

The Evolution of SEMS



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Introduction

The word “stent” originates from the name of Dr. Charles Stent, an English dentist who developed a “prosthesis” made from natural latex (Gutta-percha, a tropical tree native to Southeast Asia) to fill in the empty space inside the tooth after root canal work (1, 2). The word “stent” was then adopted by many specialties and at present it is used to describe any implant inserted into a structure that has a lumen to maintain its patency (1, 2). Dr. Charters J. Symonds was the first to record the placement of a rigid esophageal tube for palliating malignant esophageal stricture (3). Since then tubes or stents have been used to palliate almost any gastrointestinal (GI) luminal malignancy (4, 5).

Due to their modern shape and design, the use of stents has expanded to treat and palliate many other conditions, including GI leaks, perforations and fistulas (6). Moreover, the indications, delivery methods and techniques to place stents continue to expand (7-10). Self-expanding metal stents (SEMS) are now used to access cavities such as pseudocysts, enter the stomach through the skin, drain retroperitoneal collections percutaneously and even create anastomosis of the gallbladder to the stomach or duodenum (7-10). In this review we will focus on SEMS and its use to treat and palliate endoluminal GI and pancreatobiliary disorders in clinical practice.

Esophagus

SEMS are one of the pillars for palliative therapy for patients with malignant and some forms of esophageal stenosis (4, 5). In addition, SEMS are an essential tool to palliate and treat esophageal leaks, fistulas and perforations (6). SEMS have become increasingly popular as a result of improvement in design and the availability of different models.

When choosing stents as palliative therapy several aspects need to be taken into consideration such as patient condition, tumor location and characteristics, presence of fistula and previous or planned treatments such as chemotherapy or radiation therapy. The presence of leak, fistula or perforation mandates the use of a partially or fully-covered SEMS. The success of esophageal SEMS placement requires precise knowledge of the location and length of the anatomical disruption to be palliated.

Case: A 65-year-old patient presented with dysphagia to solids and liquids as well as massive weight loss. Esophagogastroduodenoscopy (EGD) and CT demonstrated an ulcerating, stenosing adenocarcinoma of the esophagus (Figures 1A and B). The stricture was 5 cm long

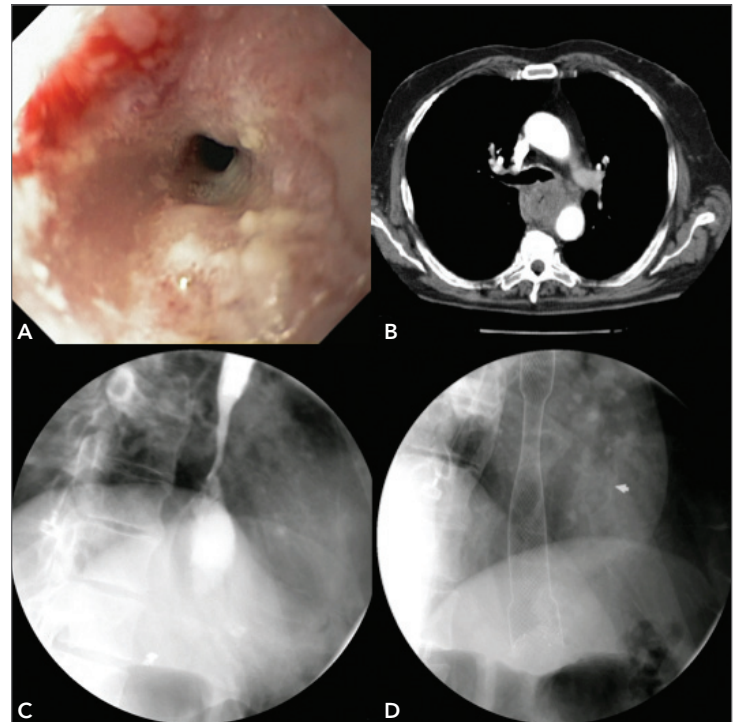


Figure 1

(Figure 1C). Therefore, a 120 mm long Evolution stent was inserted to bridge the stenosis (Figure 1D). The patient was able to resume oral intake and was also given palliative radiation therapy. On follow-up three months later, the patient's condition has improved and the patient is able to eat.

Stomach

SEMS are now a key palliative option for patients with malignant gastric outlet obstruction due to various types of cancers. Current delivery systems allow placing palliative SEMS through the scope, making a targeted delivery more feasible. However, only scopes with large (i.e. > 3.2 mm) working channels can be used (colonoscope, duodenoscope, therapeutic gastroscope).

Case: A 60-year-old patient with advanced gastric cancer presented with pyloric obstruction. Stent placement at another hospital had failed. The stricture could only be defined by injection of water-soluble contrast using a biliary catheter (Figure 2A). A guide wire was advanced into the upper jejunum (Figure 2B). The Evolution duodenal stent could be delivered through the working channel of a therapeutic gastroscope (Figure 2C).

The braided-to-coiled construction of the Flexor delivery catheter allowed for excellent trackability and maneuverability in this difficult angulation (Figures 2B and C). The tight stricture was well bridged (Figure 2D). The proximal and distal radiopaque markers of the Evolution SEMS provide excellent visualization for stent placement and localization. The patient has been able to eat since the stent insertion and is stable on follow-up two months later.

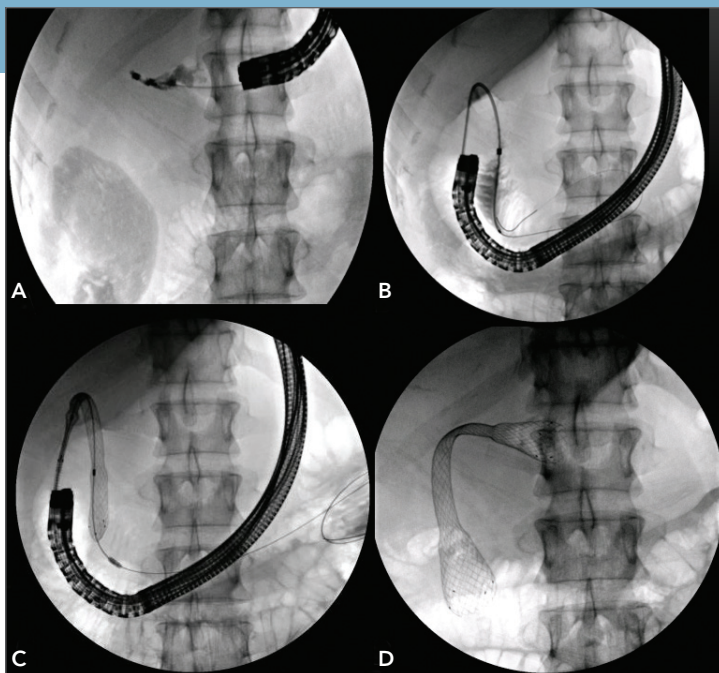


Figure 2

Duodenum and Small Bowel

The advent of deep enteroscopy methods has improved our diagnostic and therapeutic approach to small bowel disorders, including the palliation of malignant and benign stenosis. Whereas placement of SEMS is relatively easy in patients with malignant pyloric obstruction, delivery of a SEMS to the distal duodenum and small bowel may be fraught by difficulties, as the anatomy may be distorted due to massive stomach dilation and the wire may not provide enough tensile force for the stent to be delivered passed the stricture. A useful trick to deliver SEMS to the distal duodenal or small bowel strictures is using the overtube technique (6) (Figure 3A).

After localizing, interrogating and determining the length of the stricture using endoscopy and fluoroscopy, a guide wire is advanced through the stricture (Figure 3B), the scope is removed and the SEMS is advanced over the wire and through the overtube, which serves a large “working-channel” (Figure 3C). The overtube’s shape and strength allow for the SEMS to travel through it smoothly towards and through the stricture. This process is performed under fluoroscopy.

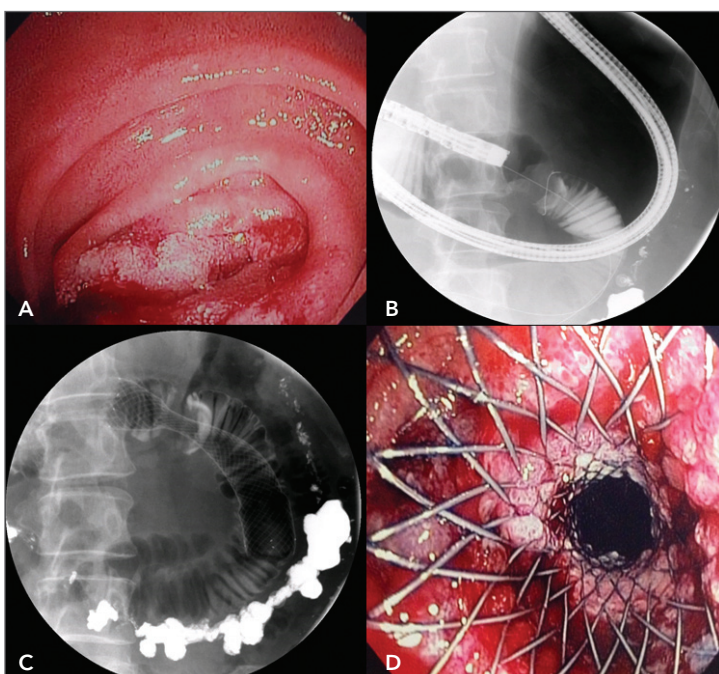


Figure 3

Once the stent is delivered, the scope can be reintroduced and a visual inspection of the proximal stent expansion can be performed (Figure 3D).

Colon

A large percentage of patients with colon cancer present with bowel obstruction. In addition, many other malignancies can result in bowel obstruction due to external compression. Thus, placement of a colorectal stent is indicated for preoperative decompression or for palliative purposes.

Case: A 65-year-old patient presented with sigmoid colon obstruction due to metastatic ovarian cancer (Figure 4A). Because the patient had almost complete bowel obstruction, a SEMS was placed to decompress the colon and serve as a “bridge to surgery.” The Evolution Colonic SEMS was easily inserted using combined

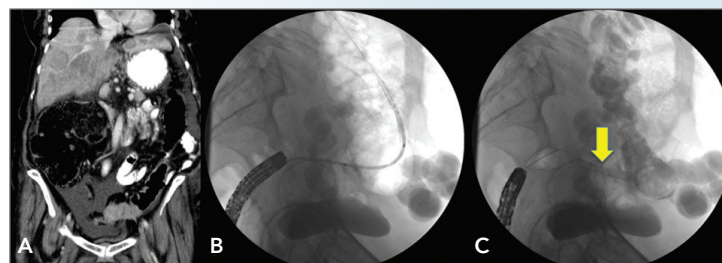


Figure 4

endoscopic-fluoroscopic technique (Figures 4B and C, yellow arrow). Once the colon was decompressed and the patient’s condition had improved, the patient underwent exploratory laparotomy with resection of the cancerous mass, including the involved colon and SEMS. An end-to-end anastomosis of the colon was possible.

Pancreatobiliary

The two most common causes of malignant bile duct obstruction are pancreatic cancer and cholangiocellular carcinoma. Decompression of bile duct obstruction relieves jaundice, pruritus, improves appetite and reduces fat malabsorption (4). Decompression may be palliative in poor surgical candidates or only temporary in those patients undergoing potential curative resection (4).

The data clearly shows that SEMS are more cost effective for patients who survive longer than three to six months, whereas a single ERCP with placement of a plastic stent may suffice in patients with shorter life expectancy (4). Regardless of the indication, SEMS should be well selected and placed. In my practice, I prefer the Evolution Controlled-Release Stent, as it has excellent radiopaque markers and has an excellent delivery mechanism, making it a secure, safe and efficient stent. The role of SEMS to treat benign biliary conditions has been expanding. When using SEMS to treat benign conditions, a fully covered SEMS should be employed.

Case: An 88-year-old patient was referred to us for palliation of a T4N1MX pancreatic head cancer leading to biliary obstruction (Figure 5A). The tight, irregular, tortuous, 2 cm long, distal common bile duct stricture was palliated using an Evolution SEMS (Figure 5B). This SEMS has various radiopaque markers at its end, which facilitate the fluoroscopy placement and visualization (Figures 5B and C). The SEMS expanded nicely after deployment, relieving this patient’s jaundice within few days (Figure 5D). The smaller diameter Evolution biliary SEMS are also excellent to provide bilateral intrahepatic bile duct drainage (Figure 6).

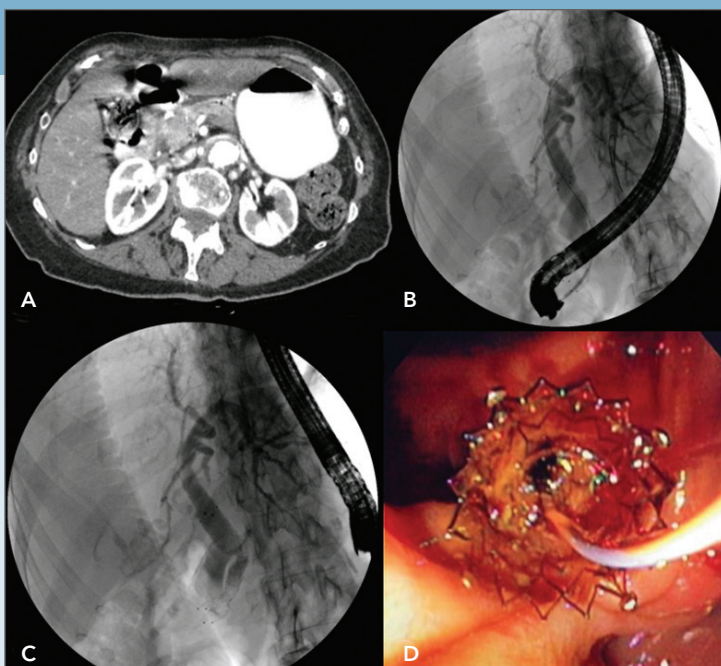


Figure 5

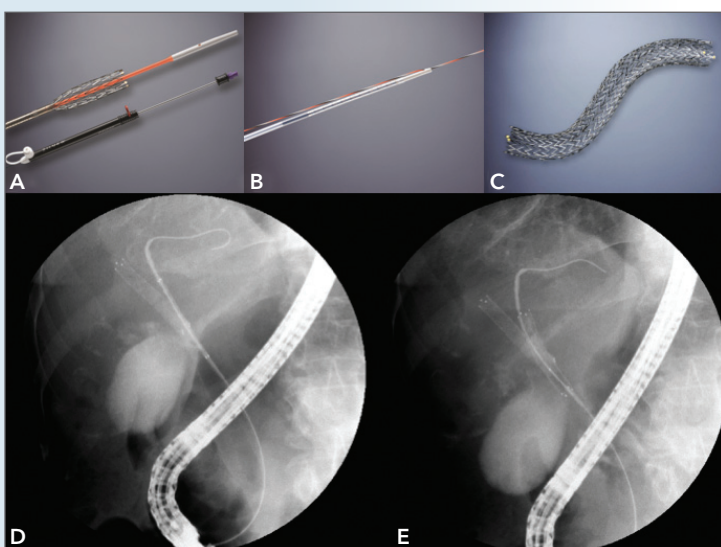


Figure 6

The Evolution of SEMS, continued from page 15

Future Directions

Additional clinical applications of SEMS in the future will likely include palliation and treatment of various other GI disease processes (7-10). The use of fully or partially covered SEMS to drain pancreatic fluid collections is being performed more frequently. This makes sense, as the thick and complex material within the cavity may not exit through small diameter plastic stents. SEMS utilization can create anastomosis within the gallbladder and stomach or duodenum (7). This palliative treatment option offers a great alternative to percutaneous drainage of the gallbladder in poor surgical candidates.

The use of SEMS to create percutaneous access to cavities (e.g. pancreatic necrosis) or luminal organs (e.g. stomach) to provide endoscopic access is expanding (9). Because current enteroscopes do not have a large-diameter channel to deliver SEMS into the bile duct of patients with surgically altered upper GI anatomy, we have developed overtube-assisted methods to place SEMS into the bile duct or perform direct cholangioscopy (8, 10). Therefore, further research into the development of small caliber delivery devices and/or specific overtubes to master difficult anatomical situations is mandatory.

Finally, fully covered SEMS may provide an excellent option to control esophageal variceal hemorrhage. The radial expansile forces of a fully covered SEMS may cause enough compression of the bleeding varices, leading to hemostasis, coagulum and fibrosis formation of the esophageal wall.

In summary, I have presented a brief description of modern uses of SEMS. The key aspects emphasized were the advances in shapes, delivery methods and techniques used to place these stents into various luminal cavities of the body thus permitting to palliate and treat a myriad of GI conditions. ■

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