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Colorectal Stents: Current Status

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A self-expandable metal stent (SEMS) is an effective and safe method for the decompression of colon obstruction. Based on recent evidence, colorectal SEMS is now recommended for the palliation of patients with colonic obstruction from incurable colorectal cancer or extracolonic malignancy and also as a bridge to surgery in those who are a high surgical risk. Prophylactic SEMS insertion in patients with no obstruction symptoms is not recommended. Most colorectal SEMS are inserted endoscopically under fluoroscopic guidance. The technical and clinical success rates of colorectal SEMS are high, and the complication rate is acceptable. Advances in this technology will make the insertion of colorectal SEMS better and may expand the indications of colorectal SEMS in the future.

Key Words: Colon; Stents; Colorectal neoplasms; Obstruction

INTRODUCTION

Colonic obstruction develops in 8% to 13% of patients with colorectal cancer (CRC).[1-3] It is one of the most common causes of emergency surgery in CRC patients. Despite the necessity of emergency surgery due to colonic obstruction in CRC, perioperative morbidity and mortality are not low, with their highest published rates reaching 60% and 22%, respectively.[4] In addition, temporary or permanent colostomy/ileostomy is often inevitable if surgical decompression is attempted in such cases, which leads to poor quality of life in these patients. Since its introduction in 1991 for the decompression of CRC obstruction, the indications for a self-expandable metal stent (SEMS) have been broadened from the palliation of incurable CRC obstruction to its use as a bridge to surgery.[5] Although colorectal stenting is now used widely in daily clinical practice, the scientific evidence for SEMS in the colorectum is not yet sufficient; the debate regarding the advantages and limitations of SEMS is still ongoing. The purpose of this article is to review investigations regarding colorectal SEMS and to define the current indications for SEMS, techniques of SEMS insertion, and outcomes after SEMS insertion in colorectal obstruction.

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INDICATIONS

SEMS has been used in both malignant and benign obstructions. Malignant obstruction is the main indication for SEMS in the colon. The purposes of SEMS insertion in malignant colon obstruction can be classified as either a bridge to surgery or palliation in inoperable patients.

SEMS as a bridge to surgery in potentially curable CRC obstruction

For the past 20 years, SEMS has been inserted as a bridge to surgery before elective surgery in left-sided CRC obstruction. The proximal colon in CRC obstruction is usually dilated and ischemic, which may increase the risk of colostomy/ileostomy if emergency surgery is performed. Many studies have shown that in this situation, SEMS may decompress the dilated, ischemic proximal colon, thus obviating the necessity of emergency surgery with colostomy/ileostomy.[6,7] A recent meta-analysis demonstrated that SEMS insertion as a bridge to surgery followed by elective surgery showed a lower overall postoperative morbidity (33.1% vs. 53.9%, p=0.03), higher primary anastomosis rate (67.2% vs. 55.1%, p<0.01), and lower stoma rate (9% vs. 27.4%, p<0.01) when compared to emergency surgery in left-sided CRC obstruction.[8] A Korean study also showed lower rates of admission to the intensive care unit (4.2% vs.

31.8%), a second surgery for stoma take-down (0% vs. 27.3%), and postoperative complications (4.2% vs. 27.1%) in patients who underwent SEMS followed by elective surgery as compared to those who had emergency surgery.[9] Despite these favorable immediate postoperative clinical courses, the overall postoperative mortality after SEMS insertion as a bridge to surgery was similar to that after emergency surgery (10.7% vs. 12.4%).[8] Furthermore, the long-term oncological outcome, such as disease recurrence, was worse in the group with SEMS as a bridge to surgery than in the emergency surgery group (Table 1).[10-12] Based on these unfavorable long-term oncological outcomes, the recent SEMS guidelines by the European Society of Gastrointestinal Endoscopy (ESGE) do not recommend routine SEMS insertion as a bridge to surgery in potentially curable left-sided CRC obstruction, and this recommendation was endorsed by the Governing Board of the American Society for Gastrointestinal Endoscopy.[13] Therefore, emergency surgery should be considered first in left-sided CRC obstruction rather than SEMS as a bridge to surgery, unless new scientific evidence emerges. Nonetheless, further studies will be necessary because the numbers of enrolled patients in the original studies were small and the difference in disease recurrence in some studies was not statistically significant.

Although the routine insertion of SEMS as a bridge to surgery has been abandoned, it is still useful and safe in patients who are at high surgical risk.[14] Thus, the latest ESGE guidelines stated that SEMS as a bridge to surgery may be considered as an alternative to emergency surgery in patients with potentially curable left-sided CRC obstruction with a high risk of postoperative mortality, such as elderly patients over 70 years of age and those with an American Society of Anesthesiologists (ASA) classification ≥III.[13]

The appropriate time for surgery after SEMS insertion as a bridge to surgery has yet to be clarified. Sufficient expansion of the stent followed by reversal of the ischemia of the dilated proximal bowel and bowel cleansing requires enough time after SEMS insertion. Theoretically, surgery may be delayed for at least 1 week or longer after SEMS insertion to minimize the risk of stoma formation and postoperative complications, such as anastomotic leak, abscess, and wound problems. However, with a longer delay in the surgery, the frequency of stent-related complications may increase. Therefore, in general, surgical colonic resection is recommended on the 5th to 10th day after SEMS insertion.[15]

Because primary anastomosis without the need for ileostomy is possible in most patients with right-sided CRC obstruction, emergency surgery may be preferred to SEMS insertion as a bridge to surgery in potentially curable right-sided CRC obstruction despite the paucity of relevant studies.

Palliative SEMS for colonic or extracolonic malignancy

Palliation of incurable CRC obstruction is an important indication for SEMS. A meta-analysis that reviewed 13 studies regarding palliative SEMS for incurable CRC obstruction (n=404) in comparison to palliative surgery (n=433) showed a shorter duration of admission (10 days vs. 19 days) and a lower frequency of admission to the intensive care unit (0.8% vs. 18%). Chemotherapy could also be started earlier after palliative SEMS insertion than after palliative surgery (16 days vs. 33 days). In addition, colostomy/ileostomy was required less frequently after palliative SEMS insertion (13% vs. 54%).[16,17] Furthermore, it has been reported that chemotherapy after palliative SEMS insertion in incurable CRC obstruction could improve the overall survival.[18,19] Despite the usefulness of palliative SEMS insertion, the long-term complications were more common in the palliative SEMS group, which included colonic

Table 1. Oncological Outcome after SEMS Insertion as a Bridge to Surgery for Left-Sided Colorectal Cancer Obstruction

Study	Study population	Study design	Results
Sloothaak et al. (2013)[10]	Preoperative SEMS (n=26) Emergency surgery (n=32)	Follow-up data of RCT	5-Year overall recurrence rate (p=0.027): SEMS as a bridge to surgery: 42% (11/26) Emergency surgery: 25% (8/32)
Tung et al. (2013)[11]	Preoperative SEMS (n=24) Emergency surgery (n=24)	Follow-up data of RCT	Overall recurrent disease (p=0.4): SEMS as a bridge to surgery: 50% (11/22) Emergency surgery: 23% (3/13) 5-Year overall survival rate (p=0.076): SEMS as a bridge to surgery: 48% Emergency surgery: 27%
Alcántara et al. (2011)[12]	Preoperative SEMS (n=15) Emergency surgery (n=13)	RCT	No difference in overall survival (p=0.843) Tumor reappearance (p=0.055): SEMS as a bridge to surgery: 53% (8/15) Emergency surgery: 15% (2/13)

SEMS, self-expandable metal stent; RCT, randomized controlled trial.

perforation (10%), stent migration (9%), and re-obstruction (18%). However, the overall morbidity was similar (34% in the SEMS group vs. 38% in the surgery group).[16] Thus, considering all these findings, the ESGE guidelines recommend SEMS placement as the preferred treatment for palliation of incurable CRC obstruction.[13]

Palliative SEMS insertion has been also attempted in patients with colonic obstruction due to extracolonic malignancy. A technically successful SEMS insertion was achieved in 67% to 96%, while clinical success was attained in 20% to 96% in this clinical scenario.[20-22] Although these outcomes may be slightly worse than those of SEMS insertion for primary CRC obstruction, palliative SEMS can still be indicated in patients with colonic obstruction from extracolonic malignancy, especially in those with a relatively short expected survival time and those who are poor surgical candidates.[22]

Because of the paucity of data, it is difficult to conclude the usefulness of palliative SEMS insertion in patients with peritoneal carcinomatosis. One retrospective analysis showed a lower technical success rate of SEMS insertion in patients with peritoneal carcinomatosis than in those without (83% vs. 93%).[23] Nonetheless, palliative SEMS insertion may be considered in selective patients with peritoneal carcinomatosis whose expected survival time is short and/or whose medical condition is not appropriate for surgical decompression.

In some cases, a covered SEMS has been inserted for the management of a malignant fistula between the colorectum and adjacent organs, such as the urinary bladder and vagina.[24,25]

SEMS insertion for benign colonic obstruction

SEMS was attempted for the management of benign colonic obstruction due to various etiologies. SEMS was successfully inserted, and decompression was achieved in patients with anastomotic, Crohn's, and radiation-induced strictures.[26-28] Despite these reports, a long-term safety concern exists regarding SEMS insertion in benign colonic obstruction due to the lack of sufficient existing long-term data. Therefore, SEMS insertion for benign colonic obstruction is not recommended as the first-line option and should be used only as the last choice for those who are at high surgical risk.[29] Some experts also recommend a cautious attempt of SEMS removal within 4 to 8 weeks of SEMS insertion for benign colonic obstruction before the stent is imbedded completely in the tissue.[28]

CONTRAINDICATIONS

The only absolute contraindication of SEMS insertion is colonic perforation. Diverticulitis with stricture is a relative contraindication of SEMS because of the high risk of perforation.[30] SEMS insertion is rarely indicated for obstructions in the distal rectum as pain, tenesmus, and fecal incontinence may occur after SEMS insertion in this region. Prophylactic SEMS insertion for patients with no evidence of symptomatic obstruction is discouraged because SEMS-related complication risks outweigh the potential benefits of SEMS insertion.[13] Thus, colorectal SEMS should be inserted only in those patients with both obstruction symptoms and endoscopic or radiologic evidence of obstruction.

Several studies have reported a higher risk of perforation in patients with SEMS who were treated with antiangiogenic agents, such as bevacizumab.[31] Therefore, SEMS should not be inserted in patients who are and/or will be managed by antiangiogenic chemotherapeutic agents.

INSERTION PROCEDURE

Patient preparation

Abdominopelvic computed tomography (CT) scan is usually performed to determine the etiology of colonic obstruction. CT scan can also provide information on the anatomy of the patient's colon, the length and severity of the obstruction, and any other concurrent problems, such as perforation.[32,33] Colonoscopy may be considered in those patients in whom the cause of the colonic obstruction cannot be diagnosed using a CT scan.[13]

Patients with complete obstructions usually have evacuated their stool below the lesion before they visit the medical facilities. Therefore, a colonoscope can be inserted without any prior bowel cleansing. Bowel cleansing with an oral lavage of a large amount of laxatives could even be harmful due to the risk of aggravation of proximal bowel dilation and complications, such as perforation and aspiration. Thus, one or two cleansing enemas are usually recommended prior to SEMS for complete obstruction, especially distal colonic obstruction.[28] In the case of incomplete obstruction, especially in the proximal colon, cautious oral lavage may be performed. However, patients should be educated to stop the oral lavage if they experience aggravation of their obstruction symptoms.

A prospective study demonstrated that only 6.3% (4/64) of patients who underwent stent insertion showed positive blood culture for bacteria, and all four patients with positive cultures showed no clinically significant symptoms related to bacteremia.[34] Therefore, the administration of prophylactic antibiotics prior to colonic SEMS insertion is, in general, not recommended. However, some argue that prophylactic antibiotics should be considered in those with complete obstruction and a markedly dilated proximal colon because microperforation may develop during the SEMS insertion.[35]

Insertion technique

Colonic SEMS insertion techniques are divided into endoscopic versus radiologic placement. Endoscopic insertion techniques are further classified as through-the-scope (TTS) and non-TTS methods. In general, most cases of endoscopic placement are performed with fluoroscopic guidance.

Currently, the majority of colonic SEMS insertions are performed using the TTS technique. As the endoscope reaches the obstructing lesion, a guidewire is passed through the obstruction if the obstruction is complete and the endoscope cannot be passed through. If the obstruction is incomplete and the endoscope can pass through, then the endoscope is passed through the obstruction, and the guidewire is left at the proximal colon of the obstructing lesion. In both cases, the length of the guidewire at the proximal colon of the obstruction should be 20 cm or longer to prevent it from slipping back through the obstruction. A catheter is introduced through the guidewire, and radiocontrast dye is injected to assess the morphology and the length of obstruction. Thereafter, a SEMS is introduced through the guidewire. The length of the SEMS is determined based on the length of the obstruction. Usually, a stent that is 4 to 6 cm longer than the length of the obstructing lesion is chosen so that each side of the stent can have a 2 to 3 cm long, free stent margin from the edge of the obstructing lesion.[36,37] The diameter of the SEMS should be 24 mm or larger so that decompression will be effective.[36,37] The introductions of the guidewire, catheter, and SEMS are performed via the working channel of the endoscope; this technique is called TTS insertion. Once the SEMS has been positioned at the proximal colon, the SEMS is gradually deployed. The deployment of the proximal portion of the SEMS should be monitored by fluoroscopy. The distance between the distal edge of the obstructing lesion and the distal end of the SEMS should be maintained in the endoscopic view during deployment. After completion of SEMS deployment, radiocontrast dye should be injected to fluoroscopically assess the correct position of the inserted SEMS and its expansion. A simple X-ray of the abdomen should be taken daily for 2 to 3 days to assess the expansion of the SEMS, decompression of the dilated proximal colon, and complications, such as perforation.

In a non-TTS placement technique, the endoscope is withdrawn after the insertion of the guidewire, and a SEMS is introduced via the guidewire under fluoroscopic guidance. A purely radiologic stent insertion is still performed under fluoroscopic guidance. However, studies have revealed a trend towards lower technical success by purely radiologic stent placement than by combined TTS and fluoroscopy techniques.[13]

Pooled analysis on retrospective studies showed that the risk of perforation increases after stricture dilation before and/or after SEMS insertion for CRC obstruction, although these data are based on low quality evidence with a small number of patients.[13,31,38] Therefore, routine balloon dilation before and/or after SEMS insertion for CRC obstruction should not be performed.

CLINICAL OUTCOME

Technical and clinical success

A meta-analysis of 54 studies analyzed the clinical outcomes of 1,198 patients who underwent colorectal SEMS insertion for malignant colorectal obstruction. Overall, technical and clinical successes were achieved in a median 94% and 91% of patients, respectively. In this report, the clinical success of palliative SEMS insertion was 93%, while the clinical success as a bridge to surgery was 76% (Table 2).[38] Another meta-analysis reviewed seven randomized controlled trials, which enrolled 195 patients who underwent preoperative SEMS insertion and 187 patients who had emergency surgery for acute left-sided malignant colonic obstruction. The mean technical success rate of colonic SEMS insertion was 77% (Table 2).[8] A Korean study about palliative SEMS insertion for malignant colonic obstruction reported a technical success rate of 100% and a clinical success rate of 89%.[39] Other previous studies reported that the creation of stoma could be avoided in 85% to 100% of patients who underwent colorectal SEMS insertion.[6,40] The median duration of stent patency has ranged from 55 to 343

Table 2. Short-Term Clinical Outcomes after SEMS Insertion for Malignant Colorectal Obstruction

Study	Study design	Study population	Results of colorectal SEMS
Sebastian et al. (2004)[38]	Meta-analysis of 54 case series about colorectal SEMS insertion	Palliative (*n*=791)	Technical success: median 96% (range, 67−100) Clinical success: median 93% (range, 62−100)
		Bridge to surgery (*n*=407)	Technical success: median 84% (range, 33−100) Clinical success: median 76% (range, 45−84)
Huang et al. (2014)[8]	Meta-analysis of 7 RCTs about preoperative SEMS vs. emergency surgery	SEMS as a bridge to surgery (*n*=195) Emergency surgery (*n*=187)	Mean technical success rate: 77% (range, 47−100) Permanent stoma rate: 9% Primary anastomosis rate: 67% Overall mortality rate: 11%

SEMS, self-expandable metal stent; RCT, randomized controlled trial.

days.[41,42]

Factors influencing the technical and clinical success have not been investigated thoroughly. Technical success was reported to be high when SEMS was tried in the rectosigmoid colon rather than the descending or more proximal colon (94.2% vs. 84.6% to 85.5%). Technical success was lower in patients with colon obstruction by metastatic, extracolonic malignancy than in those with primary CRC obstruction (78% vs. 93.5%).[38] Clinical success was also lower in patients with colonic obstruction by extracolonic malignancy than in those with primary CRC obstruction (88.2% vs. 96.2%).[38] Two retrospective studies investigated the relation between the length of the stricture segment and the technical/clinical success of SEMS insertion.[43,44] They reported that the SEMS success rate was higher in patients with a shorter segment stricture than a long segment stricture, especially those with a stricture of 4 cm or longer. The efficacy of SEMS, such as its technical and clinical success rates, was not different between covered and uncovered SEMS.[36-38]

Complications

Colorectal SEMS-related complications may be classified as early or late complications. Early complications are defined as adverse events that develop within 30 days following SEMS insertion; late complications are those that occur thereafter. Major early complications include perforation (0% to 12.8%), stent migration (0% to 4.9%), reobstruction (0% to 4.9%), pain (0% to 7.4%), and bleeding (0% to 3.7%).[23,45] Stent reobstruction (4.0% to 22.9%) and stent migration (1.0% to 12.5%) are two common late complications,[16,23] and perforation may also occur as a late complication.

The most serious complication is perforation. Although some patients can be managed conservatively, such as with nil per os and antibiotics, emergency surgical intervention is necessary in most cases.[46] Stent migration occurs mainly as an early complication, especially within several hours after SEMS insertion. Most migrations are distal, and spontaneous expulsions of the stents per anus occur occasionally.[38] Risk factors for migration include colonic stents with a small diameter less than 24 mm, pre-procedural balloon dilation, and a short length of the stricture segment.[43,47,48] Covered SEMS is also a risk factor for migration (5.5% vs. 21.3% in the uncovered SEMS group).[36,37] The most common late complication is reobstruction. Most reobstruction cases are caused by tumor ingrowth.[49] Tumor overgrowth, fecal impaction, and mucosal prolapse can also lead to stent reobstruction. According to a meta-analysis of 54 case series, the reobstruction rate in the covered SEMS group was lower than that in the uncovered SEMS group (4.7% vs. 7.8%, p=0.003).[38] The lower rate of reobstruction in the covered SEMS group is believed to be related to the lower rate of tumor ingrowth (0.9% vs. 11.4%).[36,37] Both migration and reobstruction can be managed with endoscopic intervention. Stent reobstruction can be treated by balloon dilation, Argon laser therapy, and additional stent insertion. Additional SEMS insertion may be the most effective and commonly used treatment option for reobstruction, and the overall clinical success of additional SEMS insertion is 75% to 86%.[39,50,51] Migrated stents can be removed endoscopically, and another stent can be applied at the same time if necessary. Because migration is now more common after covered SEMS insertion, and reobstruction is frequently observed after uncovered SEMS insertion, the overall safety profile appears to be similar between covered and uncovered SEMS.

Mortality may be noted after SEMS insertion because of a variety of reasons, such as perforation, sepsis, underlying cancer progression, and so on.[38] However, the 30-day stent-related mortality was less than 4%.[16,38,45]

CONCLUSIONS

Colorectal SEMS is generally safe and effective for the relief of colon obstruction and decompression. Therefore, for the past two decades, colorectal SEMS has been used safely and effectively for the purpose of preoperative decompression, thus providing a bridge to surgery of potentially curable CRC obstruction and palliation for patients with incurable CRC and/or extracolonic malignancy. However, recent evidence suggests that the long-term oncological outcome after SEMS insertion as a bridge to surgery is less favorable than that following emergency surgery. Therefore, current indications for colorectal SEMS insertion include palliation for colonic obstruction by primary CRC or extracolonic malignancy and insertion as a bridge to surgery only in those at high surgical risk, such as those with an ASA classification ≥III and elderly patients aged over 70 years. Because colorectal SEMS has a variety of clinical benefits and can be inserted safely and easily, further investigations should be performed to overcome its limitations. Recent and continual progress in the technology regarding endoscopy procedures and accessories may expand the indications for colorectal SEMS in the future.

Conflicts of Interest

The authors have no financial conflicts of interest.

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