

Current Status of Metal Stents for Malignant Gastro-Duodenal Obstruction

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Abstract

Metal stent insertion to relieve malignant gastroduodenal obstruction is an effective alternative to surgery, but there are some problems associated with existing metal stents for malignant gastroduodenal obstruction. Common complications of covered and uncovered stents are migration and obstruction, respectively. To date, there are several practice-improved stents, such as partially covered, double-layer, three-layer, and individualized stents designed according to the shape and size of the Gastric Outlet Obstruction (GOO). Choosing the most appropriate type of stent is arduous and should be done mainly in relation to the morphological aspects of the stricture. In general, the stent is implanted by a Through-The-Endoscope (TTS) method, but certain types of stent can only be implanted by a peroral route. After adequate training, endoscopic gastroduodenal stent insertion is a reproducible, simple, safe, and cost-effective procedure, with high technical and clinical success rates.

Keywords: Metal stent; Malignant gastro-duodenal obstructions; Biliary obstruction

Introduction

Gastroduodenal obstruction is the most common complication of advanced distal gastric, periampullary, or duodenal malignancy. The majority of cases occur as a pre-terminal adverse event in the above malignancies, with poor prognosis and a median survival of 3 to 6 months [1,2]. Patients often suffer from intractable nausea, vomiting, and severe weight loss. The role of endoscopic management of this condition has significantly changed in the last 20 years. As early as 1992, metallic stents were used to treat malignant gastroduodenal obstruction [3,4]. Metal stents are used more and more for the palliative treatment of malignant gastroduodenal obstruction because of their safety and effectiveness. Enteral stenting has a success rate similar to surgery, is associated with shorter time before a patient can resume food intake, and reduces hospital stay and costs [5-14]. However, stent use is complicated by several thorny issues, including recurrent obstruction as a result of progressive tumor ingrowth or overgrowth [15-17] and stent migration [18-22]. Many attempts have been made to solve these problems [23-27]. This article reviews the characteristics, differences, and treatment options of the available gastroduodenal Self-Expandable Metallic Stents (SEMS).

Definition of gastroduodenal obstruction

At present, definitions of gastroduodenal obstruction vary. The term gastric outlet obstruction (GOO) appears more in published articles, [28-32] and is preferred by most endoscopists [19,26,33-40]. Some endoscopists call Gastroduodenal Obstructions GOOs [41] and a few separate GOO from duodenal obstruction in describing gastroduodenal obstruction [1,42]. We consider GOO and duodenal obstruction as two different concepts.

The stomach and duodenum are adjacent digestive tracts that food passes by. However, the pylorus is the only exit for gastric contents; accordingly, the gastric outlet should be confined to antrum and pylorus. That is to say, gastroduodenal obstruction consists of gastric outlet and duodenal obstruction, and gastroduodenal obstruction is not equal to gastric outlet obstruction. The definition has clinic significance for stenting when treating malignant gastroduodenal obstruction. Because the stomach cavity is wide and the duodenal lumen is relatively small, GOO stents should be different from those used to treat duodenal obstruction.

Indications for enteral stent placement

The most common reason caused duodenal obstruction is pancreatic

malignancy, [19,31,39,43,44] and ampullary, cholangiocarcinoma, gallbladder cancer, hepatobiliary malignancy can also lead to duodenal obstruction, reported in some studies [45]. The reason caused GOO is mainly advanced gastric cancer [1,20,46,47]. Enteral stents are frequently employed in above patients who are poor surgical candidates with shortened life expectancy, advanced or metastatic disease, significant medical comorbidities, and known anesthesia risk [48-52].

Stent type

Many types of metal stent are used to treat malignant gastroduodenal obstruction, including covered [46] and uncovered stents [53]. Uncovered stents are currently accepted by most endoscopists [43,54]. A recent study demonstrated that the use of uncovered stents might be a preferred option for malignant duodenal obstruction because of their lower rate of stent migration and longer patency compared to covered stents [55]. The migration rate of covered stents used for malignant gastroduodenal obstruction was found to be unacceptably high, [18,22,56] Whereas, obstruction caused by tumor in growth is the most common complication associated with uncovered stents [16,17,21,24,34]. Although these complications can be managed by interventional treatments, re-intervention will undoubtedly increase patient cost and pain. Therefore, many attempts have been made to identify ideal stents, and there have been many types of stents developed as a result [23,25,57-59]. Double- and triple-layer stents are representative of these newly developed stents, and their common feature is that two (one of stents is covered) stents are overlapped together, or a membrane is sandwiched between two nitinol self-expanding metal stent layers. All these stents are suitable for malignant duodenal obstruction. However, whether these stents are appropriate for malignant GOO is worth investigating. Shi et al. [60] studied the shape and size of GOO caused by distal gastric cancer, and two basic shapes of stomach cancer were observed: cup shaped and funnel

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shaped. The mean maximum breadth of the obstruction cup is 51.3 mm, and the mean maximum breadth of the obstruction funnel is 40.6 mm. However, the diameter of the end of the above-described stents ranges from 18 to 28 mm [31,43,53,57,59,61] which is not suitable for the proximal end of malignant GOO. Two studies demonstrated that individualized stents designed according to GOO shape and size can help reduce tumor in growth and stent migration [60,62].

Stent placement

Almost all uncovered stents and some covered ones are designed for through-the-scope deployment and require a therapeutic channel endoscope (working channel > 3.7 mm) [26,50,63]. All procedures were performed by experienced interventional endoscopists with ample experience in placement of duodenal stents [26]. Some published literatures describe the methods of through-the-endoscope (TTS) deployment in detail [61,64]. It is important to emphasize that imaging of the obstructed length and extent must be obtained before stenting. If the endoscope cannot advance through the stenotic area, the obstructing area should be passed by a guidewire, and a catheter should be inserted along the guidewire. Then, contrast medium is injected via the catheter to judge the position of the guidewire. The SEMS delivery system can be passed over the guidewire through the working channel of the endoscope only when the guidewire is confirmed to be located in the intestine lumen. Moreover, stent retraction should be taken into account when the stent is released. The location of the delivery system should be adjusted in time to ensure accurate stent positioning. However, it is not possible to adjust the delivery system when the stent is more than half released.

Metallic stents that cannot be mounted on the TTS delivery system must be implanted by a peroral method under fluoroscopic guidance without the use of endoscopy. That is to say, after the endoscope is withdrawn, the delivery system is perorally inserted over the guidewire. It is important that the position of the guidewire is steadily maintained when the delivery system is inserted. Guidewire migration can cause stent dislocation or intestinal perforation. The whole procedure is performed under fluoroscopic guidance or fluoroscopic and endoscopic guidance [65,66]. The technical success rate of non-TTS is lower than that of TTS. The main cause of failure is that delivery system bends in the gastric lumen. Abdominal compression and overtube are used to aid advancement of the delivery system when necessary [62].

Technical and clinical success

Technical success is defined by accurate stent placement with adequate stent expansion and evidence of luminal patency post-procedure, which is usually evaluated by performing a water-soluble or barium contrast study. The reported technical success rates range from 88.2 to 100% [1,22,24,26,31,33,48,53,61,67-70]. The main causes of technical failure is the inability to pass the guidewire across the stricture [31,54] and inability to negotiate the stent delivery system over the guidewire into the duodenum because of stent delivery system looping in the dilated gastric fundus [71,72].

Clinical success is determined by resolution of the patient's obstructive symptoms, the ability to resume a regular diet after stent placement, and maintaining adequate oral intake during follow-up. The reported clinical success rates range from 83% to 90% [31,36,43,73,74]. However, some studies have reported rates as high as 96% to 98.6% [20-22,25].

After stent placement, some patients may not show improvements in symptoms due to lack of stomach and bowel motility in a chronically obstructed stomach, unrecognized distal small bowel strictures, or

functional GOO due to neural involvement of the tumor [24,36,75]. Therefore, it is important that the additional bowel obstruction is adequately judged before stenting and that prokinetic agents are used after stenting.

Complications

Stent obstruction and migration: The incidence of uncovered stent obstruction ranges from 12% to 41.7% [16,17,21,24,34,61]. Restenosis of uncovered stents may be inevitable with tumor in growth. Although covered stents can decrease restenosis by tumor ingrowth, the advantage of covered stents is offset by their higher migration rate, which ranges from 6.9% to 27.3% [54,56,57,61,66]. Moreover, covered stents cannot solve the problems of tumor overgrowth or stent collapse [15,76] and do not offer any improvement in outcome over uncovered stents [66]. Therefore, both uncovered and covered stents can require re-intervention [76,77]. Chemotherapy after stent placement may decrease the likelihood of tumor in growth and overgrowth and increase the duration of stent patency [19,52]. However, chemotherapy may also increase the incidence of stent migration [22,24,48,74]. A more migration-resistant design for covered stents would be required to minimize migration from the gastric outlet and allow for better stent patency. Double- or triple-layered stents seem to prevent migration and tumor in growth [23,57,71]. A comparative study demonstrated that double stents were superior to uncovered stents in both median stent patency time and median patient survival [58]. However, another report suggested that stent migration and collapse remain problematic [59]. Tumor overgrowth is also inevitable with the prolongation of survival time [15]. To overcome these problems, Kim and colleagues proposed a design to prevent migration, which includes using a covered "stent within stent design" that employs three endoscopic clips on the proximal end that help to anchor the stent in place [27], and Isayama et al. advised that stents should be long enough to avoid tumor overgrowth or in growth at the uncovered portion [25]. Theoretically, extended double stents should be the best choice to treat malignant duodenal obstruction. However, any extended stent may not be suitable for GOO caused by gastric cancer because the extended part of stent can only be free in wide gastric cavity. The proximal portion of the stent should be big enough to avoid migration and in growth at the uncovered portion. Individualized stents designed according to GOO shape and size should be reasonable choices, but determining whether individualized stents are truly superior to standard versions will require larger case-control studies.

Biliary obstruction: Approximately 61% of patients with malignant duodenal obstruction experience biliary obstruction [78]. Therefore, biliary obstruction has to be taken into account before performing duodenal stenting. It is very difficult to endoscopically place biliary stents through the mesh of duodenal stents [1], although there are some reports that biliary stents were successfully placed throughout duodenal stent meshes [79-81].

The rate of biliary obstruction after gastroduodenal stent placement has been found to range from 1.3% to 11% [1,19,24,82]. Even though biliary stents are placed before duodenal stenting, there is a risk of bile obstruction after duodenal stenting. A recent report described six patients that developed cholangitis after duodenal stenting despite placement of a biliary stent prior to enteral stenting [31]. Another report showed that duodenal SEMS placement is a risk factor for biliary SEMS dysfunction [83]. Such a biliary obstruction may be associated with stent placement bridging the ampulla of Vater and limit the use of covered stents. If the ampulla of Vater can be covered by an enteral stent, uncovered stents should be employed, although other studies reported

that the rate of biliary obstruction after covered stent placement was not as high as expected [71,84]. In order to reduce the risk of bile duct obstruction, it may be wise to perform biliary decompression prior to covered stent placement. Simultaneous biliary and duodenal obstruction is the most difficult problem because duodenal obstruction may influence the ability for endoscopic biliary stent placement, and biliary decompression usually requires a percutaneous transhepatic approach. A new duodenal metal stent was designed to simultaneously address the problems of biliary and duodenal stenting [85]. This new stent has a unfixed structure in its central 3-cm portion, which contributes to the easy insertion of a biliary stent through the mesh wall of the central portion of the duodenal stent without resistance. This is perhaps the best treatment option for simultaneous biliary and duodenal obstruction or biliary obstruction after duodenal stenting is addressed.

Conclusions

GOO and duodenal obstruction are two different concepts, and the stents selected to treat them should be different. Duodenal stents can be covered and uncovered. The former have a high incidence of migration, and the latter have a high incidence of re-stenosis due to tumor in growth. Uncovered stents seem more likely to be accepted for palliation of malignant duodenal obstruction. Double- or triple- layered stents have been developed and seem to be superior to uncovered and covered stents in both preventing stent migration and tumor in growth. Biliary obstruction has to be taken into account before performing duodenal stenting. It is unclear what stent type is most suitable for GOO, but individualized stents seem to be a popular trend.

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