Review Article

Endoscopic stent placement: indications and success rates

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Abstract: Endoscopic placement of endoluminal self-expanding stents has become a useful therapy for a myriad of gastrointestinal (GI) diseases. Following the early successes of palliative stent placement for inoperable malignant disease, application of this modality has expanded to benign conditions and anastomotic complications such as leak and stricture. This review highlights the indications and success rates for endoscopic stent placement from the esophagus to the rectum.

Keywords: Endoscopy; stents; endoluminal; indications; success rates

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Introduction

The clinical applications for endoluminal stent placement continue to expand. Although the most robust pool of literature pertains to management of malignant esophageal stricture, endoluminal stenting has become a versatile and clinically beneficial tool along the entire gastrointestinal (GI) tract. Endoscopists with the skillset to deploy an increasingly-versatile array of stents, now have the opportunity to help a diverse population of patients and fellow physicians with disease processes that are very difficult to manage.

This review will discuss the widespread indications and success rates for endoscopic stent placement. Although many different types of stents may be mentioned throughout the text, comparison of the variable stent materials or brands is outside the scope of this review. In general, covered stents have long been advocated for benign disease given the relative ease of subsequent removal. They are also used for malignant disease as they resist tumor ingrowth. They are employed for closure of leaks and fistulae as they prevent extraluminal flow and promote healing. However, covered stents are associated with higher rates of migration. Uncovered stents are more-commonly used within the gastric outlet, duodenum, and colon. They can also be used for malignant disease when resection with concurrent stent removal is planned. Partially-covered stents theoretically decrease incidence of stent migration and still allow for safe endoscopic removal. Self-expanding metal stents (SEMS) and self-expanding plastic stents (SEPS) are the most-commonly used endoluminal stents and can be placed through the scope (TTS) or over the wire (OTW) with fluoroscopic and endoscopic guidance (1).

Starting in the esophagus, we will review the success rates of endoscopic stent placement for malignant and benign esophageal strictures, esophageal perforation, and anastomotic complications such as esophagojejunostomy (EJ) leak and stricture (*Table 1*). Although SEMS are only FDA-approved for malignant strictures, they are commonly used off-label for many other purposes. We will then briefly review the growing literature that supports the use of endoscopic stents for management of bariatric surgery complications such as gastric sleeve leak and Roux-en-Y gastric bypass (RNYGB) anastomotic leak and stricture. Next, we will review the literature regarding endoluminal stent placement for benign and malignant gastric outlet obstruction (*Table 2*). We will then move distally to discuss stent placement for benign and malignant colorectal disease (*Table 3*). Finally,

Table 1 Esophageal stent indications and success rates

Indication for endoluminal stent	Clinical success rate (%)	Success defined
Malignant esophageal stricture	95	Per oral tolerance of at least liquids
Benign esophageal stricture (Caustic, peptic, radiation, anastomotic)	6–56	Variable definitions; technical success rates 98–100%
Malignant esophageal fistula	70–100	Fistula closure
Benign esophageal fistula	64.7–71.4	Resolution without requiring further intervention
Benign esophageal perforation	86	Includes iatrogenic and spontaneous perforations
Variceal bleeding	96	Hemostasis within 24 h*
Esophageal anastomotic leak	81.4 overall; (95% CI: 58–92)	Resolution without requiring further intervention; success may be location dependent

*, 36% adverse events: rebleeding, ulceration, or stent migration.

Table 2 Gastroduodenal stent indications and success rates

Indication for endoluminal stent	Success rate (%)	Success defined
RNYGB and gastric sleeve leak	80–94	Toleration of liquid diet with 3 days
RNYGB anastomotic stricture	12.5	Per oral diet tolerance without need for re-intervention
Malignant gastric outlet obstruction	80–92	Improved diet tolerance*
Benign gastric outlet obstruction	90	Symptom free at mean 11 months

*, 15–40% require re-intervention. RNYGB, Roux-en-Y gastric bypass.

Table 3 Colorectal stent indications and success rates

Indication for endoluminal stent	Success rate (%)	Success defined
Benign colonic stricture	76–95	Resolution of obstruction
Malignant colonic stricture	70–92	Resolution of obstruction
Anastomotic leak	86.4	Resolution of leak with stent removal

endoscopic management of colorectal surgical complications and less common uses for endoscopic stenting will be discussed.

Esophagus

Malignant esophageal stricture

The earliest endoluminal stents were approved for use in patients with advanced esophageal cancer not amenable to surgical excision. These patients typically experience progressive dysphagia, malnutrition and weight loss, and can progress to frequent aspiration complicated by pneumonia and death. The clinical benefits of endoscopic stenting for malignant obstruction in the esophagus are well-documented. Over 95% of patients undergoing stent placement for malignant esophageal stricture show clinical improvement defined by per-oral tolerance of at least liquids (2). However, these encouraging numbers must be taken in context: endoscopic stent adjustment or exchange is often required to maintain clinical benefit. In a study of 41 patients who underwent SEMS placement for malignant esophageal obstruction, Im *et al.* reported patency rates of 94%, 78%, and 67% at 30, 90, and 180 days, respectively (3).

Neoadjuvant chemotherapy with subsequent esophagectomy has become the standard of care for resectable and borderline-resectable lesions. As a result, SEMS have been utilized as a bridging therapy for locally

advanced cancer with dysphagia. In a retrospective study of 55 patients with locally advanced esophageal adenocarcinoma, Siddiqui *et al.* demonstrated improved dysphagia scores with SEMS placement. Of note, stent migration occurred in 31% of patients (4).

Adverse events are common following esophageal stent placement. Medeiros *et al.* demonstrated an adverse event rate as high as 64% in their retrospective review of 40 patients with a mean 11-month follow-up (5). Potential adverse events include stent migration, reflux, chest pain or foreign body sensation, food bolus impaction, recurrent dysphagia, tumor ingrowth, tracheal compression, perforation, bleeding, and morbidity and mortality related to sedation such as aspiration and respiratory arrest.

Benign esophageal stricture

Self-expandable metal, plastic, and biodegradable stents have also been used for benign strictures of variable etiologies such as peptic stricture, caustic injury, radiation-induced and anastomotic strictures. Unfortunately, clinical success of stenting benign strictures is much lower than for malignant disease. In a comprehensive pooled analysis of the literature related to clinical outcomes of self-expandable stent placement for benign esophageal disease, a clinical success rate of 24% after single stent placement was reported (6). Likely attributable to variable etiology, severity of stricture, and inconsistent definitions of "refractory stricture", this clinical success rate was significantly lower than previous similar reviews conducted by Thomas *et al.* (46.2%) and Repici *et al.* (52%) (7,8). Holm *et al.* reported a long-term improvement rate of 6% after stent removal (9). Stenting for benign disease should therefore involve a multi-disciplinary discussion and a patient-specific approach that considers factors such as alternative interventions available, symptomatic profile, and patient-specific risks and benefits of the procedure itself.

Malignant esophageal fistula

Esophageal endoluminal stenting is also a clinically effective therapy for patients with recurrent esophageal cancer, extrinsic compression from extra-esophageal malignancy, and closure of malignant esophageal fistulae. Self-expanding stents placed for esophageal fistula formation in patients with malignant esophageal strictures can result in fistula closure in up to 70–100% of patients (10,11).

Esophageal perforation and fistula

Covered endoluminal stent placement has revolutionized management of esophageal perforation and anastomotic leak. In a 2014 review, Dasari *et al.* demonstrated an 86.2% overall clinical success rate. They also concluded that SEMS result in lower stent migration and reintervention rates, but a higher post-intervention stricture rate compared to plastic stents (12). A more recent study reported a relatively lower clinical success rate of 76.8% for this patient population, however this disparity could be attributed to inclusion of a larger proportion of patients with fistulae (6). Their subset analysis of 358 patients showed that clinical success rate varied based on etiology, including post-surgical leak (81.4%), perforation (81.4%), and fistula (64.7%).

Esophageal anastomotic complications

Stent placement for post-surgical anastomotic complications such as stricture and fistula have produced similar patterns of clinical success. van Halsema *et al.* reported a 56% clinical success rate for benign strictures, however etiology-based subset analysis could not be performed due to a lack of available data (6). Of note, Cho *et al.* reported a clinical success rate of 70% for stents placed for anastomotic strictures secondary to cancer recurrence. In their retrospective study of 20 patients with gastric cancer, partial gastrectomy with gastrojejunostomy or total gastrectomy with EJ were complicated by anastomotic stricture. Clinical success was defined by improved obstructive symptoms and oral intake 1–3 days after stent placement. They did not perform a subset analysis to determine statistical differences between type of anastomosis (13).

Stenting for esophageal anastomotic leak is successful in approximately 81–83% of cases overall, however efficacy is likely location-dependent (6,14). Hoeppner *et al.* retrospectively examined 35 patients with anastomotic leak and demonstrated variable clinical success rates based on anatomical location: cervical esophagogastrostomy (20%), mediastinal EJ (50%), mediastinal EJ (92%), and abdominal EJ (67%) (15). Finally, Licht *et al.* reported a clinical success rate of 55% for covered SEMS alone and advocated for a combined endoscopic approach with concurrent use of direct percutaneous endoscopic jejunostomy (16). Factors that may be associated with successful primary closure with stent placement include shorter time from diagnosis to stent insertion and a smaller luminal opening size (14).

Stomach and duodenum

Anastomotic complications

The increasing prevalence of bariatric surgery along with its associated complications has led to multiple publications that illustrate the value of endoscopic adjuncts to therapy. The most-feared technical complication of these elective procedures is certainly anastomotic leak. Early post-operative leak has long been an indication for an emergent return to the operating room, however the morbidity and mortality associated with re-operation have inspired many endoscopists and bariatric surgeons to seek less-invasive treatment for stable patients. Patient selection is very important in these matters as unstable patients still warrant re-exploration.

Anastomotic leaks occur in about 1–3% of laparoscopic RNYGB and gastric sleeve procedures; These disruptions most commonly occur at the gastrojejunal anastomosis or proximal staple line, respectively (17). Multiple studies have reported an 80–94% clinical success rate for endoscopic stent placement for acute anastomotic leaks (18-21). However, stent placement for chronic fistulae has proven less fruitful (19–64%) (22,23). Finally, anastomotic stricture is a rare, late complication of RNYGB. Due to the relative success of endoscopic dilation, stent placement is rarely indicated and only considered in refractory cases as supported by Puig *et al.*'s reported success rate of 12.5% (24).

Gastric outlet obstruction

Gastroduodenal obstruction most commonly occurs due to malignant disease such as pancreatic cancer, gastric cancer, cholangiocarcinoma, ampullary and duodenal cancers, and metastatic disease. Symptoms include progressive nausea and vomiting, esophagitis, diet intolerance, electrolyte disturbances, and dehydration. For patients in whom disease has reached the point of causing luminal narrowing, oncologic resection is often not feasible or may first require neoadjuvant therapy. Therefore, endoscopic stent placement often serves a palliative role. Enteral stents can be adequately placed in over 90% of these patients with clinical success rates as high as 80–92% (25,26). Despite the relatively-frequent need for re-intervention (15–40% require repeat endoscopic therapy), morbidity and mortality from stent placement alone is low (27). A 2014 study reported primary stent patency rates of 92.9% at 1 month, 81.9% at 3 months, and 63.4% at 6 months (28). Since re-intervention is more commonly required in those who undergo stent over surgeries such as gastrojejunostomy, many have concluded that endoscopic stent placement should be the treatment of choice in patients with shorter life expectancies.

Patients with benign gastric outlet obstruction may also benefit from endoscopic stenting, especially if they are poor surgical candidates. The volume of available literature is limited to mostly case reports, however one retrospective case series of 10 patients with peptic ulcer-related gastric outlet obstruction reported a 90% success rate at median 11-month follow-up. Stent migration occurred in 20% of these patients (29).

Colon and rectum

Malignant colonic stricture

Colorectal cancer is one of the most common malignancies and causes of cancer-related death in the United States. Since many tumors cause partial or complete obstruction of the lumen, endoscopic stent placement may be efficacious in multiple clinical scenarios. Palliation of inoperable colorectal cancer is a feasible and safe alternative to surgical diversion (30). Secondly, stenting may serve as a bridge to surgery in order to avoid emergent two-step procedures and allow for preoperative staging and medical optimization. Finally, stenting can offer relief for patients with extracolonic malignancies that cause extrinsic compression of the GI tract.

In a 2007 systematic review of the literature that included 88 studies and 1,785 patients undergoing SEMS for malignant colorectal disease, Watt *et al.* reported a 92% clinical success rate. The median rate of stent migration was 11%, perforation rate was 4.5%, and the observed rate of re-obstruction was 12%. Primary stent patency ranged from 68 to 288 days among the reviewed studies and there was little observed difference in success rate based on indication for stent placement or etiology of the obstruction (31). Most of the aforementioned literature pertains to left sided colonic lesions as right-sided lesions are often amenable to a one-stage oncologic resection and primary anastomosis at the time of presentation.

Benign colonic stricture

Colonoscopic stent placement is also feasible for patients with benign obstructive disease. In a relatively large series of 23 patients treated with SEMS, Small *et al.* reported

a 95% success rate (32). However, a 38% complication rate including instances of migration, re-obstruction, and perforation suggests careful patient selection is paramount. A case series of 21 patients with Crohns-related, diverticular, or anastomotic strictures similarly showed clinical success and complication rates of 76% and 43%, respectively (33). Further investigation is needed to determine which subset of these patients are most likely to benefit from endoscopic intervention as a bridge to surgery.

Anastomotic complications

Finally, SEMS deployment has been utilized for anastomotic complications following colorectal surgery with increasing frequency. Lamazza *et al.* reported a 70% clinical success rate using SEMS for benign anastomotic stricture following rectal resection for cancer (34). Another large study reported clinical success and recurrence rates of 100% and 13%, respectively (35).

Anastomotic leaks occur in approximately 5–15% of colorectal anastomoses (36). Stent placement has long been discussed for treatment of early anastomotic leaks and is becoming an increasingly accepted salvage therapy for stable patients. A 2019 comprehensive review of the literature identified nine case series or cohort studies with a total of 58 patients who underwent colonoscopic stenting for anastomotic leak. Clinical success rates ranged from 50–100% (37). The largest of these studies reported an overall anastomotic salvage rate of 86.4% (38).

Miscellaneous indications

Successful use of endoscopic self-expanding stents has been reported for many other disease processes, however the volume of data available limits our ability to confidently report clinical success. A 2016 meta-analysis suggested that endoscopic SEMS placement may be feasible for tamponade of variceal bleeding (39). Small case series have also been published demonstrating successful non-operative management of perforated peptic ulcer disease (40). Finally, case reports advocating stent placement for refractory enterocutaneous and colocutaneous fistulae have showed promise but further investigation is needed.

Conclusions

Endoscopic stenting is a useful and dynamic tool that may help patients overcome a myriad of challenging and debilitating conditions. Although the most robust data supports their use for malignant obstruction of the esophagus, gastric outlet, and left colon, an expanding wealth of literature supports broadening its application benign disease, perforation, and anastomotic complications. Further study is needed to validate the early promise of endoscopic stent placement in these scenarios in order to benefit a larger population of patients.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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