Enteral stents: from esophagus to colon

Enteral stents are increasingly being used in the management of GI luminal obstruction. Initially developed as a nonsurgical treatment for palliation of esophageal cancer, enteral stents now have an emerging role in the management of benign conditions as well as in other segments of the GI tract. Although formal training is limited, fellows should become familiar with enteral stent placement—including its indications, safety, and potential adverse events—because enteral stents may provide a critical yet often overlooked therapeutic option for our patients. In this month’s Fellows’ Corner, Drs Rajan Kochar and Nimeesh Shah from the Stanford University School of Medicine review the use of enteral stents and provide tips for successful stent placement.

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Enteral stents are devices used to maintain or restore bowel luminal patency. Stents were originally designed as rigid, cylinder-like prostheses and, as a result, had poor efficacy and high adverse event rates. In recent years, considerable advances have been made in the design of enteral stents. Several types of flexible and self-expandable stents with greater success rates have been developed. Currently available enteral stents include self-expandable metal stents (SEMS) for esophageal, gastroduodenal, and malignant colon obstruction and self-expandable plastic stents (SEPS) for malignant or benign esophageal strictures. Metal stents are made of stainless steel and alloys such as nitinol (nickel and titanium) and Elgiloy (cobalt, nickel, and chromium), which have a higher degree of flexibility and are capable of generating high radial forces to maintain stent patency and position. SEMS are available as uncovered, fully covered, or partially covered varieties, with the coating usually being a plastic membrane or silicone. Each of these stent types has its own inherent advantages and disadvantages and optimal uses in clinical practice (Table 1).

In most training programs across the country, general gastroenterology fellows are limited in their exposure to enteral stent placement. This article serves to provide an overview of enteral stenting in the esophagus, gastroduodenum, and the colon, with an emphasis on the appropriate indications, technical aspects (Table 2), adverse events, and outcomes.

ESOPHAGEAL STENTS

Indications
Esophageal stents may be used for malignant or benign indications in the esophagus, gastroesophageal junction, and gastric cardia. The earliest indication for esophageal stent placement was dysphagia secondary to esophageal cancer. In recent years, the use of esophageal stents has increased to include benign esophageal strictures (peptic, radiation induced, anastomotic, and caustic), postoperative leaks, iatrogenic perforations, external compression from extraluminal tumors, and tracheoesophageal fistulas. Given that the vast majority of patients with esophageal cancer have incurable disease at presentation, palliation of inoperable malignant obstruction remains the most common indication for esophageal stent placement.

Several partially covered and fully covered SEMSs and SEPSs have been developed and approved for esophageal obstruction. In general, partially covered and fully covered SEMSs provide equal relief of malignant dysphagia. Fully covered SEMSs have the advantage of decreased tissue and/or tumor ingrowth and overgrowth but a higher migration rate compared with partially covered SEMSs. Overall, there are only minor differences in efficacy and adverse event rates between the various commercially available SEMSs, such that the use of one brand over the other cannot be recommended. At this time, the fully covered Polyflex SEPS (Boston Scientific, Natick, MA) is the only U.S. Food and Drug Administration (FDA)–approved stent for benign refractory esophageal strictures. However, fully covered SEMSs often are used off-label for benign indications.

Technique
Esophageal stent placement is frequently performed with the patient under general anesthesia, given the potential risk of tracheal compression with stent deployment. Assessment of the length of the stricture and degree of obstruction is the first step. If the stricture is too tight to advance a standard gastroscope, an ultrathin endoscope
may be used. Alternatively, a guidewire may be advanced across the stricture through a biliary or balloon catheter followed by cautious stricture dilation and passage of the gastroscope. Contrast dye may be injected through a biliary catheter to delineate the stricture before stent placement. To guide accurate stent deployment, the proximal and distal ends of the stricture need to be marked appropriately. This can be accomplished with radiopaque markers such as metal clips placed on the patient’s skin, hemoclips deployed endoscopically, or submucosal injection of a radiopaque contrast agent. The stent is then advanced over the guidewire under fluoroscopic guidance alone or with both fluoroscopic and endoscopic views with advancement of a gastroscope adjacent to the stent delivery system. During stent selection, it is important to choose a stent length that is 4 cm longer than the stricture being stented. This allows for 2 cm of stent on either end of the stricture to decrease the risk of migration.

During stent deployment under fluoroscopy, it is important to understand the concept of foreshortening. Foreshortening is the property of the stent by which, on fluoroscopy, the stent constrained in its catheter will appear longer than the unconstrained deployed stent length. Different stents have varying degrees of foreshortening, and this should be kept in mind during stent deployment. In order to avoid adverse events such as persistent globus sensation and proximal stent migration, care must be taken while stenting a stricture in the cervical esophagus to ensure at least a 2-cm distance between the proximal end of the stent and the upper esophageal sphincter. An esophageal stent with a proximal release system may be helpful in proximal strictures to ensure accurate placement.

**Adverse events**

Potential adverse events of esophageal stenting include perforation, stent migration, stent obstruction resulting from tissue and/or tumor ingrowth or overgrowth, tracheal compression, and bleeding. Stents in the cervical esophagus may cause a globus sensation. Distal esophageal stents that traverse the gastroesophageal junction may cause significant reflux and increase the risk of aspiration, and, therefore, patients should be treated with proton pump inhibitor therapy. In addition, esophageal stents with an anti-reflux valve could be considered to potentially reduce reflux. Migrated stents in patients receiving neoadjuvant therapy generally indicate treatment response and can be removed easily by using forceps to pull the purse-string suture into the endoscope channel and collapsing the top of the stent.

### GASTRODUODENAL STENTS

**Indications**

Gastroduodenal obstruction causing gastric outlet obstruction is commonly encountered in patients with advanced malignancy of the pancreas, duodenum, and
stomach. Advanced pancreatic adenocarcinoma is the most common cause of gastric outlet obstruction in the United States. These patients have significant symptoms including nausea, vomiting, early satiety, and abdominal discomfort, which, in turn, lead to weight loss, malnutrition, and a poor quality of life. Gastroduodenal stent placement has emerged as a non-surgical alternative to achieve symptom relief and improve quality of life. There have been reports of gastroduodenal stenting in patients with benign gastroduodenal obstruction who are poor surgical candidates.1–6

Case series and reviews of observational studies of gastroduodenal SEMS placement have demonstrated >95% technical success and 85% to 95% clinical success with adequate decompression of outlet obstruction and patients’ ability to tolerate at least a mechanical soft diet. Several studies7,8 have shown that stent placement is usually associated with better short-term outcomes such as faster ability to tolerate oral intake and shorter duration of hospital stay, whereas surgery is associated with better long-term outcomes including a low rate of re-intervention. Therefore, stent placement is a reasonable alternative to palliative surgery in patients with a short life expectancy, generally less than 6 months.

**Technique**

The Wallflex Duodenal, Wallstent Enteral (Boston Scientific), and Evolution Duodenal (Cook Medical, Bloomington, IN), all uncovered SEMSs deployed through the endoscope, have been approved for palliation of malignant gastric outlet obstruction. Esophageal stents have also been used successfully to relieve gastroduodenal obstruction in case reports.9,10 A radiographic contrast study should first be obtained to assess the length of the stricture and degree of obstruction and to rule out additional sites of obstruction. Peritoneal carcinomatosis is a relative contraindication to stent placement, although limited recent data suggest that these patients have similar outcomes to those without carcinomatosis.11 If biliary obstruction is present or impending, it is prudent to place a biliary stent before gastroduodenal stenting to avoid difficult biliary access at a later date. To avoid aspiration, the patient is positioned in the left lateral or prone position (better for stent visualization) rather than the supine position (unless the patient is intubated for airway protection). Stricture dilation before stent placement is usually unnecessary and carries a risk of perforation. Gastroduodenal stent placement is performed under endoscopic and fluoroscopic guidance. A therapeutic upper endoscope is used with a working channel large enough to accommodate the stent delivery system. During endoscopy, the stricture length may be estimated accurately by advancing the endoscope through the stricture or by injection of contrast material with the use of fluoroscopy. A guidewire is advanced across the stricture into the distal bowel under fluoroscopy. A through-the-scope stent of appropriate size, generally 4 cm longer than the size of the stricture, is then advanced over the guidewire and deployed under endoscopic and fluoroscopic guidance. At least a 2 cm length of stent should be flared at both ends of the stricture to attain an appropriate “waist”; otherwise, overlapping stents may be needed to fully traverse the length of the stricture.

**Adverse events**

Procedure-related adverse events of gastroduodenal SEMS placement may be classified as mild or severe and early or late. Mild adverse events include abdominal discomfort, mild fever, and occasional vomiting without obstruction. Major adverse events occurring within the first week include bleeding, perforation, stent migration, severe pain, fever, and jaundice. Significant late adverse events include fistula formation, stent obstruction, late perforation or bleeding, biliary obstruction, and stent migration.

**COLON STENTS**

**Indications**

Colorectal cancer often causes partial or complete bowel obstruction. Management options for such patients include surgical resection or endoscopic stent placement. In recent years, colorectal stenting has become an important tool in the palliation of advanced disease and management of acute colon obstruction as a possible bridge to surgery (ie, converting an emergent 2-stage surgery with creation of an ostomy to an elective 1-stage surgery). Colon stenting has been reported to be technically successful in up to 93% of patients and clinically successful with

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<th>TABLE 2. Tips for successful stent placement</th>
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<td>Obtain a “road map” by performing a radiographic contrast study before endoscopy if possible.</td>
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<td>Select appropriate scope (variable length, diameter, and size of working channel) and stent (correct stent type, length and diameter).</td>
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<td>Review specific stent properties, including degree of foreshortening and delivery system, including ability to constrain the partially deployed stent.</td>
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<td>Make sure to attain a “waist” in the middle of the stricture and a flare at both edges during stent deployment and allow room for stent foreshortening.</td>
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improvement in symptoms in 85% to 90% of patients overall. In addition, with the advent of newer through-the-scope stents, palliation of advanced right-sided malignant obstruction has become easier, with technical and clinical success rates greater than 85%. Aside from the use of stents to manage obstruction from colorectal cancer, there are very limited data on the use of stents for the management of benign colon strictures.\(^1\)

**Palliation of malignant obstruction.** Several observational studies have demonstrated effective palliation of malignant colon obstruction with SEMS placement in patients with advanced metastatic disease as well as those who are poor surgical candidates because of underlying medical conditions. In the few studies comparing SEMSs with surgery for palliation of malignant colon obstruction, patients undergoing SEMS placement tended to have a shorter duration of hospital stay, lower rate of early adverse events, and a lower stoma creation rate but a higher delayed adverse event rate and reintervention rate, with comparable overall survival rates. In summary, retrospective data indicate that SEMS placement is a safe and effective alternative to surgery for palliation in patients with malignant colon obstruction. Several factors should be considered in deciding between stent placement and surgery, including the presence of medical comorbidities, plan for chemotherapy, and endoscopist experience.

**Acute colon obstruction.** Colon SEMSs may be used as a bridge to surgery in patients with acute left-sided obstruction who are considered surgical candidates. The alternative in such patients is a 2-stage surgery comprised of emergent surgical resection and ostomy creation, followed by ostomy take-down and bowel reanastomosis at a later date. Preoperative stenting offers multiple advantages over emergent surgery including (1) avoidance of an ostomy, allowing a 1-stage operation, (2) appropriate staging of disease, (3) correction of electrolyte and volume status and optimization of comorbidities, and (4) conversion of an emergency surgery to an elective operation with adequate bowel preparation and the possibility of laparoscopic resection. In patients with acute right-sided colon obstruction, preoperative SEMS placement does not alter the surgical course, because a 1-stage right hemicolectomy with an ileocolonic anastomosis can be performed emergently in the unprepared bowel. Still, preoperative colon SEMS placement can convert an emergency surgery into an elective one, providing time for optimization of medical comorbidities before surgery.

**Technique**

Colon SEMSs may be covered or uncovered, through-the-scope or not through-the-scope. Only uncovered stents are currently approved in the United States because
of high migration rates of covered stents. Smaller-diameter stents are generally used in the right side of the colon and larger-diameter stents in the left side of the colon to prevent solid stool impaction. Ideally, a radiologic imaging study such as a barium enema or CT scan with rectal contrast should be obtained before stent placement to assess the degree of obstruction and the length and location of the stricture. A bowel preparation is often not possible or necessary in patients with complete obstruction. However, a few tap water enemas may be administered before the procedure in patients with a subtotal colon obstruction. Prophylactic antibiotics should be considered in patients with complete obstruction because air insufflation may lead to microperforation.

The choice of colonoscope depends on the location of the stricture and the type of stent. Through-the-scope stents require a colonoscope with a working channel large enough to accommodate the stent delivery system. Therefore, for left-sided obstruction, a therapeutic upper endoscope is ideal, whereas an adult colonoscope is often required for right-sided obstruction. When the colonoscope is advanced, air insufflation should be minimized to avoid the risk of proximal bowel distension and perforation. The colonoscope may be advanced to the stricture by using water immersion or carbon dioxide insufflation. The length of the stricture may be assessed endoscopically by traversing through it. This may not be possible with a tight stricture, in which case contrast material injection, with the use of fluoroscopy, through a balloon catheter or a biliary cannula may help delineate the strictured segment (Fig. 1). A guidewire is advanced into the bowel proximal to the stricture, and the stent delivery system is then advanced over the guidewire followed by deployment of the stent under fluoroscopic and endoscopic guidance. Ideally, a 2-cm segment of stent should be spared beyond both the proximal and distal edges of the stricture to allow the formation of a waist in the middle and a flare at both ends. Rectal stents should be deployed at least 2 cm proximal to the anal verge to avoid pain and incontinence. Stents that are not through-the-scope are deployed under fluoroscopic guidance by using a stiff guidewire, and endoscopic views may be obtained by advancing a regular gastroscope alongside the stent delivery system. Successful stent deployment is generally associated with immediate passage of stool and flatus. Failure to achieve decompression could be a result of incomplete stenting of the entire length of the stricture, additional sites of intestinal obstruction, early stent migration, incomplete expansion of the stent, or fecal impaction.

### Adverse events

Colorectal stenting is associated with several potential adverse events such as perforation, bleeding, stent migration, abdominal pain, recurrent obstruction due to stent malposition, and tissue or tumor ingrowth and/or overgrowth. Rectal SEMS placement may cause tenesmus and incontinence.

Perforation is one of the most dreaded adverse events of colorectal SEMS placement. Bowel perforation may occur at the stent site because of tumor invasion or pressure from the stent or at a proximal site from colon distension (eg, stent obstruction). Procedure-related perforation may result from dilation of the stricture, malposition of the guidewire or stent delivery catheter, or excessive air insufflation. Of note, several studies and case reports have demonstrated a higher rate of colon SEMS–related perforation in patients treated with the chemotherapeutic agent bevacizumab.14,15

### SUMMARY

Because of significant advances in endoscopic techniques and the development of high-quality stents, endoscopic enteral stent placement is increasingly being performed for the management of malignant GI obstruction. Palliative stenting is now routinely performed for malignant esophageal, gastric, duodenal, and colon obstruction. In addition to palliative indications, preoperative stenting in the colon may be performed as a bridge to surgery to achieve immediate decompression and convert an emergent surgery into an elective, 1-stage procedure.

The realm of enteral stenting has recently expanded to include management of benign conditions such as leaks, fistulas, and benign strictures in the GI tract. Further research is required to study the use of enteral stents in benign conditions and to adequately compare endoscopic stent placement with surgical intervention. Promising new technologies such as biodegradable stents and drug-eluting stents also require further investigation. With continued innovation in endoscopic techniques and stenting devices, the field of enteral stenting is likely to expand further, with an increase in indications and improvement in outcomes.

### DISCLOSURE

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Abbreviations: FDA, Food and Drug Administration; SEMS, self-expandable metal stent; SEPS, self-expandable plastic stent.

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