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## Retrospective Study

## Efficacy of uncovered self-expandable metallic stent for colorectal obstruction by extracolonic malignancy

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**Abstract****BACKGROUND**

Self-expandable metallic stent (SEMS) is widely used for malignant colorectal obstruction. Recently, SEMS has been used for palliative option for colorectal obstruction caused by extracolonic malignancy (ECM).

**AIM**

To evaluate the efficacy of SEMS for colorectal obstruction caused by ECM, and to identify the factors associated with stent occlusion.

**METHODS**

Seventy-two patients who were treated with uncovered SEMS insertion for malignant colorectal obstructions caused by colorectal metastasis or peritoneal seeding of ECM at Samsung Medical Center between April 2012 to March 2016 were enrolled. We analyzed technical and clinical outcomes of stent insertion, the factors associated with stent occlusion and long term outcomes after stent insertion.

**RESULTS**

Technical success rate was determined as 90.3% with a clinical success rate of 87.7%. Stent occlusion developed in 28.1%, with a median duration of 51 d. Further, 81.3% with stent occlusion could be treated with secondary stent insertion. Clinical failure was observed to be related to the male sex ( $P = 0.020$ ) and right colon obstruction ( $P = 0.017$ ). Stent length  $\leq 10$  cm was found to be associated with stent occlusion ( $P = 0.003$ ). Median survival time after stent insertion was 4.7 mo and 40.4% were able to receive their oncological treatments after stent insertion without surgery.

**CONCLUSION**

Uncovered SEMS is effective for the treatment of colorectal obstruction caused by

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ECM, considering life expectancy of patients with ECM.

**Key Words:** Self-expandable metallic stent; Colorectal stent; Colorectal obstruction; Extracolonic malignancy; Retrospective study

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**Core Tip:** This is a single center, retrospective study to evaluate the efficacy of the insertion of self-expandable metallic stent (SEMS) for palliative option for colorectal obstructions by extracolonic malignancy (ECM). Seventy-two patients who were diagnosed with colorectal obstruction by ECM and treated with SEMS were enrolled. Technical success rate was determined as 90.3% with a clinical success rate of 87.7%. We also evaluated factors associated with clinical failure and long-term outcomes after SEMS insertion. Palliative treatment using uncovered SEMS insertion for colorectal obstruction caused by ECM was found to be as effective and safe treatment approach, considering life expectancy of patients with ECM.

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## INTRODUCTION

Colorectal obstruction is a common complication of colorectal cancer, and usually requires rapid intervention due to bacterial translocation, dehydration, electrolyte imbalance, and increased risk of colonic perforation<sup>[1,2]</sup>. Since its development by Dohmoto in 1991, endoscopic self-expandable metallic stent (SEMS) insertion has become the main therapeutic option as a bridge to surgery and palliation of colorectal obstruction caused by inoperable colorectal cancer (CRC)<sup>[3-7]</sup>. Besides CRC, less than 20% of colorectal obstructions are caused by extracolonic malignancy (ECM) through peritoneal metastasis, colonic direct invasion, or extraluminal compression<sup>[8]</sup>. In the past, palliative colostomy for obstructive ECM was the only therapeutic option, and was associated with considerable perioperative morbidity, mortality, and decreased quality of life<sup>[9]</sup>. Since 2000, very few studies have reported the results of metal stent placement for colorectal obstruction by ECM<sup>[8,10,11]</sup>. Shin *et al*<sup>[11]</sup> performed SEMS placement in 39 patients with colorectal obstruction by ECM, with 87.2% technical success rate and 82.1% clinical success rate. Some studies evaluated the comparison between SEMS placement for colorectal obstruction by CRC and ECM. Keswani *et al*<sup>[12]</sup> reported a comparison of efficacy and complications in colonic versus extracolonic malignancy. In this retrospective study, clinical success was significantly higher in patients with CRC than in those with ECM (94.1% *vs* 20%,  $P < 0.0001$ )<sup>[12]</sup>. In contrast, Kim *et al*<sup>[13]</sup> reported similar clinical success rates in these two groups (92.6% *vs* 86.7%,  $P = 0.688$ ). In another study, Kim *et al*<sup>[14]</sup> evaluated the clinical outcomes and complications of SEMS compared with emergency surgery, where technical and clinical success rates were higher in the emergency surgery group.

Most of the previous studies have analyzed only a small number of patients with ECM. Moreover, the overall success rates vary among reports, and the long-term outcomes including stent occlusion were not reported. Therefore, the availability and safety of SEMS insertion in these situations have not been sufficiently determined.

The primary aim of this study was to investigate the technical and clinical successes, together with the factors associated with stent occlusion in uncovered SEMS insertion for colorectal obstruction by ECM. The secondary aim was to determine the long-term clinical outcomes including stent obstruction and management.

## MATERIALS AND METHODS

### **Study design, participants, procedures**

This is a retrospective analysis conducted in 72 patients who were diagnosed with colorectal obstructions caused by ECM, and treated with SEMS at Samsung Medical Center in Seoul, South Korea, from April 2012 to March 2016. Inclusion criteria for stent insertion was colorectal obstruction by peritoneal seeding or direct invasion of ECM that were surgically unresectable. The diagnosis of colorectal obstruction was established based on the clinical history, physical examination, simple radiograph, and computed tomography (CT) findings. Patients with obstruction by primary CRC, and who were suspected of small bowel obstruction, perforation, or peritonitis were excluded. Stent insertion was performed by a single expert endoscopist using endoscopic guidance under fluoroscopy. All of the stents used in this study were uncovered SEMS (Bonastent<sup>®</sup>, EndoChoice, Inc. Alpharetta, US and Hanarostent<sup>®</sup>, M.I. Tech Co. Ltd., Gyeonggi-do, Korea) with a diameter of 24 mm and a length of 6-16 cm.

The study was conducted in accordance with relevant guidelines and regulations. Written informed consents were obtained from all the patients or their guardians before the procedure and the Institutional Review Board of the Samsung Medical Center approved this study (No.2017-01-009).

### **Definitions and statistical analysis**

The right colon was defined as the colonic region from the cecum to the splenic flexure, while the left colon was defined as the colonic region from the descending colon to the rectum. Technical success was defined as the successful passage of the guide wire and deployment of the stent through the stricture. Clinical success was defined as the decompression of the bowel with relief of the obstruction symptoms and stent expansion > 70% in plain abdominal radiograph within 48 h. Stent occlusion was defined as the ingrowth or overgrowth of tumor proven by colonoscopy after 48 h of stent insertion. Statistical analysis was performed using SPSS version 23.0 (IBM Inc., NY, US). Student's *t* test for continuous variables and Chi-square test for categorical variables was used. Results were considered statistically significant for *P* values less than 0.05.

## RESULTS

### **Patient characteristics**

Table 1 shows baseline characteristics of the study population. The mean age of the included patients was 56.1 years with 34 (45.9%) being males. The most frequent primary malignancy was found to be gastric cancer (61.1%), followed by pancreaticobiliary cancer (15.3%). The most frequent locations of obstruction were the rectum (26.4%) and sigmoid colon (26.4%), followed by the transverse colon (22.2%) and splenic flexure (20.8%). Cases of near total obstruction impenetrable to scope passage was 88.9% and peritoneal seeding suspected in CT was 70.8%.

### **Clinical outcomes**

The overall technical success rate was 90.3% (65/72) and clinical success rate was 87.7% (57/65) (Table 2). Technical failure occurred in 7 participants, including long segment obstruction (3 participants), failure to reach the obstruction site because of severe adhesions (2 participants), and total obstruction impenetrable to guidewire passage (2 participants). Clinical failure occurred in 8 participants, including insufficient stent expansion (4 participants), multiple obstruction (2 participants) and colon perforation (2 participants). Table 3 shows comparisons between the success, technical failure, and clinical failure groups. There were no statistically significant differences in variables between the success and technical failure groups. In the clinical failure group, male gender (*P* = 0.020) and right colon obstruction (*P* = 0.017) were significantly associated with clinical failure. But age, primary malignancy, degree of obstruction, peritoneal carcinomatosis, previous chemotherapy or radiotherapy, and stent length showed no statistical differences between both groups.

### **Stent occlusion and management**

Stent occlusions were developed in 28.1% (16/57), and the median duration to obstruction was 51 d (range 14-158 d) (Table 4). Tumor ingrowth and overgrowth caused 75% and 25% obstructions, respectively. Of the total 16 participants with stent

**Table 1** Baseline characteristics of 72 patients with colorectal obstructions caused by extracolonic malignancy, *n* (%)

Characteristics	Value
Age (yr, mean $\pm$ SD)	56.1 $\pm$ 11.8
Male	34 (45.9)
Primary malignancy	
Gastric cancer	44 (61.1)
Pancreaticobiliary cancer	11 (15.3)
Ovary cancer	6 (8.3)
Uterine cancer	2 (2.8)
Bladder cancer	6 (8.3)
Breast cancer	2 (2.8)
Esophageal cancer	1 (1.4)
Obstruction site	
Rectum	19 (26.4)
Sigmoid colon	19 (26.4)
Descending colon	1 (1.4)
Splenic flexure	15 (20.8)
Transverse colon	16 (22.2)
Hepatic flexure	2 (2.8)
Ascending colon	0
Degree of obstruction (scope passing)	
Partial	8 (11.1)
Near total	64 (88.9)
Peritoneal carcinomatosis	51 (70.8)
Previous chemotherapy	63 (87.5)
Previous radiotherapy	12 (16.7)
Stent diameter (mm, median)	24 (24-24)
Stent length (cm, median)	10 (8-12)
Stent length $\leq$ 10 cm	38 (58.5)

obstruction, 81.3% (13/16) could be treated with secondary stent insertion, and 18.8% (3/16) were managed with surgical diversion. There were no differences between the patent stent and stent occlusion groups except with respect to the stent length. Stent length lesser than 10 cm was found to be associated with stent occlusion (Table 5).

### Long term outcomes

Overall long-term outcomes in stent success group (*n* = 57) are summarized in Table 6. The median survival time was 4.7 mo (range 0.8-25.5 mo). 40.4% (23/57) were able to receive their oncological treatments (chemotherapy or radiotherapy) and the median duration to oncological treatments after stent was 15 d (range 2-163 d). The remaining 34 patients did not receive oncological treatments due to poor performance status or patient's refusal. 26.3% (15/57) eventually needed surgery (colostomy or ileostomy) due to multiple obstruction (7 participants), colon perforation (7 participants) and stent fracture (1 participant, 53 d after stent). The median duration to surgery after stent was 25 d (range 7-385 d).

**Table 2 Clinical outcomes of stent insertion**

Technical success (%)	65/72 (90.3%)
Cause of technical failure ( <i>n</i> = 7)	
Long segment obstruction	3
Severe peritoneal adhesion	2
Total obstruction (unable to guidewire passage)	2
Clinical success (%)	57/65 (87.7%)
Cause of clinical failure ( <i>n</i> = 8)	
Insufficient expansion of stent	4
Multiple obstruction	2
Colon perforation (after 2 d)	2

**Table 3 Baseline characteristics according to success or failure of stent insertion, *n* (%)**

	Success group ( <i>n</i> = 57)	Technical failure group ( <i>n</i> = 7)	<i>P</i> value	Clinical failure group ( <i>n</i> = 8)	<i>P</i> value
Age (yr, mean ± SD)	56.2 ± 12.4	58.3 ± 7.9	0.660	53.9 ± 11.1	0.623
Male	23 (40.4)	4 (57.1)	0.443	7 (87.5)	0.020
Primary malignancy			0.352		0.255
Upper abdominal cancer	42 (73.7)	5 (71.4)		8 (100.0)	
Lower abdominal cancer	12 (21.1)	2 (28.6)		0	
Extra abdominal cancer	3 (5.3)	0		0	
Obstruction site			0.110		0.017
Left colon	35 (63.2)	2 (28.6)		1 (12.5)	
Right colon	21 (36.8)	5 (71.4)		7 (87.5)	
Degree of obstruction			0.359		1.000
Partial	6 (10.5)	1 (14.3)		1 (12.5)	
Near total	51 (89.5)	6 (85.7)		7 (87.5)	
Peritoneal carcinomatosis	42 (73.7)	4 (57.1)	0.391	5 (62.5)	0.675
Previous chemotherapy	49 (86.0)	7 (100.0)	0.582	7 (87.5)	1.000
Previous radiotherapy	9 (15.8)	2 (28.6)	0.593	1 (12.5)	1.000
Stent length ≤ 10 cm (%)	36 (63.2)	NA	NA	2 (25.0)	0.058

Upper abdominal cancer: Gastric cancer and pancreaticobiliary cancer; Lower abdominal cancer: Ovarian cancer, uterine cancer, and bladder cancer; Left colon: From the rectum to descending colon; Right colon: From the splenic flexure to ascending colon.

## DISCUSSION

This study demonstrates that uncovered SEMS can resolve colorectal obstruction caused by ECM with 90.3% technical success rate and 87.7% clinical success rate. Previous studies have shown that SEMS is an effective modality for the management of malignant colorectal obstruction by CRC<sup>[15-20]</sup>. However, very few studies have evaluated the efficacy of SEMS insertion in colorectal obstruction caused by ECM. Yoon *et al*<sup>[21]</sup> evaluated 412 patients with malignant colorectal obstruction in whom covered or uncovered SEMS insertion was attempted. Of these, 114 patients with colorectal obstruction by ECM showed 80.7% technical success rate and 83.7% clinical success rate. Kim *et al*<sup>[22]</sup> evaluated the efficacy of SEMS (*n* = 111) and emergency surgery (*n* = 69) for palliation of malignant colorectal obstruction in advanced gastric cancer patients. They reported 73.9% technical success rate and 54.1% clinical success

**Table 4 Results of stent occlusion**

Stent occlusion	16/57 (28.1%)
Duration to stent occlusion (days, median)	51 (14-158)
Cause of stent occlusion	
Tumor ingrowth	12 (75.0%)
Tumor overgrowth	4 (25.0%)
Management of stent occlusion	
Stent reinsertion	13 (81.3%)
Surgery	3 (18.8%)

**Table 5 Baseline characteristics according to stent occlusion, n (%)**

	Patent stent group (n = 41, 71.9%)	Stent occlusion group (n = 16, 28.1%)	P value
Age (yr, mean ± SD)	56.2 ± 12.4	58.3 ± 7.9	0.660
Male	15 (36.6)	8 (50.0)	0.354
Primary malignancy			0.231
Upper abdominal cancer	28 (68.3)	14 (87.5)	
Lower abdominal cancer	11 (26.8)	1 (6.3)	
Extra abdominal cancer	2 (4.9)	1 (6.3)	
Obstruction site			0.198
Left colon	28 (68.3)	8 (50.0)	
Sigmoid colon	13 (31.7)	8 (50.0)	
Obstruction			1.000
Partial	4 (9.8)	2 (12.5)	
Near total	37 (90.2)	14 (87.5)	
Peritoneal carcinomatosis	31 (75.6)	11 (68.8)	0.739
Previous chemotherapy	35 (85.4)	14 (87.5)	1.000
Previous radiotherapy	6 (14.6)	3 (18.8)	0.700
Stent length ≤ 10 cm	21 (51.2)	15 (93.8)	0.003

Upper abdominal cancer: Gastric cancer and pancreaticobiliary cancer; Lower abdominal cancer: Ovarian cancer, uterine cancer, and bladder cancer; Left colon: From the rectum to descending colon; Right colon: From the splenic flexure to ascending colon.

rate for SEMS, which seemed to be less effective than emergency surgery for the palliation. Moon *et al*<sup>[23]</sup> compared the outcomes of SEMS insertion for malignant colorectal obstruction caused by ECM ( $n = 44$ ) and CRC ( $n = 53$ ). This study showed 93.2% and 98.1% technical success rate, and 77.3% and 84.9% clinical success rate in the ECM and CRC groups, respectively. This difference was not statistically significant. Recently, Ahn *et al*<sup>[24]</sup> compared the outcomes of SEMS for ECM ( $n = 56$ ) and CRC ( $n = 29$ ). In 54 patients with ECM, technical success rate and clinical success rate were 96.4% and 88.9%, respectively. Our study showed similar or better clinical outcomes than the previous studies. This may be attributed to the fact that a single experienced endoscopist performed all the procedures, thereby maintaining the quality of the study methods.

In this study, we found that male sex and colon obstruction on the right side were associated with clinical failure. Right side colon obstruction was regarded to be more arduous for stent insertion compared to left side colon obstruction due to the difficulty in approaching the lesion from the right side. Further, the most frequent primary malignancy was found to be gastric cancer in this study. In Korea, gastric cancer is also the most commonly diagnosed cancer and the incidence is higher in men than in

**Table 6 Long-term outcomes of stent success group**

Long-term outcomes	n = 57
Survival time after 1 <sup>st</sup> stent insertion (months, median)	4.7 (0.8-25.5)
Oncological treatment after stent without surgery	23 (40.4%)
Chemotherapy only	22
Chemotherapy + Radiotherapy	1
Duration to oncological treatments after stent insertion (d, median)	15 (2-163)
Surgery after clinical success (except stent occlusion)	15 (26.3%)
Multiple obstruction	7
Colon perforation	7
Stent fracture	1 (53 d after stent)
Duration to surgery after stent insertion (d, median)	25 (7-385)

women. Therefore, the most frequent ECM causing colorectal stenosis may vary depending on the most prevalent cancer in each country.

With regard to the obstruction after stent insertion, it was found that all obstructions were caused by tumor ingrowth and overgrowth. Although stent patency duration had a median of 51 d (range 14-158 d), and stent restenosis was developed in 28.1% of the patients, most of the stent occlusions were treated by stent reinsertions (81.3%). Also, there was no stent migration or dysfunction.

The long-term outcomes showed that median survival time was 4.7 mo and median duration to chemotherapy after stent was 15 d. Considering stoma-related morbidity and complications of adjuvant chemotherapy after surgery<sup>[9,25]</sup>, SEMS seems to have the clinical advantages in oncological treatment with less invasiveness and shorter recovery time. Despite these advantages, 26.3% of participants eventually needed surgery after stent insertion due to disease progression. Therefore, considering life expectancy of patients with ECM and distant metastasis, uncovered SEMS insertion for colonic stenosis by ECM seems to be a reasonable treatment option to selected patients.

This study had several limitations. Firstly, this is a single center, retrospective, and nonrandomized study. Therefore, several biases including selection bias are unavoidable. Secondly, there was no control group, such as a surgical group, to compare the clinical outcomes. However, these patients were in poor general condition and were a high-risk group for surgery and general anesthesia. Therefore, comparative study on the treatment options is not in accordance with research ethics. Thirdly, the ECM group was heterogeneous, and the most prevalent type of cancer varies from one country to another. Therefore, the type of ECM causing colonic obstruction, and the location of the obstruction might be different in different areas.

In conclusion, palliative treatment using uncovered SEMS insertion for colorectal obstruction caused by ECM was found to be as effective and safe treatment approach comparable to that performed for obstruction by CRC. Further, the associated clinical outcome and stent patency duration might be adequate for palliative purposes, considering the shorter life expectancy of such patients and resulting improved quality of life.

## ARTICLE HIGHLIGHTS

### Research background

Self-expandable metallic stent (SEMS) is widely used for malignant colorectal obstruction. Recently, SEMS has been used for palliative option for colorectal obstruction caused by extracolonic malignancy (ECM).

### Research motivation

There is a debate about the role of endoscopic stent insertion and few studies have reported the results of stent insertion for colorectal obstruction by ECM.

**Research objectives**

In this study, the authors aimed to evaluate the efficacy of SEMs for colorectal obstruction caused by ECM, and to identify the factors associated with stent occlusion.

**Research methods**

Seventy-two patients who were treated with uncovered SEMs for malignant colorectal obstructions caused by colorectal metastasis or peritoneal seeding of ECM at Samsung Medical Center between April 2012 to March 2016 were enrolled. Technical and clinical outcomes of stent insertion, the factors associated with stent occlusion and long-term outcomes after stent insertion were analyzed.

**Research results**

Technical success rate was determined as 90.3% with a clinical success rate of 87.7%. Stent occlusion developed in 28.1%, with a median duration of 51 d. Further, 81.3% patients with stent occlusion could be treated with secondary stent insertion. Clinical failure was observed to be related to the male sex and right colon obstruction. Stent length  $\leq 10$  cm was found to be associated with stent occlusion ( $P = 0.003$ ). Median survival time after stent insertion was 4.7 mo and 40.4% were able to receive their oncological treatments after stent insertion without surgery.

**Research conclusions**

Uncovered SEMs is effective for the treatment of colorectal obstruction caused by ECM.

**Research perspectives**

Palliative treatment using uncovered SEMs insertion for colorectal obstruction caused by ECM was found to be as effective and safe treatment. The associated clinical outcome and stent patency duration might be adequate for palliative purposes, considering the shorter life expectancy of such patients and resulting improved quality of life.

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