

# Esophageal stenting for benign and malignant disease: European Society of Gastrointestinal Endoscopy (ESGE) Guideline – Update 2021



## Authors

Manon C. W. Spaander<sup>1</sup> , Ruben D. van der Bogt<sup>1</sup>, Todd H. Baron<sup>2</sup>, David Albers<sup>3</sup>, Daniel Blero<sup>4</sup>, Antonella de Ceglie<sup>5</sup> , Massimo Conio<sup>6</sup>, László Czako<sup>7</sup>, Simon Everett<sup>8</sup>, Juan-Carlos Garcia-Pagán<sup>9</sup>, Angels Ginès<sup>10</sup>, Manol Jovani<sup>11</sup> , Alessandro Repici<sup>12,13</sup>, Eduardo Rodrigues-Pinto<sup>14</sup>, Peter D. Siersema<sup>15</sup>, Lorenzo Fuccio<sup>16</sup> , Jeanin E. van Hoof<sup>17</sup>

## Institutions

- 1 Department of Gastroenterology and Hepatology, Erasmus MC University Medical Center, Rotterdam, The Netherlands
- 2 Department of Internal Medicine, Division of Gastroenterology and Hepatology, University of North Carolina, Chapel Hill, North Carolina, USA
- 3 Department of Internal Medicine and Gastroenterology, Elisabeth-Krankenhaus Academic Hospital, University of Duisburg-Essen, Essen, Germany
- 4 Department of Gastroenterology, Hepatopancreatology and Digestive Oncology, CUB Erasme Hospital, ULB (Free University of Brussels), Brussels, Belgium
- 5 Department of Gastroenterology, Ospedale Civile di Sanremo, Sanremo (IM), Italy
- 6 Department of Gastroenterology, Ospedale Santa Corona, Pietra Ligure (SV), Italy
- 7 First Department of Medicine, Faculty of Medicine, University of Szeged, Szeged, Hungary
- 8 Department of Gastroenterology and Hepatology, Leeds Teaching Hospital NHS Trust, Leeds, UK
- 9 Barcelona Hepatic Hemodynamic Laboratory, Liver Unit – Health Care Provider of the European Reference Network on Rare Liver Disorders (ERN-Liver) – Hospital Clinic, IDIBAPS and CIBERehd, University of Barcelona, Barcelona, Spain
- 10 Gastroenterology Department, Hospital Clinic of Barcelona, IDIBAPS and CIBERehd, University of Barcelona, Barcelona, Spain
- 11 Department of Gastroenterology and Hepatology, Johns Hopkins Medical Institutions, Baltimore, Maryland, USA
- 12 Endoscopy Unit, IRCCS Istituto Clinico Humanitas, Rozzano, Milan, Italy
- 13 Department of Biomedical Sciences, Humanitas University, Pieve Emanuele, Milan, Italy
- 14 Gastroenterology Department, Centro Hospitalar São João, Porto, Portugal
- 15 Department of Gastroenterology and Hepatology, Radboud University Medical Center, Nijmegen, The Netherlands
- 16 Gastroenterology Unit, Department of Medical and Surgical Sciences, S. Orsola-Malpighi Hospital, University of Bologna, Bologna, Italy
- 17 Department of Gastroenterology and Hepatology, Leiden University Medical Center, Leiden, The Netherlands

published online 30.4.2021

## Bibliography

Endoscopy 2021; 53: 751–762

DOI 10.1055/a-1475-0063

ISSN 0013-726X

© 2021. European Society of Gastrointestinal Endoscopy

All rights reserved.

This article is published by Thieme.

Georg Thieme Verlag KG, Rüdigerstraße 14,  
70469 Stuttgart, Germany

 Tables 1s–6s

Supplementary material is available under  
<https://doi.org/10.1055/a-1475-0063>

## Corresponding author

Manon C.W. Spaander, MD, PhD, Department of Gastroenterology and Hepatology, Erasmus MC University Medical Center, Rotterdam, The Netherlands  
[v.spaander@erasmusmc.nl](mailto:v.spaander@erasmusmc.nl)

## MAIN RECOMMENDATIONS

### Malignant disease

**1** ESGE recommends placement of partially or fully covered self-expandable metal stents (SEMSs) for palliation of malignant dysphagia over laser therapy, photodynamic therapy, and esophageal bypass.

Strong recommendation, high quality evidence.

**2** ESGE recommends brachytherapy as a valid alternative, alone or in addition to stenting, in esophageal cancer patients with malignant dysphagia and expected longer life expectancy.

Strong recommendation, high quality evidence.

**3** ESGE recommends esophageal SEMS placement for sealing malignant tracheoesophageal or bronchoesophageal fistulas.

Strong recommendation, low quality evidence.

**4** ESGE does not recommend SEMS placement as a bridge to surgery or before preoperative chemoradiotherapy because it is associated with a high incidence of adverse events. Other options such as feeding tube placement are preferable.

Strong recommendation, low quality evidence.

### Benign disease

**5** ESGE recommends against the use of SEMSs as first-line therapy for the management of benign esophageal strictures because of the potential for adverse events, the availability of alternative therapies, and their cost.

Strong recommendation, low quality evidence.

**6** ESGE suggests consideration of temporary placement of self-expandable stents for refractory benign esophageal strictures.

Weak recommendation, moderate quality evidence.

**7** ESGE suggests that fully covered SEMSs be preferred over partially covered SEMSs for the treatment of refractory benign esophageal strictures because of their very low risk of embedment and ease of removability.

Weak recommendation, low quality evidence.

**8** ESGE recommends the stent-in-stent technique to remove partially covered SEMSs that are embedded in the esophageal wall.

Strong recommendation, low quality evidence.

**9** ESGE recommends that temporary stent placement can be considered for the treatment of leaks, fistulas, and perforations. No specific type of stent can be recommended, and the duration of stenting should be individualized.

Strong recommendation, low quality of evidence.

**10** ESGE recommends considering placement of a fully covered large-diameter SEMS for the treatment of esophageal variceal bleeding refractory to medical, endoscopic, and/or radiological therapy, or as initial therapy for patients with massive bleeding.

Strong recommendation, moderate quality evidence.

## SOURCE AND SCOPE

This Guideline is an official statement of the European Society of Gastrointestinal Endoscopy (ESGE). It provides guidance on the use of esophageal stents for both malignant and benign conditions. The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system was adopted to define the strength of recommendations and the quality of evidence.

## 1 Introduction

Esophageal cancer is the seventh most common cancer type worldwide, with a global incidence of 604 100 new cases in 2020 [1–3]. The main symptoms of esophageal cancer include dysphagia, with concomitant weight loss and odynophagia [4]. Because patients with esophageal cancer are usually asymptomatic in the early stages, more than half of patients are diagnosed at an advanced stage of the disease and are not eligible for treatment with curative intent [5].

One of the main goals of palliative treatment is to relieve dysphagia and improve nutritional intake. A variety of therapeutic options are available, including external beam radiation therapy (EBRT), brachytherapy, and esophageal stent placement. Esophageal stent placement is preferable in patients with an expected short-term survival because of its rapid relief of dysphagia symptoms [6]. Different stent designs are available, varying in stent material (plastic, metal), covering, diameter, and antimigration features. Partially covered self-expandable metal stents (PCSEMSs) and fully covered self-expandable metal stents (FCSEMSs) are most often used in current practice.

In addition to their use for the palliation of dysphagia, esophageal stents can be used for the treatment of benign esophageal diseases. Stents are usually removed after several weeks as this timeframe allows for the resolution of disease and safe stent removal. FCSEMSs have been mostly used for the treatment of benign disorders. In recent years, biodegradable stents (BDSs) have gained increasing attention for obviating the need for stent removal.

This is an update of the clinical guideline on the use of esophageal stents for benign and malignant disease issued in

## ABBREVIATIONS

<b>BDS</b>	biodegradable stent
<b>CI</b>	confidence interval
<b>CRP</b>	C-reactive protein
<b>EBRT</b>	external beam radiation therapy
<b>ESCOG</b>	Eastern Cooperative Oncology Group
<b>ESGE</b>	European Society of Gastrointestinal Endoscopy
<b>ESPEN</b>	European Society of Parenteral and Enteral Nutrition
<b>FCSEMS</b>	fully covered self-expandable metal stent
<b>GRADE</b>	Grading of Recommendations Assessment, Development and Evaluation
<b>LAMS</b>	lumen-apposing metal stent
<b>OD</b>	odds ratio
<b>PCSEMS</b>	partially covered self-expandable metal stent
<b>RBES</b>	refractory benign esophageal stricture
<b>RCT</b>	randomized controlled trial
<b>SEMS</b>	self-expandable metal stent
<b>SEPS</b>	self-expandable plastic stent
<b>TIPS</b>	transjugular intrahepatic portosystemic shunting

2016 by the European Society of Gastrointestinal Endoscopy (ESGE) [7]. In this guideline update, the current evidence will be discussed and recommendations on the use of esophageal stents will be provided.

## 2 Methods

The ESGE Guidelines Committee (chair, J.v.H.) commissioned this guideline update and appointed a Guideline leader (M.S.). Key questions (**Table 1s**, see online-only Supplementary Material) were prepared by a coordinating team (M.S., R.v.d.B., L.F., T.B., J.v.H.) and were approved by all guideline participants. Each guideline participant was assigned to a research question in one of two areas: malignant disease (taskforce leader, L.F.) and benign disease (taskforce leader, T.B.).

A literature search of MEDLINE and the Cochrane library was conducted in August 2020 using the PICO structure (where P stands for population/patient, I for intervention/indicator, C for comparator/control, and O for outcome). The quality of collected studies was graded according to the Grading Recommendations Assessment, Development and Evaluation (GRADE) system and retrieved study outcomes were translated into evidence tables. Evidence tables and proposed guideline recommendations were collected by the Guideline leader and circulated 2 weeks before the digital face-to-face meeting held on 22 October 2020. During the digital face-to-face meeting, outcomes of the PICOs were discussed and consensus was reached on guideline recommendations.

In November 2020, a draft was prepared by M.S. and R.v.d.B. and sent to the guideline team. The revised draft was reviewed by two independent experts. After adjustment and final ap-

proval by the guideline team, the manuscript was submitted for publication by *Endoscopy*.

This Guideline was issued in 2021 and will again be considered for updating in 2025.

## 3 Malignant disorders

### 3.1 Efficacy

#### RECOMMENDATION

ESGE recommends placement of partially or fully covered self-expandable metal stents (SEMSs) for palliation of malignant dysphagia over laser therapy, photodynamic therapy, and esophageal bypass.

Strong recommendation, high quality evidence.

#### RECOMMENDATION

ESGE recommends brachytherapy as a valid alternative, alone or in addition to stenting, in esophageal cancer patients with malignant dysphagia and expected longer life expectancy.

Strong recommendation, high quality evidence.

#### RECOMMENDATION

ESGE recommends patient characteristics be taken into account when selecting patients for esophageal stent placement as a palliative method.

Strong recommendation, low quality evidence.

#### RECOMMENDATION

ESGE recommends against the placement of nonexpandable and expandable plastic stents for the palliation of malignant esophageal strictures.

Strong recommendation, high quality evidence.

Several randomized controlled trials (RCTs) have compared the outcomes of esophageal stent placement with other treatment strategies for the palliation of malignant dysphagia due to esophageal cancer (**Table 2s**). Laser therapy, photodynamic therapy, and esophageal bypass surgery have shown comparable outcomes to esophageal stent placement [8–13].

Based on two RCTs comparing the outcomes of self-expandable metal stent (SEMS) placement versus brachytherapy, brachytherapy may be considered over SEMS placement in patients with expected long-term survival [14,15]. Even though SEMS placement leads to a more rapid relief of dysphagia, brachytherapy is preferable in these patients for its durable relief of symptoms [15,16]. Furthermore, the use of brachytherapy is associated with a lower risk of serious adverse events and favorable quality of life outcomes [14,15]. Despite these benefits, the availability of brachytherapy in daily practice is restricted by the need for local expertise and dedicated logistics

[17]. A short course of EBRT may be a valid alternative to brachytherapy [18]. In patients with a good performance status, chemoradiotherapy can be considered to prolong dysphagia-free survival, but is associated with an increased toxicity compared with radiotherapy alone [19].

Esophageal stent placement is indicated in patients with an expected short-term survival (i.e. less than 3 months) for its rapid relief of symptoms, usually within 1–2 days after stent placement [6]. Several prognostic tools may aid the selection of esophageal stent candidates, but these lack external validation [20–22]. The presence of metastases and poor performance status have repeatedly been shown to be associated with poor survival [21–24]. When esophageal stent placement is considered, SEMs are recommended over self-expandable plastic stents (SEPSs) owing to a lower rate of symptom recurrence and serious adverse events [6]. To date, there have been no differences shown in the outcomes of FCSEMs and PCSEMs placement, or the placement of SEMs with or without an anti-reflux mechanism [25–28].

### 3.2 Safety

In the previous ESGE guideline, a meta-analysis of the available evidence was performed for the occurrence of stent-related adverse events [7]. The major adverse event rate was reported to be 21% for FCSEMs and 18% for PCSEMs. The most frequent early adverse events were reflux (9.3%), severe pain (8.7%), and bleeding (7.6%). The most frequent late adverse events were reflux (15%), severe pain (15%), and ingrowth/overgrowth (14%).

In recent years, an increase in stent-related adverse events has been reported, which has been attributed to the increased use of chemotherapy and/or radiotherapy before SEM placement [29]. Other patient characteristics that appear to be associated with an increased risk of adverse events include female sex and dilation before SEM placement [28, 29].

### 3.3 Fistula

#### RECOMMENDATION

ESGE recommends esophageal SEM placement for sealing malignant tracheoesophageal or bronchoesophageal fistulas.

Strong recommendation, low quality evidence.

#### RECOMMENDATION

ESGE recommends the application of double stenting (esophagus and airway) when fistula occlusion is not achieved by esophageal or airway prosthesis placement alone.

Strong recommendation, low quality evidence.

The incidence of esophageal fistulas has increased markedly as a result of advances in palliative therapies for esophageal cancer [30, 31]. Esophageal fistulas usually occur in the context of advanced esophageal cancer, but may also result from other malignancies or prior (palliative) therapy [30–34]. The symptoms of an esophageal fistula include cough, fever, and pneumonia [35]. Because the development of an esophageal fistula is considered to be an indicator of poor survival (weeks to months), treatment strategies should aim to rapidly relieve symptoms and improve the patient's remaining quality of life.

The clinical success rate of SEM placement for malignant fistulas ranges between 56% and 100% [35–44]. Factors associated with treatment failure include proximal fistula location, fistula orifice size >1 cm, and Eastern Cooperative Oncology Group (ECOG) performance status of 3–4 [42, 43]. After the fistula has been successfully sealed, reopening occurs in 0–39% of patients [39–42]. In most cases, reopening can be managed endoscopically by repositioning the SEM or by placement of an additional SEM [41, 42]. Airway stenting may be considered in addition to esophageal SEM placement to improve the success rate and prevent airway obstruction [44–47].

The outcomes of SEM placement have been compared with other treatment strategies in two retrospective studies [37, 38]. Chen et al. reported on the outcomes of SEM placement (n=30) versus feeding gastrostomy/jejunostomy (n=35) and found SEM placement to be associated with an improved overall survival [37]. In a study by Hu et al., the outcomes of SEM placement (n=17) were compared with gastrostomy (n=9) and best supportive care (n=9) [38]. The median survival was comparable among the treatment arms. Patients who underwent SEM placement had favorable quality of life outcomes on several subscales, including eating and respiratory problems.

### 3.4 Bridge to surgery

#### RECOMMENDATION

ESGE does not recommend SEM placement as a bridge to surgery or before preoperative chemoradiotherapy because it is associated with a high incidence of adverse events. Other options such as feeding tube placement are preferable.

Strong recommendation, low quality evidence.

Neoadjuvant therapy followed by surgery is the current clinical standard for treatment with curative intent for esophageal cancer [48, 49]. Malnutrition and cachexia – common in esophageal cancer patients – are known risk factors for treatment-related adverse events and poor survival [50–52]. From this perspective, the European Society of Parenteral and Enteral Nutrition (ESPEN) recommends regular assessment of a patient's nutritional status [53]. Initial screening can be performed by assessment of nutritional intake, weight change, and body mass index. Nutritional support is strongly recommended for patients at severe nutritional risk, defined as more than 10%–15% weight loss in the previous 6 months [54, 55].

Esophageal stents have been used to improve nutritional status before neoadjuvant therapy and surgery. In a meta-analysis of nine studies (5 SEPS, 3 SEMs, 1 SEPS+SEMS), the outcomes of 180 patients undergoing stent placement prior to or during neoadjuvant therapy were pooled [56]. Stent placement was technically successful in 95% of patients, with a statistically significant improvement in dysphagia symptoms, but without improvement in weight or serum albumin levels. Stent migration and chest discomfort occurred in 32% and 51% of patients, respectively. The relatively high rate of stent migration in this setting has been attributed to neoadjuvant therapy-induced tumor shrinkage, as most of these patients do not require repeated intervention [56,57]. To overcome the substantial risk of adverse events, van den Berg et al. investigated the outcomes of BDS placement in 10 patients scheduled to undergo neoadjuvant chemoradiotherapy [58]. A statistically significant decrease in dysphagia symptoms occurred without any major adverse events. Nevertheless, 7 of 10 patients required additional nutritional support and median weight loss before surgery was 5.4 kg.

In the past, SEMs placement before surgery has been reported to be associated with a worse oncologic outcome with a lower rate of R0 resections, a higher rate of major adverse events, and decreased overall survival [59,60]. Contrarily, recent studies have reported no difference in R0 resection rate, overall survival, and postoperative complications [61–63].

Alternatives to esophageal stent placement include oral nutritional supplements, nasogastric tube placement, percutaneous feeding tube placement, and parenteral nutrition. In general, the use of percutaneous feeding tube placement (i.e. percutaneous endoscopic gastrostomy or endoscopic jejunostomy) is recommended when enteral feeding is expected to be continued for at least 4 weeks [64–66]. In surgical candidates, percutaneous endoscopic gastrostomy is considered by some surgical teams to be a contraindication as it may compromise the construction of a gastric conduit created during distal esophageal/proximal stomach reconstruction.

### 3.5 Combined approach

#### RECOMMENDATION

ESGE does not recommend the concurrent use of radiotherapy if an esophageal stent is present.  
Strong recommendation, low quality evidence.

#### RECOMMENDATION

ESGE suggests that SEMs placement with concurrent single-dose brachytherapy is safe and effective for relief of dysphagia.  
Weak recommendation, low quality evidence.

To improve the outcome of stent placement, the use of radiotherapy in addition to SEMs placement has been investigated. This combined approach may potentially lead to prolonged

dysphagia relief and improved overall survival [67–70]. Nevertheless, a high risk of major adverse events has been reported for the combination of EBRT and stent placement, suggesting stent placement is better reserved for patients who have failed prior radiotherapy [71].

In contrast to EBRT, the combination of single-dose brachytherapy and SEMs placement is safe and effective [67]. The use of irradiated SEMs has been a topic of interest that potentially provides an advantage of combining the benefits of SEMs placement and brachytherapy. Based on a meta-analysis of six RCTs, the use of irradiated SEMs led to an increased dysphagia-free time compared with traditional SEMs, without affecting the rate of adverse events [72]. To date, however, all of these studies have been performed in Chinese populations, thereby warranting (prospective) evaluation in Western populations.

Only one study has investigated the outcomes of single-dose brachytherapy in addition to BDS placement [68]. Although satisfactory relief of symptoms was achieved, an unacceptably high rate of major adverse events was observed, which necessitated premature study termination.

### 3.6 Prior palliative therapy

In patients with recurrent dysphagia after first-line palliative radiotherapy, SEMs placement is considered the main treatment [73]. However, the association between prior palliative therapy and stent-related adverse events remains controversial. Several studies have reported that prior chemotherapy and/or radiotherapy increase the risk of life-threatening adverse events after SEMs placement, whereas other studies have shown the risk of adverse events to be unaffected [29, 34,74–82]. Pneumonia, fistula formation, and stent-related pain may be increased in patients with prior therapy who receive stents [29,34,80–82].

The increased risk of adverse events has been explained by pulmonary toxicity and radiation-induced changes, which increase the susceptibility to pressure necrosis [29,79,81–85]. The potential role of radiotherapy-induced changes is supported by the increase in the rate of adverse events with a corresponding increase in radiation dosage [82,83]. Regardless, the increased adverse event rate may also be partially explained by advanced disease stage, which is known to be related to an increased risk of life-threatening bleeding and fistula formation [34,79].

## 4 Benign disease

### 4.1 Refractory benign esophageal strictures

#### RECOMMENDATION

ESGE recommends against the use of SEMs as first-line therapy for the management of benign esophageal strictures because of the potential for adverse events, the availability of alternative therapies, and their cost.  
Strong recommendation, low quality evidence.

**RECOMMENDATION**

ESGE suggests consideration of temporary placement of self-expandable stents for refractory benign esophageal strictures.

Weak recommendation, moderate quality evidence.

**RECOMMENDATION**

ESGE suggests that fully covered SEMS fixation by endoscopic suturing or over-the-scope clips be considered in patients with previous stent migration.

Weak recommendation, low quality evidence.

The use of esophageal stents for the treatment of benign esophageal strictures has mainly been investigated in the context of refractory or recurrent benign esophageal strictures (RBESs; **Table 3s**). As defined by Kochman et al., these patients either fail to reach a target diameter of 14mm after biweekly dilations over 5 weeks or fail to maintain the target diameter up to 4 weeks after the last dilation [86]. Esophageal stent placement has a potential benefit because of its continuous expansion force, which may lead to stricture remodeling. Although stent placement has not been compared with dilation in treatment-naïve patients, it is generally accepted that esophageal stent placement should only be considered as a second-line approach owing to its relatively high rate of adverse events and its cost.

In a recent meta-analysis, the outcomes of 18 studies with a total of 444 patients were pooled [87]. The clinical success rate after stent placement was 40.5% (95% confidence interval [CI] 31.5%–49.5%). Stent migration was the most common stent-related adverse event, occurring in 28.6% (95%CI 21.9%–37.1%). Other adverse events occurred in 20.6% (95%CI 15.3%–28.1%). Treatment outcomes did not differ among the SEMS, SEPS, and BDS groups.

To reduce the risk of SEMS migration, endoscopic stent fixation by endoscopic suturing or over-the-stent clips has been investigated (**Table 4s**). In general, endoscopic stent fixation is highly successful (96.7%; 95%CI 92.3%–98.6%) and safe (procedure-related adverse events, 3.7%; 95%CI 1.6%–8.2%) [88]. In the largest study of RBES patients, endoscopic suturing of the FCSEMS led to a reduction in stent migration rate compared with no suturing (9.4% vs. 39.5%;  $P=0.01$ ) [89]. It remains unclear if there is a benefit of routine stent fixation, and it may be considered in patients with prior stent migration.

Another method to reduce the risk of stent migration is the use of lumen-apposing metal stents (LAMs). It is believed that the typical wide flanges and short lengths of LAMs may prevent stent migration. To date, LAMs have only been investigated in mixed study populations restricted by small sample sizes [90–94]. More studies are needed to evaluate their potential benefit in RBES patients.

## 4.1.1 Factors predicting successful treatment

**RECOMMENDATION**

ESGE does not recommend permanent stent placement for refractory benign esophageal stricture; stents should usually be removed at a maximum of 3 months following insertion.

Strong recommendation, low quality evidence.

**RECOMMENDATION**

ESGE suggests that fully covered SEMSs be preferred over partially covered SEMSs for the treatment of refractory benign esophageal strictures because of their very low risk of embedment and ease of removability.

Weak recommendation, low quality evidence.

**RECOMMENDATION**

ESGE does not recommend the use of biodegradable stents over SEMSs in the treatment of benign esophageal strictures.

Strong recommendation, low quality evidence.

**RECOMMENDATION**

ESGE recommends the stent-in-stent technique to remove partially covered SEMSs that are embedded in the esophageal wall.

Strong recommendation, low quality evidence.

The current literature provides some evidence that patient characteristics affect outcomes following stent placement in RBES patients. The previously mentioned meta-analysis showed a tendency toward a higher clinical success rate in studies that included a larger proportion of patients with radiotherapy-induced strictures and anastomotic strictures [87]. A similar trend was observed for the risk of stent-related adverse events, with the risk seeming to be lower in anastomotic strictures compared with other etiologies. In addition to stricture etiology, cervical stricture location and increasing stricture length have been reported to be associated with lower clinical success rates [95–97]. Because most studies do not take into account patient characteristics when reporting study outcomes, their specific impact remains unclear.

The optimal stent duration for the management of RBES patients has not been formally tested. It is recommended that stents remain in place for at least 6–8 weeks, but not longer than 10–12 weeks after stent placement. It is believed that this stent duration provides sufficient time to induce stricture remodeling and at the same time prevents stent embedment. One retrospective study investigated the influence of stent duration on the safety of stent removal but found no such association [98]. Stent design was the only independent predictor

of complicated stent removal. Adverse events were more common with PCSEMSs (odds ratio [OR] 8.83; 95%CI 3.29–23.70) and SEPSs (OR 4.71; 95%CI 1.39–15.97) when compared with FCSEMSs. The use of BDSs has been suggested to obviate stent removal, but compelling evidence for BDSs over other stent types is lacking [96, 99].

Different methods for endoscopic removal of an embedded PCSEMS have been described [100–106]. Most studies have reported on the use of the stent-in-stent technique, which relies on the placement of an additional FCSEMS fully overlapping the location of the embedded PCSEMS. To induce pressure necrosis, the stent diameter of the additional FCSEMS should be at least that of the embedded PCSEMS. In >90% of patients, both SEMSs can be safely removed 10–14 days after placement of the additional FCSEMS [100, 101]. If removal of the embedded PCSEMS is unsuccessful, the stent-in-stent technique can be re-attempted.

#### 4.1.2 Combined approach

##### RECOMMENDATION

ESGE suggests that a combined approach of stent placement with additional techniques (e.g. corticosteroid injection, chemotherapeutic topical application) should not be undertaken in an attempt to improve the long-term benefit of temporary stenting.

Weak recommendation, very low quality evidence.

Concurrent endoscopic incisional therapy, corticosteroid injection, and mitomycin-C application are reported to enhance treatment outcomes of endoscopic dilation therapy. Data on the use of these endoscopic interventions in combination with esophageal stent placement are scarce. Only one study has reported on the outcomes of corticosteroid injection in combination with FCSEMS placement but no clear benefit was found [107].

#### 4.1.3 Options after stent failure

##### RECOMMENDATION

ESGE suggests alternative treatment strategies such as self-dilation or surgical treatment for patients with refractory benign esophageal strictures that have not satisfactorily improved after two separate treatments with temporary stenting.

Weak recommendation, low quality evidence.

##### RECOMMENDATION

In poor surgical candidates, ESGE recommends self-dilation with rigid dilators.

Strong recommendation, low quality evidence.

In patients with recurrent dysphagia after stent placement, repeated esophageal stent placement may be considered, but has not been shown to have significant incremental benefit [108, 109]. When repeat esophageal stent placement does not lead to satisfactory results, alternative treatment strategies should be considered. Surgical treatment represents a valid option in selected patients, depending on the stricture location and patient performance status. Furthermore, self-dilation is safe and effective in the majority of patients [110–112]. Treatment success with self-dilation relies on patient compliance, restricting its use to self-motivated patients and poor surgical candidates.

## 4.2 Leaks, fistulas, and perforations

##### RECOMMENDATION

ESGE recommends that temporary stent placement can be considered for the treatment of leaks, fistulas, and perforations. No specific type of stent can be recommended, and the duration of stenting should be individualized.

Strong recommendation, low quality of evidence.

##### RECOMMENDATION

ESGE recommends esophageal stents be placed as early as possible for the treatment of leaks, fistulas, and perforations.

Strong recommendation, moderate quality evidence.

##### RECOMMENDATION

ESGE recommends including stent placement in a multimodality treatment protocol for leaks, fistulas, and perforations to optimize the healing success rate and minimize the risk of adverse events.

Strong recommendation, low quality evidence.

Esophageal stents are increasingly used in the management of esophageal perforations [113]. Based on three systematic reviews on the use of PCSEMSs, FCSEMSs, and SEPSs in anastomotic leaks and perforations, the clinical success rate of esophageal stent placement is 81%–87%, with no difference among the stent types [114–116]. Even though the clinical success rates are comparable, SEMSs are reported to perform better than SEPSs in leaks and perforations, with higher technical success (95% vs. 91%;  $P=0.03$ ), and reduced risk of migration (16% vs. 24%;  $P=0.001$ ) and stent repositioning (3% vs. 11%;  $P<0.001$ ), as well as a reduced risk of perforation when considering anastomotic leaks only (0% vs. 2%;  $P=0.01$ ) [116]. Data on the use of BDSs in these patients are restricted to a few small retrospective studies (Table 5s) [117–119].

To identify patients who may benefit from esophageal stent placement, van Halsema et al. developed a clinical prediction

rule based on four clinical parameters: etiology (leak, fistula, perforation), location, orifice size, and C-reactive protein (CRP) level [120]. In the validation cohort, the sensitivity and specificity for a 70% predicted probability of clinical success were 33% and 89%, respectively. Multivariable logistic regression showed fistulas and orifice size of >2 cm to be associated with a lower rate of clinical success. The observed difference between anastomotic leaks and fistulas emphasizes that leaks, fistulas, and perforations are different entities and may require an individual approach. For instance, in fistula patients, SEMS placement is usually performed in combination with other therapies and a longer stent duration may be needed in anastomotic leaks compared with perforations [121, 122]. Nevertheless, the current literature provides insufficient data to formulate separate recommendations.

No study has investigated the optimal stent duration. Stents are usually removed 6–8 weeks after insertion and repeated stent placement is needed in 11% of patients [114–116]. In patients who are endoscopically treated for benign esophageal perforations, early diagnosis (<24 hours) has been shown to be associated with a lower need for re-intervention and intensive care admission, and a shorter hospital stay [123].

Recently, the outcomes of SEMS placement have been compared with endoscopic vacuum therapy for the treatment of post-surgical leaks [124]. The use of endoscopic vacuum therapy was associated with a higher leak closure rate, more endoscopic device changes, shorter duration of treatment, and lower in-hospital mortality. Because the management of these patients may be challenging and often requires a multimodality approach, esophageal stent placement may still be considered in addition to other endoscopic techniques to optimize treatment outcomes [119].

#### 4.2.1 Safety

Stent migration is the most common stent-related adverse event and tends to be higher when FCSEMSs (26%) and SEPSs are used (31%) compared with PCSEMSs (12%) [114]. The use of large-diameter SEMSs has been suggested to reduce the risk of stent migration in anastomotic leaks [119]. Furthermore, suturing of FCSEMSs may render migration rates similar to those of PCSEMSs, without the difficulties associated with the removal of PCSEMSs and with a lower risk of adverse events [125]. Other stent-related adverse events include the development of a stricture, stent erosion, perforation, and bleeding [114–116]. Repeated endoscopic intervention is needed in 17%–25% of patients and 7%–13% require surgical intervention [114–116].

### 4.3 Acute variceal bleeding

#### RECOMMENDATION

ESGE recommends considering placement of a fully covered large-diameter SEMS for the treatment of esophageal variceal bleeding refractory to medical, endoscopic, and/or radiological therapy, or as initial therapy for patients with massive bleeding.

Strong recommendation, moderate quality evidence.

Esophageal stent placement for acute variceal bleeding has mainly been investigated in small retrospective studies using a dedicated stent design (SX-ELLA stent DANIS) for the treatment of refractory bleeding (Table 6s). Stent duration is reported to range from 1–30 days [126]. Pooled data analysis shows that SEMS placement leads to control of bleeding in >80% of patients, without severe stent-related adverse events [126, 127]. In 21% of patients, bleeding reoccurs within 6 weeks after SEMS placement [128]. Only one RCT has performed a direct comparison of SEMSs and balloon tamponade [129]. In this study of 28 patients, SEMS placement led to a higher rate of control of bleeding during the first 15 days (85% vs. 47%;  $P=0.04$ ) and a lower rate of adverse events (31% vs. 73%;  $P=0.02$ ).

Despite its effectiveness, the 30-day mortality rate after SEMS placement may be as high as 36%, also reflecting the severity of the underlying condition [127]. Accordingly, SEMSs have been proposed as a bridge to transjugular intrahepatic portosystemic shunting (TIPS) or liver transplantation.

### Disclaimer

The legal disclaimer for ESGE guidelines [130] applies to this Guideline.

### Acknowledgments

The authors are grateful to Dr. Cesare Hassan, Nuovo Regina Margherita Hospital, Rome, Italy, and Professor Konstantinos Triantafyllou, National and Kapodistrian University of Athens, Athens, Greece, for their review of this manuscript; and for comments received from Dr. David Karsenti on behalf of the French Society of Digestive Endoscopy (SFED), Dr. Tony C. K. Tham on behalf of the Irish Society of Gastroenterology (ISG), and Dr. Endrit Shahini, University of Bari Aldo Moro, Bari, Italy.

### Competing interests

T.H. Baron has been a speaker and consultant for Boston Scientific and Cook Endoscopy (2014 to present). A. Repici has been on the advisory board and provided consultancy to Boston Scientific and Medtronic, and provided consultancy to ERBE (all 2017 to present). P.D. Siersema receives research support from Pentax, The eNose company, Norgine, Motus GI, and MicroTech; he is Editor-in-Chief of Endoscopy. M.C.W. Spaander has received research support from Boston Scientific (2013 to present). J.E. van Hooft has provided consultancy to Boston Scientific (2014 to 2017) and Olympus (2021), has received lecture fees from Medtronic (2014, 2015, and 2019) and Cook Medical (2019); her department has received research grants from Cook Medical (2014 to 2019) and Abbott (2014 to 2017). D. Albers, D. Blero, M. Conio, L. Czakó, A. de Ceglie, S. Everett, L. Fuccio, J.-C. Garcia-Pagán, A. Ginès, M. Jovani, E. Rodrigues-Pinto, R.D. van der Bogt declare that they have no conflict of interest.

### References

- [1] Bray F, Ferlay J, Soerjomataram I et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2018; 68: 394–424

- [2] Arnold M, Ferlay J, van Berge Henegouwen MI et al. Global burden of oesophageal and gastric cancer by histology and subsite in 2018. *Gut* 2020; 69: 1564–1571
- [3] International Agency for Research on Cancer. Global Cancer Observatory: Cancer Today; 2020. <https://gco.iarc.fr/today/online-analysis-table> (accessed: 25 March 2021)
- [4] Daly JM, Fry WA, Little AG et al. Esophageal cancer: results of an American College of Surgeons patient care evaluation study. *J Am Coll Surg* 2000; 190: 562–572 discussion 572–563
- [5] Enzinger PC, Mayer RJ. Esophageal cancer. *NEJM* 2003; 349: 2241–2252
- [6] Dai Y, Li C, Xie Y et al. Interventions for dysphagia in oesophageal cancer. *Cochrane Database Syst Rev* 2014: CD005048
- [7] Spaander MC, Baron TH, Siersema PD et al. Esophageal stenting for benign and malignant disease: European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline. *Endoscopy* 2016; 48: 939–948
- [8] Alderson D, Wright PD. Laser recanalization versus endoscopic intubation in the palliation of malignant dysphagia. *Br J Surg* 1990; 77: 1151–1153
- [9] Carter R, Smith JS, Anderson JR. Laser recanalization versus endoscopic intubation in the palliation of malignant dysphagia: a randomized prospective study. *Br J Surg* 1992; 79: 1167–1170
- [10] Fuchs KH, Freys SM, Schaube H et al. Randomized comparison of endoscopic palliation of malignant esophageal stenoses. *Surg Endosc* 1991; 5: 63–67
- [11] Adam A, Ellul J, Watkinson AF et al. Palliation of inoperable esophageal carcinoma: a prospective randomized trial of laser therapy and stent placement. *Radiology* 1997; 202: 344–348
- [12] Aoki T, Osaka Y, Takagi Y et al. Comparative study of self-expandable metallic stent and bypass surgery for inoperable esophageal cancer. *Dis Esophagus* 2001; 14: 208–211
- [13] Dallal HJ, Smith GD, Grieve DC et al. A randomized trial of thermal ablative therapy versus expandable metal stents in the palliative treatment of patients with esophageal carcinoma. *Gastrointest Endosc* 2001; 54: 549–557
- [14] Bergquist H, Wenger U, Johnsson E et al. Stent insertion or endoluminal brachytherapy as palliation of patients with advanced cancer of the esophagus and gastroesophageal junction. Results of a randomized, controlled clinical trial. *Dis Esophagus* 2005; 18: 131–139
- [15] Homs MY, Steyerberg EW, Eijkenboom WM et al. Single-dose brachytherapy versus metal stent placement for the palliation of dysphagia from oesophageal cancer: multicentre randomised trial. *Lancet* 2004; 364: 1497–1504
- [16] Fuccio L, Mandolesi D, Farioli A et al. Brachytherapy for the palliation of dysphagia owing to esophageal cancer: A systematic review and meta-analysis of prospective studies. *Radiother Oncol* 2017; 122: 332–339
- [17] Fuccio L, Guido A, Hassan C et al. Underuse of brachytherapy for the treatment of dysphagia owing to esophageal cancer. An Italian survey. *Dig Liver Dis* 2016; 48: 1233–1236
- [18] Jeene PM, Vermeulen BD, Rozema T et al. Short-course external beam radiotherapy versus brachytherapy for palliation of dysphagia in esophageal cancer: a matched comparison of two prospective trials. *J Thorac Oncol* 2020; 15: 1361–1368
- [19] Penniment MG, De Ieso PB, Harvey JA et al. Palliative chemoradiotherapy versus radiotherapy alone for dysphagia in advanced oesophageal cancer: a multicentre randomised controlled trial (TROG 03.01). *Lancet Gastroenterol Hepatol* 2018; 3: 114–124
- [20] Driver RJ, Handforth C, Radhakrishna G et al. The Glasgow prognostic score at the time of palliative esophageal stent insertion is a predictive factor of 30-day mortality and overall survival. *J Clin Gastroenterol* 2018; 52: 223–228
- [21] Steyerberg EW, Homs MY, Stokvis A et al. Stent placement or brachytherapy for palliation of dysphagia from esophageal cancer: a prognostic model to guide treatment selection. *Gastrointest Endosc* 2005; 62: 333–340
- [22] Park JH, Woodley N, McMillan DC et al. Palliative stenting for oesophagogastric cancer: tumour and host factors and prognosis. *BMJ Support Palliat Care* 2019; 9: 332–339
- [23] Bergquist H, Johnsson A, Hammerlid E et al. Factors predicting survival in patients with advanced oesophageal cancer: a prospective multicentre evaluation. *Aliment Pharmacol Ther* 2008; 27: 385–395
- [24] Rosenblatt E, Jones G, Sur RK et al. Adding external beam to intraluminal brachytherapy improves palliation in obstructive squamous cell oesophageal cancer: a prospective multi-centre randomized trial of the International Atomic Energy Agency. *Radiother Oncol* 2010; 97: 488–494
- [25] Wang C, Wei H, Li Y. Comparison of fully-covered vs partially covered self-expanding metallic stents for palliative treatment of inoperable esophageal malignancy: a systematic review and meta-analysis. *BMC Cancer* 2020; 20: 73
- [26] Persson J, Smedh U, Johnsson A et al. Fully covered stents are similar to semi-covered stents with regard to migration in palliative treatment of malignant strictures of the esophagus and gastric cardia: results of a randomized controlled trial. *Surg Endosc* 2017; 31: 4025–4033
- [27] Pandit S, Samant H, Morris J et al. Efficacy and safety of standard and anti-reflux self-expanding metal stent: A systematic review and meta-analysis of randomized controlled trials. *World J Gastrointest Endosc* 2019; 11: 271–280
- [28] Didden P, Reijm AN, Erler NS et al. Fully vs. partially covered self-expandable metal stent for palliation of malignant esophageal strictures: a randomized trial (the COPAC study). *Endoscopy* 2018; 50: 961–971
- [29] Reijm AN, Didden P, Schelling SJC et al. Self-expandable metal stent placement for malignant esophageal strictures - changes in clinical outcomes over time. *Endoscopy* 2019; 51: 18–29
- [30] Hurtgen M, Herber SCA. Treatment of malignant tracheoesophageal fistula. *Thorac Surg Clin* 2014; 24: 117–127
- [31] Rodriguez AN, Diaz-Jimenez JP. Malignant respiratory-digestive fistulas. *Curr Opin Pulm Med* 2010; 16: 329–333
- [32] Spigel DR, Hainsworth JD, Yardley DA et al. Tracheoesophageal fistula formation in patients with lung cancer treated with chemoradiation and bevacizumab. *J Clin Oncol* 2010; 28: 43–48
- [33] Gore E, Currey A, Choong N. Tracheoesophageal fistula associated with bevacizumab 21 months after completion of radiation therapy. *J Thorac Oncol* 2009; 4: 1590–1591
- [34] Didden P, Spaander MC, Kuipers EJ et al. Safety of stent placement in recurrent or persistent esophageal cancer after definitive chemoradiotherapy: a case series. *Gastrointest Endosc* 2012; 76: 426–430
- [35] Balazs A, Kupcsulik PK, Galambos Z. Esophagorespiratory fistulas of tumorous origin. Non-operative management of 264 cases in a 20-year period. *Eur J Cardiothorac Surg* 2008; 34: 1103–1107
- [36] Sarper A, Oz N, Cihangir C et al. The efficacy of self-expanding metal stents for palliation of malignant esophageal strictures and fistulas. *Eur J Cardiothorac Surg* 2003; 23: 794–798
- [37] Chen YH, Li SH, Chiu YC et al. Comparative study of esophageal stent and feeding gastrostomy/jejunostomy for tracheoesophageal fistula caused by esophageal squamous cell carcinoma. *PLoS One* 2012; 7: e42766
- [38] Hu Y, Zhao YF, Chen LQ et al. Comparative study of different treatments for malignant tracheoesophageal/bronchoesophageal fistulae. *Dis Esophagus* 2009; 22: 526–531

- [39] May A, Ell C. Palliative treatment of malignant esophagorespiratory fistulas with Gianturco-Z stents. A prospective clinical trial and review of the literature on covered metal stents. *Am J Gastroenterol* 1998; 93: 532–535
- [40] Dumonceau JM, Cremer M, Lalmand B et al. Esophageal fistula sealing: choice of stent, practical management, and cost. *Gastrointest Endosc* 1999; 49: 70–78
- [41] Shin JH, Song HY, Ko GY et al. Esophagorespiratory fistula: long-term results of palliative treatment with covered expandable metallic stents in 61 patients. *Radiology* 2004; 232: 252–259
- [42] Kim PH, Kim KY, Song HY et al. Self-expandable metal stent use to palliate malignant esophagorespiratory fistulas in 88 patients. *J Vasc Interv Radiol* 2018; 29: 320–327
- [43] Ribeiro MSI, da Costa Martins B, Simas de Lima M et al. Self-expandable metal stent for malignant esophagorespiratory fistula: predictive factors associated with clinical failure. *Gastrointest Endosc* 2018; 87: 390–396
- [44] Włodarczyk JR, Kuzdzal J. Safety and efficacy of airway stenting in patients with malignant oesophago-airway fistula. *J Thorac Dis* 2018; 10: 2731–2739
- [45] Freitag L, Tekolf E, Steveling H et al. Management of malignant esophagotracheal fistulas with airway stenting and double stenting. *Chest* 1996; 110: 1155–1160
- [46] Colt HG, Meric B, Dumon JF. Double stents for carcinoma of the esophagus invading the tracheo-bronchial tree. *Gastrointest Endosc* 1992; 38: 485–489
- [47] Huang PM, Lee JM. Are single or dual luminal covered expandable metallic stents suitable for esophageal squamous cell carcinoma with esophago-airway fistula? *Surg Endosc* 2017; 31: 1148–1155
- [48] Sjoquist KM, Burmeister BH, Smithers BM et al. Survival after neoadjuvant chemotherapy or chemoradiotherapy for resectable oesophageal carcinoma: an updated meta-analysis. *Lancet Oncol* 2011; 12: 681–692
- [49] Walsh TN. Oesophageal cancer: who needs neoadjuvant therapy? *Lancet Oncol* 2011; 12: 615–616
- [50] Anandavivelan P, Lagergren P. Cachexia in patients with oesophageal cancer. *Nat Rev Clin Oncol* 2016; 13: 185–198
- [51] Kazemi-Bajestani SM, Mazurak VC, Baracos V. Computed tomography-defined muscle and fat wasting are associated with cancer clinical outcomes. *Semin Cell Dev Biol* 2016; 54: 2–10
- [52] Hebuterne X, Lemarie E, Michallet M et al. Prevalence of malnutrition and current use of nutrition support in patients with cancer. *JPEN J Parenter Enteral Nutr* 2014; 38: 196–204
- [53] Arends J, Bachmann P, Baracos V et al. ESPEN guidelines on nutrition in cancer patients. *Clin Nutr* 2017; 36: 11–48
- [54] Weimann A, Braga M, Harsanyi L et al. ESPEN Guidelines on Enteral Nutrition: Surgery including organ transplantation. *Clin Nutr* 2006; 25: 224–244
- [55] Senesse P, Assenat E, Schneider S et al. Nutritional support during oncologic treatment of patients with gastrointestinal cancer: who could benefit? *Cancer Treat Rev* 2008; 34: 568–575
- [56] Nagaraja V, Cox MR, Eslick GD. Safety and efficacy of esophageal stents preceding or during neoadjuvant chemotherapy for esophageal cancer: a systematic review and meta-analysis. *J Gastrointest Oncol* 2014; 5: 119–126
- [57] Siddiqui AA, Sarkar A, Beltz S et al. Placement of fully covered self-expandable metal stents in patients with locally advanced esophageal cancer before neoadjuvant therapy. *Gastrointest Endosc* 2012; 76: 44–51
- [58] van den Berg MW, Walter D, de Vries EM et al. Biodegradable stent placement before neoadjuvant chemoradiotherapy as a bridge to surgery in patients with locally advanced esophageal cancer. *Gastrointest Endosc* 2014; 80: 908–913
- [59] Mariette C, Gronnier C, Duhamel A et al. Self-expanding covered metallic stent as a bridge to surgery in esophageal cancer: impact on oncologic outcomes. *J Am Coll Surg* 2015; 220: 287–296
- [60] Ahmed O, Bolger JC, O'Neill B et al. Use of esophageal stents to relieve dysphagia during neoadjuvant therapy prior to esophageal resection: a systematic review. *Dis Esophagus* 2020; 33: doz090. doi:10.1093/dote/doz090
- [61] Helminen O, Kauppila JH, Kyto V et al. Preoperative esophageal stenting and short-term outcomes of surgery for esophageal cancer in a population-based study from Finland and Sweden. *Dis Esophagus* 2019; 32: doz005. doi:10.1093/dote/doz005
- [62] Rodrigues-Pinto E, Ferreira-Silva J, Sousa-Pinto B et al. Self-expandable metal stents in esophageal cancer before preoperative neoadjuvant therapy: efficacy, safety, and long-term outcomes. *Surg Endosc* 2020; doi:10.1007/s00464-020-08002-8
- [63] Jarvinen T, Ilonen I, Ylikoski E et al. Preoperative stenting in oesophageal cancer has no effect on survival: a propensity-matched case-control study. *Eur J Cardiothorac Surg* 2017; 52: 385–391
- [64] Loser C, Aschl G, Hebuterne X et al. ESPEN guidelines on artificial enteral nutrition—percutaneous endoscopic gastrostomy (PEG). *Clin Nutr* 2005; 24: 848–861
- [65] Toussaint E, van Gossum A, Ballarin A et al. Enteral access in adults. *Clin Nutr* 2015; 34: 350–358
- [66] Arvanitakis M, Gkolfakis P, Despott EJ et al. Endoscopic management of enteral tubes in adult patients – Part 1: Definitions and indications. *European Society of Gastrointestinal Endoscopy (ESGE) Guideline. Endoscopy* 2021; 53: 81–92
- [67] Bergquist H, Johnsson E, Nyman J et al. Combined stent insertion and single high-dose brachytherapy in patients with advanced esophageal cancer – results of a prospective safety study. *Dis Esophagus* 2012; 25: 410–415
- [68] Hirdes MM, van Hooft JE, Wijrdeman HK et al. Combination of biodegradable stent placement and single-dose brachytherapy is associated with an unacceptably high complication rate in the treatment of dysphagia from esophageal cancer. *Gastrointest Endosc* 2012; 76: 267–274
- [69] Song HY, Lee DH, Seo TS et al. Retrievable covered nitinol stents: experiences in 108 patients with malignant esophageal strictures. *J Vasc Interv Radiol* 2002; 13: 285–293
- [70] Tinusz B, Soos A, Hegyi P et al. Efficacy and safety of stenting and additional oncological treatment versus stenting alone in unresectable esophageal cancer: A meta-analysis and systematic review. *Radiother Oncol* 2020; 147: 169–177
- [71] Nishimura Y, Nagata K, Katano S et al. Severe complications in advanced esophageal cancer treated with radiotherapy after intubation of esophageal stents: a questionnaire survey of the Japanese Society for Esophageal Diseases. *Int J Radiat Oncol Biol Phys* 2003; 56: 1327–1332
- [72] Yang ZM, Geng HT, Wu H. Radioactive stent for malignant esophageal obstruction: a meta-analysis of randomized controlled trials. *J Laparoendosc Adv Surg Tech A* 2020; doi:10.1089/lap.2020.0666
- [73] van der Bogt RD, Vermeulen BD, Reijm AN et al. Palliation of dysphagia. *Best Pract Res Clin Gastroenterol* 2018; 36–37: 97–103
- [74] Iwasaki H, Mizushima T, Suzuki Y et al. Factors that affect stent-related complications in patients with malignant obstruction of the esophagus or gastric cardia. *Gut Liver* 2017; 11: 47–54
- [75] Siersema PD, Hop WC, Dees J et al. Coated self-expanding metal stents versus latex prostheses for esophagogastric cancer with special reference to prior radiation and chemotherapy: a controlled, prospective study. *Gastrointest Endosc* 1998; 47: 113–120
- [76] Medeiros VS, Martins BC, Lenz L et al. Adverse events of self-expandable esophageal metallic stents in patients with long-term survival from advanced malignant disease. *Gastrointest Endosc* 2017; 86: 299–306

- [77] Sgourakis G, Gockel I, Radtke A et al. The use of self-expanding stents in esophageal and gastroesophageal junction cancer palliation: a meta-analysis and meta-regression analysis of outcomes. *Dig Dis Sci* 2010; 55: 3018–3030
- [78] Homs MY, Hansen BE, van Blankenstein M et al. Prior radiation and/or chemotherapy has no effect on the outcome of metal stent placement for oesophagogastric carcinoma. *Eur J Gastroenterol Hepatol* 2004; 16: 163–170
- [79] Sumiyoshi T, Gotoda T, Muro K et al. Morbidity and mortality after self-expandable metallic stent placement in patients with progressive or recurrent esophageal cancer after chemoradiotherapy. *Gastrointest Endosc* 2003; 57: 882–885
- [80] Fuccio L, Scagliarini M, Frazzoni L et al. Development of a prediction model of adverse events after stent placement for esophageal cancer. *Gastrointest Endosc* 2016; 83: 746–752
- [81] Iraha Y, Murayama S, Toita T et al. Self-expandable metallic stent placement for patients with inoperable esophageal carcinoma: investigation of the influence of prior radiotherapy and chemotherapy. *Radiat Med* 2006; 24: 247–252
- [82] Lecleire S, Di Fiore F, Ben-Soussan E et al. Prior chemoradiotherapy is associated with a higher life-threatening complication rate after palliative insertion of metal stents in patients with oesophageal cancer. *Aliment Pharmacol Ther* 2006; 23: 1693–1702
- [83] Qiu G, Tao Y, Du X et al. The impact of prior radiotherapy on fatal complications after self-expandable metallic stents (SEMS) for malignant dysphagia due to esophageal carcinoma. *Dis Esophagus* 2013; 26: 175–181
- [84] Muto M, Ohtsu A, Miyata Y et al. Self-expandable metallic stents for patients with recurrent esophageal carcinoma after failure of primary chemoradiotherapy. *Jpn J Clin Oncol* 2001; 31: 270–274
- [85] Park JY, Shin JH, Song HY et al. Airway complications after covered stent placement for malignant esophageal stricture: special reference to radiation therapy. *AJR Am J Roentgenol* 2012; 198: 453–459
- [86] Kochman ML, McClave SA, Boyce HW. The refractory and the recurrent esophageal stricture: a definition. *Gastrointest Endosc* 2005; 62: 474–475
- [87] Fuccio L, Hassan C, Frazzoni L et al. Clinical outcomes following stent placement in refractory benign esophageal stricture: a systematic review and meta-analysis. *Endoscopy* 2016; 48: 141–148
- [88] Law R, Prabhu A, Fujii-Lau L et al. Stent migration following endoscopic suture fixation of esophageal self-expandable metal stents: a systematic review and meta-analysis. *Surg Endosc* 2018; 32: 675–681
- [89] Bick BL, Imperiale TF, Johnson CS et al. Endoscopic suturing of esophageal fully covered self-expanding metal stents reduces rates of stent migration. *Gastrointest Endosc* 2017; 86: 1015–1021
- [90] Bazerbachi F, Heffley JD, Abu Dayyeh BK et al. Safety and efficacy of coaxial lumen-apposing metal stents in the management of refractory gastrointestinal luminal strictures: a multicenter study. *Endosc Int Open* 2017; 5: E861–E867
- [91] Irani S, Jalaj S, Ross A et al. Use of a lumen-apposing metal stent to treat GI strictures (with videos). *Gastrointest Endosc* 2017; 85: 1285–1289
- [92] Nogales O, Clemente A, Caballero-Marcos A et al. Endoscopically placed stents: a useful alternative for the management of refractory benign cervical esophageal stenosis. *Rev Esp Enferm Dig* 2017; 109: 510–515
- [93] Yang D, Nieto JM, Siddiqui A et al. Lumen-apposing covered self-expandable metal stents for short benign gastrointestinal strictures: a multicenter study. *Endoscopy* 2017; 49: 327–333
- [94] Larson B, Adler DG. Lumen-apposing metal stents for gastrointestinal luminal strictures: current use and future directions. *Ann Gastroenterol* 2019; 32: 141–146
- [95] Repici A, Hassan C, Sharma P et al. Systematic review: the role of self-expanding plastic stents for benign oesophageal strictures. *Aliment Pharmacol Ther* 2010; 31: 1268–1275
- [96] Canena JM, Liberato MJ, Rio-Tinto RA et al. A comparison of the temporary placement of 3 different self-expanding stents for the treatment of refractory benign esophageal strictures: a prospective multicentre study. *BMC Gastroenterol* 2012; 12: 70
- [97] Kappelle WF, van Hooft JE, Spaander MCW et al. Treatment of refractory post-esophagectomy anastomotic esophageal strictures using temporary fully covered esophageal metal stenting compared to repeated bougie dilation: results of a randomized controlled trial. *Endosc Int Open* 2019; 7: E178–E185
- [98] van Halsema EE, Wong Kee Song LM, Baron TH et al. Safety of endoscopic removal of self-expandable stents after treatment of benign esophageal diseases. *Gastrointest Endosc* 2013; 77: 18–28
- [99] 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
- [100] Hirdes MM, Siersema PD, Houben MH et al. Stent-in-stent technique for removal of embedded esophageal self-expanding metal stents. *Am J Gastroenterol* 2011; 106: 286–293
- [101] DaVee T, Irani S, Leggett CL et al. Stent-in-stent technique for removal of embedded partially covered self-expanding metal stents. *Surg Endosc* 2016; 30: 2332–2341
- [102] Peng GY, Kang XF, Lu X et al. Plastic tube-assisted gastroscopic removal of embedded esophageal metal stents: a case report. *World J Gastroenterol* 2013; 19: 6505–6508
- [103] Liu XQ, Zhou M, Shi WX et al. Successful endoscopic removal of three embedded esophageal self-expanding metal stents. *World J Gastrointest Endosc* 2017; 9: 494–498
- [104] Chandnani M, Cohen J, Berzin TM. Combined approach of cryoablation and stent-in-stent technique for removal of an embedded esophageal stent. *Case Rep Gastrointest Med* 2018; 2018: 8619252
- [105] Hill C, Khalil BK, Barola S et al. Inversion technique for the removal of partially covered self-expandable metallic stents. *Obes Surg* 2018; 28: 161–168
- [106] Dumonceau JM, Deviere J. Treatment of Boerhaave's syndrome using the ultraflex self-expandable stent. *Gastrointest Endosc* 2000; 51: 773–774
- [107] Wilson JL, Louie BE, Farivar AS et al. Fully covered self-expanding metal stents are effective for benign esophagogastric disruptions and strictures. *J Gastrointest Surg* 2013; 17: 2045–2050
- [108] Hirdes MM, Siersema PD, van Boeckel PG et al. Single and sequential biodegradable stent placement for refractory benign esophageal strictures: a prospective follow-up study. *Endoscopy* 2012; 44: 649–654
- [109] Repici A, Small AJ, Mendelson A et al. Natural history and management of refractory benign esophageal strictures. *Gastrointest Endosc* 2016; 84: 222–228
- [110] Qin Y, Sunjaya DB, Myburgh S et al. Outcomes of oesophageal self-dilation for patients with refractory benign oesophageal strictures. *Aliment Pharmacol Ther* 2018; 48: 87–94
- [111] Dzeletovic I, Fleischer DE. Self-dilation for resistant, benign esophageal strictures. *Am J Gastroenterol* 2010; 105: 2142–2143
- [112] Dzeletovic I, Fleischer DE, Crowell MD et al. Self-dilation as a treatment for resistant, benign esophageal strictures. *Dig Dis Sci* 2013; 58: 3218–3223
- [113] Thornblade LW, Cheng AM, Wood DE et al. A nationwide rise in the use of stents for benign esophageal perforation. *Ann Thorac Surg* 2017; 104: 227–233

- [114] van Boeckel PG, Sijbring A, Vleggaar FP et al. Systematic review: temporary stent placement for benign rupture or anastomotic leak of the oesophagus. *Aliment Pharmacol Ther* 2011; 33: 1292–1301
- [115] Dasari BV, Neely D, Kennedy A et al. The role of esophageal stents in the management of esophageal anastomotic leaks and benign esophageal perforations. *Ann Surg* 2014; 259: 852–860
- [116] Kamarajah SK, Bundred J, Spence G et al. Critical appraisal of the impact of oesophageal stents in the management of oesophageal anastomotic leaks and benign oesophageal perforations: an updated systematic review. *World J Surg* 2020; 44: 1173–1189
- [117] Kones O, Oran E. Self-expanding biodegradable stents for postoperative upper gastrointestinal issues. *JSLs* 2018; 22: e2018.00011
- [118] Cerna M, Kocher M, Valek V et al. Covered biodegradable stent: new therapeutic option for the management of esophageal perforation or anastomotic leak. *Cardiovasc Intervent Radiol* 2011; 34: 1267–1271
- [119] Rodrigues-Pinto E, Pereira P, Sousa-Pinto B et al. Retrospective multicenter study on endoscopic treatment of upper GI postsurgical leaks. *Gastrointest Endosc* 2020: doi:10.1016/j.gie.2020.10.015
- [120] van Halsema EE, Kappelle WFW, Weusten B et al. Stent placement for benign esophageal leaks, perforations, and fistulae: a clinical prediction rule for successful leakage control. *Endoscopy* 2018; 50: 98–108
- [121] Debourdeau A, Gonzalez JM, Dutau H et al. Endoscopic treatment of nonmalignant tracheoesophageal and bronchoesophageal fistula: results and prognostic factors for its success. *Surg Endosc* 2019; 33: 549–556
- [122] Huh CW, Kim JS, Choi HH et al. Treatment of benign perforations and leaks of the esophagus: factors associated with success after stent placement. *Surg Endosc* 2018; 32: 3646–3651
- [123] Vermeulen BD, van der Leeden B, Ali JT et al. Early diagnosis is associated with improved clinical outcomes in benign esophageal perforation: an individual patient data meta-analysis. *Surg Endosc* 2020: doi:10.1007/s00464-020-07806-y
- [124] Scognamiglio P, Reeh M, Karstens K et al. Endoscopic vacuum therapy versus stenting for postoperative esophago-enteric anastomotic leakage: systematic review and meta-analysis. *Endoscopy* 2020; 52: 632–642
- [125] Ngamruengphong S, Sharaiha R, Sethi A et al. Fully-covered metal stents with endoscopic suturing vs. partially-covered metal stents for benign upper gastrointestinal diseases: a comparative study. *Endosc Int Open* 2018; 6: E217–E223
- [126] Mohan BP, Chandan S, Khan SR et al. Self-expanding metal stents versus TIPS in treatment of refractory bleeding esophageal varices: a systematic review and meta-analysis. *Endosc Int Open* 2020; 8: E291–E300
- [127] Marot A, Trepo E, Doerig C et al. Systematic review with meta-analysis: self-expanding metal stents in patients with cirrhosis and severe or refractory oesophageal variceal bleeding. *Aliment Pharmacol Ther* 2015; 42: 1250–1260
- [128] Rodrigues SG, Cardenas A, Escorsell A et al. Balloon tamponade and esophageal stenting for esophageal variceal bleeding in cirrhosis: a systematic review and meta-analysis. *Semin Liver Dis* 2019; 39: 178–194
- [129] Escorsell A, Pavel O, Cardenas A et al. Esophageal balloon tamponade versus esophageal stent in controlling acute refractory variceal bleeding: A multicenter randomized, controlled trial. *Hepatology* 2016; 63: 1957–1967
- [130] Hassan C, Ponchon T, Bisschops R et al. European Society of Gastrointestinal Endoscopy (ESGE) Publications Policy – Update 2020. *Endoscopy* 2020; 52: 123–126