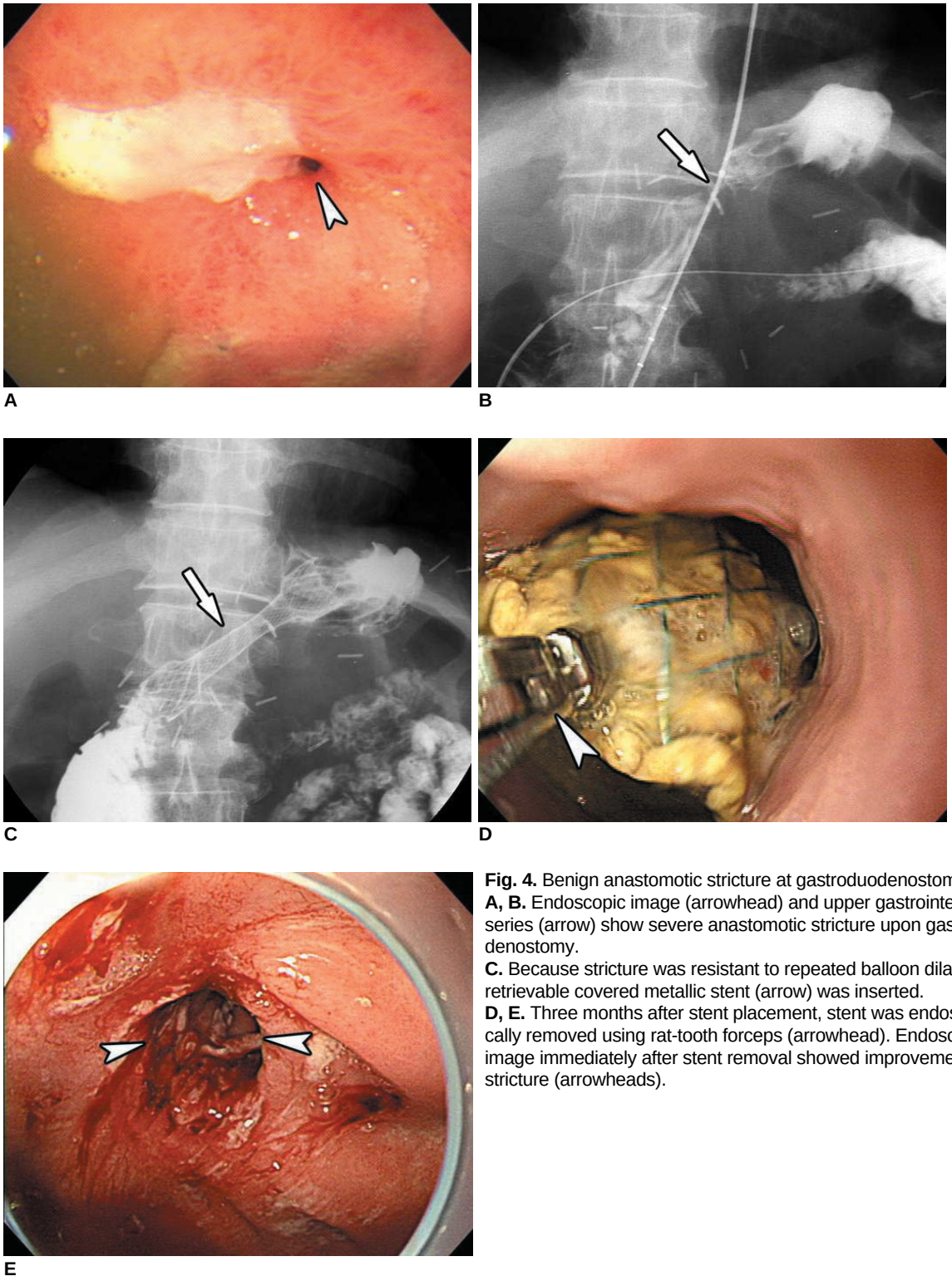


Fig. 4. Benign anastomotic stricture at gastroduodenostomy.
A, B. Endoscopic image (arrowhead) and upper gastrointestinal series (arrow) show severe anastomotic stricture upon gastroduodenostomy.
C. Because stricture was resistant to repeated balloon dilation, retrievable covered metallic stent (arrow) was inserted.
D, E. Three months after stent placement, stent was endoscopically removed using rat-tooth forceps (arrowhead). Endoscopic image immediately after stent removal showed improvement of stricture (arrowheads).

Other Options

Severely angulated, tortuous or edematous benign gastric outlet strictures are usually refractory to balloon dilation (21, 56, 57). Resistance to initial balloon dilation may result in poor long-term results, and early surgical revision has been recommended for these patients (63, 64), but several non-surgical options are available to treat these strictures.

Metallic stents are safe and effective for patients with malignant gastric outlet obstruction (65, 66) and metallic stents have been used in selected patients with benign gastric outlet strictures that are refractory to balloon dilation (Fig. 4). For example, temporary placement of a covered retrievable metallic stent for two months to treat a patient with a benign anastomotic duodenojejunal stricture that was resistant to repeated balloon dilations resulted in a favorable outcome at up to six months after stent removal (67). Stent placement in seven patients with resistant benign anastomotic strictures after gastric surgery showed benefit for five patients (71%), regardless of whether the stent placement was temporary (two patients) or permanent (three patients) (21). However, owing to the high risk of migration, stents should be used only in selected patients with resistant benign gastric outlet strictures (21).

Electrosurgical incision, with or without balloon dilation, has been successful in a small numbers of patients (< 5) with refractory benign gastric outlet strictures (68, 69). In addition, intralesional steroid injections have been used to augment the effect of balloon dilation in three patients with corrosive-induced pyloric stenosis (70).

Summary

Balloon dilation is a safe, effective initial option in the treatment of benign strictures of the esophagus and gastric outlet. Intralesional steroid therapy, electrosurgical incision or stent placement can be effective in selected patients with strictures that are resistant to balloon dilation.

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