Fully covered self-expandable metal stent for management of refractory postcorrosive esophageal strictures, is it justified?

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Introduction
Management of refractory benign esophageal strictures remains a challenge for clinicians. Randomized trials are needed to determine the optimal treatment strategy for patients with refractory and recurrent benign postcorrosive esophageal strictures.
Aim
The aim of this study was to evaluate the management of refractory postcorrosive esophageal stricture by fully covered self-expandable metal stent (SEMS) and also the optimum time for stent placement.
Patients and methods
This study was conducted in GIT Endoscopy Unit in Qena University Hospital from June 2014 to June 2016 in collaboration with General Surgery, Cardiothoracic Surgery, and Tropical Medicine Departments, Qena Faculty of Medicine, South Valley University. Eleven patients with refractory postcorrosive esophageal strictures were managed by dilations and fully covered SEMS placement.
Results
Successful stent placement was done in all patients. The mean follow-up time was 22 (12–26) months. Stent migrations occurred in two patients, and minor bleeding in one patient, with no mortality and no recurrences in dysphagia during the follow-up period.
Conclusion
Fully covered SEMSs are safe and effective in treatment of postcorrosive esophageal stricture, with optimum duration for stent placement range from 6 to 8 weeks.

Keywords:
dysphagia, postcorrosive esophageal strictures, refractory benign esophageal stricture, self-expandable metal stent

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Introduction

Benign esophageal strictures are caused by a diversity of esophageal disorders or injuries, for example, gastroesophageal reflux, radiation therapy, ablative therapy, or the ingestion of a corrosive substance. In addition, stricture formation may be a complication of esophageal resection with gastric tube formation [1]. More than 80–90% of esophageal strictures can be treated successfully with endoscopic dilatation using Savary bougies or balloons. Esophageal dilatation is a procedure with a very low rate of serious complications, mainly bleeding and perforation [2].

Dysphagia is the most common symptom in patients with a benign esophageal stricture. Remarkably, most patients do not experience severe weight loss, as can be seen in malignant esophageal strictures [3]. Treatment aims to relieve symptoms, with the avoidance of complications and the prevention of recurrences. Still, dilatation is the first-line option to treat benign esophageal strictures. Unfortunately, approximately one-third of patients develop recurrent dysphagia after dilatation within the first year. The majority of these patients are managed with repeated dilations, depending on their complexity [4].

Stricture may be simple or complex. Simple strictures are considered to be short, focal, straight, and to allow passage of a normal diameter endoscope. Overall, one to three dilatations are sufficient to relieve dysphagia in simple strictures. Only 25–35% of patients require additional sessions, with a maximum of five dilatations in more than 95% of patients. Complex strictures are usually longer (>2 cm), angulated, irregular, or have a severely narrowed diameter. These strictures are more difficult to treat and have

a tendency to be refractory or to recur despite dilatation therapy [5].

According to the Kochman criteria, refractory or recurrent strictures are defined as an anatomic restriction because of a cicatricial luminal compromise or fibrosis, resulting in clinical symptoms of dysphagia in the absence of endoscopic evidence of inflammation. This may occur because of either an inability to successfully remediate the anatomic problem to a diameter of at least 14 mm over five sessions at 2-week intervals (refractory) or as a result of an inability to maintain a satisfactory luminal diameter for 4 weeks once the target diameter of 14 mm has been achieved (recurrent). This definition is not meant to include patients with an inflammatory stricture (which will not resolve until the inflammation subsides), or those with a satisfactory diameter but having dysphagia on the basis of neuromuscular dysfunction (e.g. those with dysphagia owing to postoperative and/or postradiation therapy) [5].

In the past few years, temporary stent placement has increasingly been used for refractory benign esophageal strictures. Uncovered self-expandable metal stent (SEMS) were initially used for the treatment of refractory benign esophageal strictures [6]. In more recent years, partially or fully covered SEMS have become available and are now commonly used for this indication [7]. Self-expandable plastic stents (SEPSs) are FDA (Food and Drug Administration, USA) approved for this indication and have been used [8]. Partially and fully covered SEMSs, although not FDA approved, are also frequently used to treat benign esophageal strictures. An alternative for SEPS and SEMS is the biodegradable stent, which has the advantage of not requiring removal [9].

One of the major drawbacks of uncovered and partially covered SEMS is that they are associated with a relatively high complication rate, mostly owing to hyperplastic tissue ingrowth through the stent mesh resulting in embedding of the stent in the mucosa [10]. The complication rate of uncovered or partially covered stents has been reported to be as high as 80%. The most common complications of these stents are indeed new stricture formation owing to tissue ingrowth, and also stent migration, pain, gastroesophageal reflux if the stent is positioned across the gastroesophageal junction, and fistula formation [11]. Tissue reaction often results in recurrent dysphagia and may hamper stent removal. On the contrary, particularly minor tissue ingrowth may also reduce the risk of stent migration (only 12 vs. 36% for fully covered SEMS) [12]. The risk of tissue ingrowth increases with stenting time, but can already be seen after 1–4 weeks. To overcome the problem of stent ingrowth, fully covered stents (SEMS or SEPS) seem preferable for benign esophageal strictures [13].

A new generation of fully covered SEMS was recently evaluated, but in general, more studies are needed to compare different stent designs, and time needed to maintain dilatation and prevent recurrence of stricture.

Objectives

The aim of this study was to evaluate the management of refractory postcorrosive esophageal stricture by fully covered SEMS and also the optimum time for stent placement.

Patients and methods

This study was conducted in GIT Endoscopy Unit in Qena University Hospital from June 2014 to June 2017 in collaboration with General Surgery, Cardiothoracic Surgery, and Tropical Medicine Departments, Qena Faculty of Medicine, South Valley University. A total of 11 patients with refractory postcorrosive esophageal strictures were managed by dilatations and fully covered SEMS placement.

Exclusion criteria

Patients with malignant stricture, benign stricture due to causes other than corrosive ingestion, and dysphagia not due to strictures were excluded.

Inclusion criteria

All patients experience dysphagia due to corrosive ingestion and were subjected previously to esophageal dilatation more than five sessions in 2-week interval (refractory) or recurrent within 4 weeks.

Informed and written consents for the procedure were obtained by the parents of all children and adolescent whom included in this study after explanation of the nature of the disease and that insertion of fully covered metallic stents is the only available less invasive procedure alternative to surgery and benefit and complications of this new procedure although it is under trial. This study was approved by local ethics committee.

All patient were subjected to thoroughly history taking, clinical examination, and contrast-enhanced radiological examination of esophagus, and esophagoscopy.

After a fasting period of minimum of 6 h, examination was performed under general anesthesia with airway protection on esophagoscopy. The location, diameter,

and macroscopic aspect of the stricture were assessed to facilitate the selection of the most appropriate dilator. The guide wire was inserted under endoscopic control, with fluoroscopy, and Savary-Gilliard dilators semiflexible bougies were introduced starting from small to large diameter. After full dilation of the esophagus to at least 14 mm as illustrated in Fig. 1, then fully covered SEMS, fully covered Wallflex (Boston Scientific, Natick, Massachusetts, USA), was introduced through the guide wire under endoscopic view and fluoroscopy control (Figs 2–5).

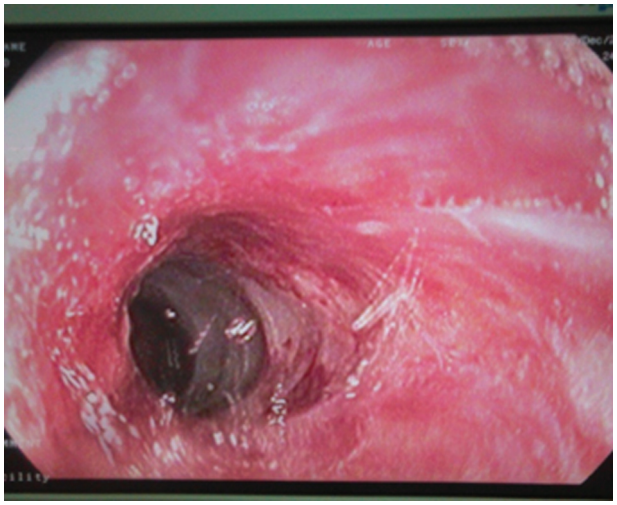
After the procedure, patients remained under observation at the endoscopy unit for 3 h. Follow-up after 2 weeks was done by endoscopy to ensure stent in place, then at 4 weeks, and then removal of the stent after 6–8 weeks. Thereafter follow-up was done at an outpatient clinic for recurrence of dysphagia every month; the entire follow-up period ranged from 12 to 24 months.

Results

A total of 11 patients were included in this study, and their age ranged from 2 to 18 years, with mean age of 4±2 years. There were seven females and four male patients. Most of the patient were between 2 and 6 years of age, with only one female patient who was 12 years old with suicidal corrosive ingestion and an 18-year-old male patient with mental retardation with accidental ingestions. The oldest age of patient in which we were inserted the stent was 18 years old patient (Tables 1 and 2).

Stents were placed successfully in all patients (100%) at first time of stent insertion. In the follow-up period, we had used chest radiographies for follow-up of stent site, and we found only two patients who had migrated stents into stomach or away from the site of stricture, and we removed the old stents and replaced them with another one. Migrations of stent had occurred after 8 days in one patient and after 10 days in another one, and stents were replaced again. In the two patients, we found that the strictures were away from each other, and one stent could not cover all strictures, so we inserted two stent at the same time one above the other to keep all strictures covered with stent after dilatation. We did not have any major complications in this study, and only minor bleeding occurred in one patient (Table 3).

Figure 1

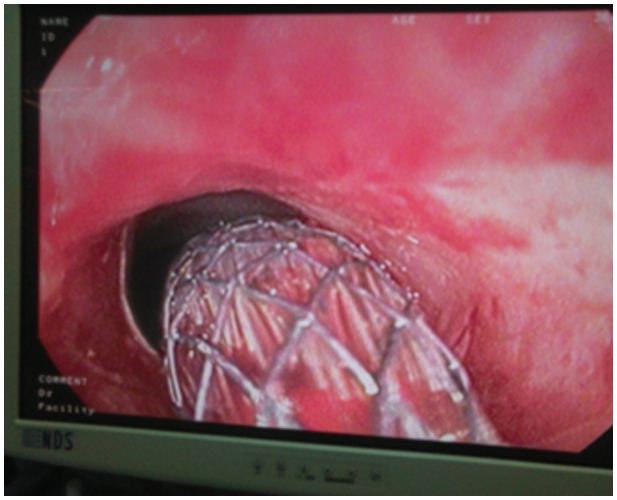


Postcorrosive esophageal stricture, dilations was done with Savary-Gilliard dilators.

Discussions

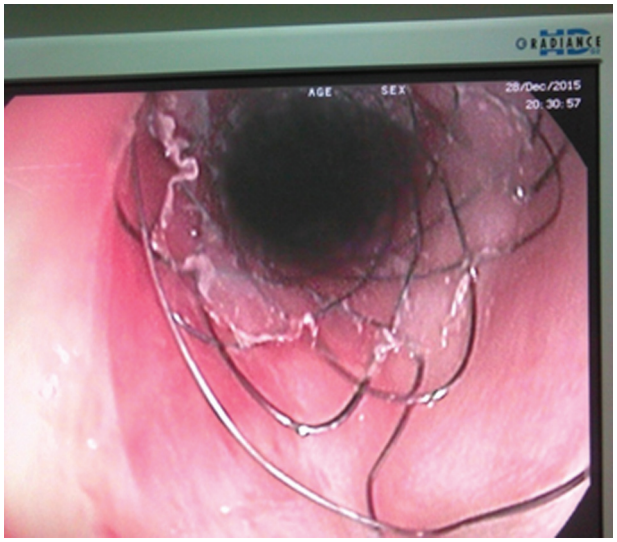
The first step in managing benign esophageal strictures remains dilation with an inflatable balloon or (Savary)

Figure 2



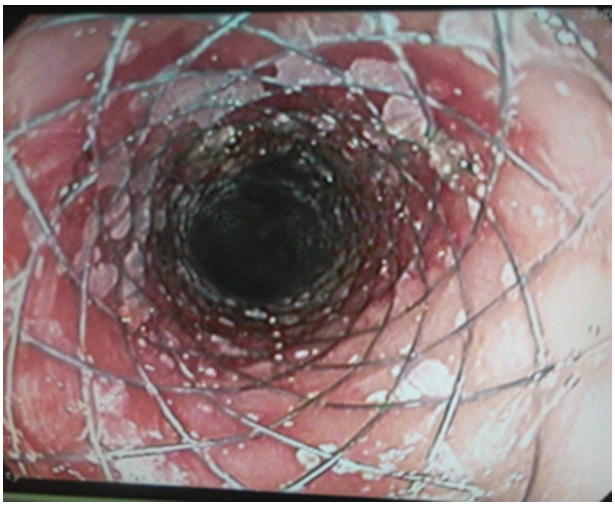
After passing stricture.

Figure 3



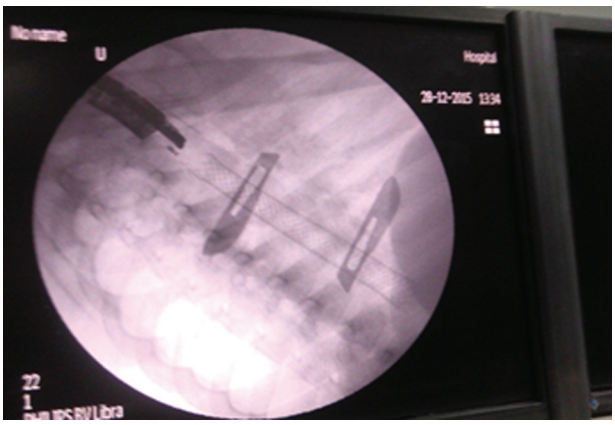
Stent in place 1.

Figure 4



Stent in place 3.

Figure 5



Stent in C-arm fluoroscopy image

bougies [3,14]. According to Cox *et al.* [15] and Yamamoto *et al.* [16], no differences have been shown regarding dilatation between balloon and bougies in relief of dysphagia and/or recurrence of dysphagia, and no differences have been shown in the risk of major complications including perforation, bleeding, and bacteremia. Scolapio *et al.* [14] stated that perforation risk varies between 0.1 and 0.4%. Although most patients are effectively treated with up to five dilatations, ~10% of patients need ongoing dilations to become dilatation free [5,17].

To reduce the number and burden of endoscopic dilatations to become dysphagia free, various endoscopic treatment options have been suggested. Adding steroid injection to endoscopic dilatation into the stricture followed by dilatation to avoid recurrent dysphagia has been reported to prevent stricture and recurrence. Camargo *et al.* [18]

Table 1 Sex ratio

Sex	*n* (%)
Male	4 (36)
Female	7 (64)

Table 2 Number of strictures constrictions

Number of stricture ring	*n* (%)
Single	8 (72)
Two	2 (18)
Multiple (>2)	1 (10)

Table 3 Complications

Complications	*n* (%)
Stent migrations	2 (18)
Bleeding	1 (9)
Perforation	0 (0)
Mortality	0 (0)
Total	3 (27)

randomized 14 patients with corrosive strictures allocated to steroid injection or placebo and did not find a difference in dilatation frequency or recurrent dysphagia between the two groups. Ramage *et al.* [19] performed a randomized trial comparing dilation to intralesional four-quadrant injection of triamcinolone injections, and they concluded that dilation combined with steroid injection reduced the number of repeat dilations and the dysphagia free period, with redilatation rates of 13% in the steroid group versus 60% in the control group (P=0.01) [19].

Dilatation of an esophageal stricture with a balloon or a bougie is usually done for a period of a few seconds or some minutes. It can, however, be imagined that if the dilator can be kept in place for a longer time, the benefits of dilation may be longer lasting. In the past few years, temporary stent placement has increasingly been used for refractory benign esophageal strictures. SEPSs are FDA approved for this indication, and have been used [20].

Partially and fully covered SEMSs, although not FDA approved, in reality, are frequently used to treat benign esophageal strictures. An alternative for SEPS and SEMS is the biodegradable stent [9]. Uncovered SEMS were initially used for the treatment of refractory benign esophageal strictures. In more recent years, partially or fully covered SEMS have become available and are now commonly used for this indication [21]. Siersema *et al.* [10] founded that the major drawbacks of uncovered and partially covered SEMS are that they are associated with a relatively high complication rate, mostly owing to

hyperplastic tissue ingrowth through the stent mesh resulting in embedding of the stent in the mucosa. In another study, Hirdes *et al.* [11] reported that the complications rate of uncovered or partially covered stents has been as high as 80%. The most common complications of these stents are indeed new stricture formation owing to tissue ingrowth, and also stent migration, pain, gastroesophageal reflux if the stent is positioned across the gastroesophageal junction, and fistula formation. Tissue ingrowth consists histologically of granulation tissue, but reactive hyperplasia and fibrous tissue are also seen. Tissue reaction often results in recurrent dysphagia and may hamper stent removal [11].

On the contrary, particularly minor tissue ingrowth may also reduce the risk of stent migration (only 12 vs. 36% for fully covered SEMS) [22]. Risk of tissues ingrowth within stent is in direct proportion with duration of stents in esophagus, when stent remain longer time within esophagus, tissue ingrowth become more evident but the canal we ready to appearing after 1–4 weeks from insertion of stent. Tissue ingrowth can successfully be treated with the stent-in-stent method described by Hirdes *et al.* [11]. Using this technique, a fully covered stent is placed inside the previously placed embedded stent [11]. The fully covered stent should have a length that at least overlaps and to have a size that is equal, or slightly larger than, the initially placed partially covered stent. Over a period of 10–14 days, pressure necrosis of the hyperplastic tissue occurs as a result of friction. Hereafter, both stents can usually easily be removed [11].

To overcome the problem of stent ingrowth, fully covered stents (SEMS or SEPS) seem preferable for benign esophageal strictures. Currently, data on the use of fully covered SEMS are limited. In the study performed by Eloubeidi and Lopes [23], a total of 36 stents were placed in 31 patients over a period of 16 months. A clinical success rate of 29% was reported. A total of 47% of these patients had no recurrence of dysphagia [23]. Bakken *et al.* [24] performed a retrospective study including seven patients with a refractory stricture. Stent migration occurred in more than half of the patients. None of the patients were treated successfully [24]. In 2011, Eloubeidi *et al.* [25] included 10 patients with a benign refractory esophageal stricture. A clinical success rate of 21% was reported, with a migration rate of 10% [25].

A new generation of fully covered SEMS, the fully Covered Wallflex (Boston Scientific), was recently evaluated by Hirdes *et al.* [11]. They included 15 patients with a refractory benign esophageal stricture. The migration rate was 35%, whereas tissue overgrowth was seen in 20% of patients. Recurrent dysphagia occurred in all patients after a median of only 15 days after stent removal. These disappointing results were however most likely owing to the highly refractory patient population in this study [26].

In our study, 11 patients with refractory postcorrosive esophageal stricture were included after failure of repeated dilatation and injection of triamcinolone to maintain dilation for ~1 month, so we used a fully SEMS covered Wallflex (Boston Scientific) after dilatation. SEMSs were successfully placed in all patients, and followed every 2 weeks for dysphagia, for ~6 weeks, and then stents were removed. No major complications occurred, with only minimal bleeding in one (0.09) case and stent migrated in two (18%) cases, and with successful rate 100%. In this study, all strictures were successfully treated with fully covered metallic stents and this successful rates could be attributed to that the cause of all stricture are due to corrosives ingestion so most of strictures are simple (73%), also treatment started early after ingestion and also 8 weeks of keeping the stent inside esophagus was enough to keep the structured part of esophagus patent for awhile.

SEPSs have been proposed as an alternative to SEMS to minimize hyperplastic tissue reflection. In 2010, Repici *et al.* [9] performed a pooled data analysis of all available studies on the use of SEPS for benign esophageal strictures. A total of 130 treated patients were included from 10 studies. Stent placement was technically successful in 98% of the patients. In 52% of patients, no further dilations were required after a median follow-up of 13 months after stent removal. Median stenting time in these studies was not reported. In patients with a proximal stricture, the success rate was somewhat lower (33%). As can be expected, owing to the fully covered stent design, a relatively high percentage (24%) of stents migrated within 4 weeks, resulting in a high rate of endoscopic re-interventions (21%). Major complications were seen in 9% of patients. One patient died of massive bleeding [9]. More recently, Ham *et al.* [26] published an updated systematic review. A total of 172 patients with a benign esophageal stricture were included and treated with SEPS. They found a technical success rate of 98% and a clinical success rate of 45%, with a rate of early stent migration of 31%. It can be concluded that SEPSs are effective for the treatment of refractory esophageal strictures, but the design needs further improvement to reduce the risk of migration. Moreover, the stent has a high radial and axial force, which may be the

cause of an increased risk of stent-related complications to the esophageal wall, for example, severe bleeding [26].

An alternative treatment option that has recently been introduced is the placement of a biodegradable stent. Van Boeckel *et al*. [27] compared biodegradable stents with SEPS, that is, Polyflex stent (Boston Scientific), in a nonrandomized head-to-head comparison. They found that both SEPSs and biodegradable stents provided long-term relief of dysphagia in 30 and 33% of patients with a refractory esophageal stricture, respectively. However, biodegradable stents require fewer procedures than SEPSs [27]; in our study, long-term relief of dysphagia was 100% with minimal complications rates.

The optimal duration of stent placement for treating refractory benign esophageal strictures is unknown, but likely depends on a number of variables, such as stricture type, severity of the inflammation, stricture length, and stent type. These factors should be evaluated in all patients. The general principle is to leave the stent in place until the inflammation is resolved. In strictures longer than 5 cm or those due to ischemic injury, dilation for a period of at least 8–16 weeks is recommended. For shorter strictures and other etiologies, shorter stenting times can be recommended, but still these strictures may also be refractory. Only fully covered stent designs can safely be removed after a prolonged time of stenting. When partially covered stents are used, repeat endoscopy should be performed at 2–4 weeks intervals to evaluate embedding of the stent in the wall. In our study, the duration of stent placement of 6 weeks in single stricture and 8 weeks in multiple strictures was enough to maintain dilatation, and no recurrences occurred.

After biodegradable stent placement, a completely different treatment strategy can be followed. Only when patients treated with a biodegradable stent present with recurrent dysphagia should a repeat endoscopy be performed. In most cases, this means that the stent is dissolved, and a new stent, either biodegradable or SEMS, can be placed.

Conclusion

The treatment of refractory benign esophageal strictures remains a challenge for clinicians. Dilatation of the stricture with Savary or balloon remains the first step. Dilatation combined with intralesional injections with steroids can be considered. After failure of these therapeutic options, stent placement can be considered with fully covered SEMSs, which are safe and effective in treatment of postcorrosive esophageal stricture. The optimal duration of stent placement for treating refractory benign esophageal strictures depends on a number of variables, such as stricture type, severity of the inflammation, and stricture length, and stent dilatations for a period of at least 6–8 weeks are recommended. Other causes of benign esophageal stricture need more studies to compare different stent designs to prevent migration and recurrent stricture. We concluded that insertion of temporary stent may be a promising and less invasive technique in management of a refractory esophageal strictures, but the number of cases were not enough to reach a safe conclusion, so we need more studies on this technique.

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Conflicts of interest
There are no conflicts of interest.

References

1 Marks RD, Richter JE. Peptic strictures of the esophagus. Am J Gastroenterol 1993; 88:1160–1173.

2 Shah JN. Benign refractory esophageal strictures: widening the endoscopist's role. Gastrointest Endosc 2006; 63:164–167.

3 Siersema PD. Treatment options for esophageal strictures. Nat Clin Pract Gastroenterol Hepatol 2008; 5:142–152.

4 Saeed ZA, Ramirez FC, Hepps KS, Cole RA, Schneider FE, Ferro PS, Graham DY. An objective end point for dilation improves outcome of peptic esophageal strictures: a prospective randomized trial. Gastrointest Endosc 1997; 45:354–359.

5 Kochman ML, McClave SA, Boyce HW. The refractory and the recurrent esophageal stricture: a definition. Gastrointest Endosc 2005; 62:474–475.

6 Tan BS, Kennedy C, Morgan R, Owen W, Adam A. Using uncovered metallic endoprostheses to treat recurrent benign esophageal strictures. Am J Roentgenol 1997; 169:1281–1284.

7 Song HY, Jung HY, Park SI, Kim SB, Lee DH, Kang SG, Il Min Y. Covered retrievable expandable nitinol stents in patients with benign esophageal strictures: initial experience. Radiology 2000; 217:551–557.

8 Pungpapong S, Raimondo M, Wallace MB, Woodward TA. Problematic esophageal stricture: an emerging indication for self-expandable silicone stents. Gastrointest Endosc 2004; 60:842–845.

9 Repici A, Vleggaar FP, Hassan C, van Boeckel PG, Romeo F, Pagano N, *et al.* Efficacy and safety of biodegradable stents for refractory benign esophageal strictures: the BEST (Biodegradable Esophageal Stent) study. Gastrointest Endosc 2010; 72:927–934.

10 Siersema PD. Stenting for benign esophageal strictures. Endoscopy 2009; 41:363–373.

11 Hirdes MM, Vleggaar FP, Siersema PD. Stent placement for esophageal strictures: an update. Expert Rev Med Devices 2011; 8:733–755.

12 Eloubeidi MA, Lopes TL. Novel removable internally fully covered self-expanding metal esophageal stent: feasibility, technique of removal, and tissue response in humans. Am J Gastroenterol 2009; 104: 1374–1381.

13 Bakken JC, Wong Kee Song LM, deGroen PC, Baron TH. Use of a fully covered self-expandable metal stent for the treatment of benign esophageal diseases. Gastrointest Endosc 2010; 72:712–720.

14 Scolapio JS, Pasha TM, Gostout CJ, Mahoney DW, Zinsmeister AR, Ott BJ, Lindor KD. A randomized prospective study comparing rigid to balloon dilators for benign esophageal strictures and rings. Gastrointest Endosc 1999; 50:13–17.

15 Cox JG, Winter RK, Maslin SC, Jones R, Buckton GK, Hoare RC, *et al.* Balloon or bougie for dilatation of benign oesophageal stricture? An interim report of a randomized controlled trial.Gut 1988; 29: 1741–1747.

16 Yamamoto H, Hughes RW Jr, Schroeder KW, Viggiano TR, DiMagno EP. Treatment of benign esophageal stricture by Eder-Puestow or balloon dilators: a comparison between randomized and prospective non randomized trials. Mayo Clin Proc 1992; 67:228–236.

17 Boyce HW. Dilation of difficult benign esophageal strictures. Am Gastroenterol 2005; 100:744–745.

18 Camargo MA, Lopes LR, Grangeia TA, Andreollo NA, Brandalise NA. Use of corticosteroids after esophageal Dilations on patients with corrosive stenosis: prospective, randomized and double-blind study. Rev Assoc Med Bras 2003; 49:286–292.

19 Ramage JI Jr, Rumalla A, Baron TH, Pochron NL, Zinsmeister AR, Murray JA, *et al.* A prospective, randomized, double-blind, placebo-controlled trial of endoscopic steroid injection therapy for esophageal peptic strictures. Am J Gastroenterol 2005; 100:2419–2425.

20 Wadhwa RP, Kozarek RA, France RE, Brandabur JJ, Gluck M, Low DE, *et al.* Use of self-expandable metallic stents in benign GI diseases. Gastrointest Endosc 2003; 58:207–212.

21 Lee JG, Hsu R, Leung JW. Are self-expanding metal mesh stents useful in the treatment of benign esophageal stenosis and fistulas? An experience of four cases. Am J Gastroenterol 2000; 95:1920–1925.

22 Johnsson E, Lundell L, Liedman B. Sealing of esophageal perforation or ruptures with expandable metallic stents: a prospective controlled study on treatment efficacy and limitations. Dis Esophagus 2005; 18:262–266.

23 Eloubeidi MA, Lopes TL. Novel removable internally fully covered self-expanding metal esophageal stent: feasibility, technique of removal, and tissue response in humans. Am J Gastroenterol 2009; 104:1374–1381.

24 Bakken JC, Wong Kee Song LM, deGroen PC, Baron TH. Use of a fully covered self-expandable metal stent for the treatment of benign esophageal diseases. Gastrointest Endosc 2010; 72:712–720.

25 Eloubeidi MA, Talreja JP, Lopes TL, Al-Awabdy BS, Shami VM, Kahaleh M. Success and complications associated with placement of fully covered removable self-expandable metal stents for benign esophageal diseases (with videos). Gastrointest Endosc 2011; 73:673–681.

26 Ham YH, Kim GH. Plastic and biodegradable stents for complex and refractory benign esophageal strictures. Clin Endosc 2014; 47:295–300.

27 Van Boeckel PG, Vleggaar FP, Siersema PD. A comparison of temporary self-expanding plastic and biodegradable stents for refractory benign esophageal strictures. Clin Gastroenterol Hepatol 2011; 9:653–659.