Long-term outcome of palliative therapy for malignant colorectal obstruction in patients with unresectable metastatic colorectal cancers: endoscopic stenting versus surgery CME

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Background: Self-expandable metal stents (SEMSs) provide a promising alternative for initial palliation of malignant bowel obstruction. However, data on the long-term outcomes of SEMSs are limited.

Objective: The aim of this study was to compare the long-term outcomes of endoscopic stenting with those of surgery for palliation in patients with incurable obstructive colorectal cancer.

Designs and Setting: A retrospective study.

Patients: From January 2000 to December 2008, patients with incurable obstructive colorectal cancer who were treated with SEMSs (n = 71) or palliative surgery (n = 73) were reviewed.

Interventions: SEMS placement by using through-the-endoscope methods or surgery.

Main Outcome Measurements: Success rates and complication rates.

Results: Early success rates in the SEMS group and those in the surgery group were not different (95.8% vs 100%, $P = .12$), and the SEMS group had fewer early complications than the surgery group (15.5% vs 32.9%, $P = .015$). Although the patency duration of the first stent in the SEMS group was shorter than that in the surgery group ($P < .001$), the median patency duration after a second stenting was comparable to that of the surgery group ($P = .239$). There were more late complications in the SEMS group than in the surgery group ($P = .028$), but the rates of major complications did not differ between the 2 groups ($P = .074$).

Limitations: Retrospective and single-center study.

Conclusions: SEMSs were not only an effective and acceptable therapy for initial palliation of malignant colorectal obstruction, but they also showed long-term efficacy comparable to that with surgery. (Gastrointest Endosc 2011;73:535-42.)

Colorectal cancer (CRC) is the fourth most common cancer worldwide, accounting for more than 940,000 new cases and 500,000 deaths annually.[1] In Korea, CRC is the fourth most common cancer, with an estimated 17,625 new cases and 5997 deaths each year.[2] Among CRC patients, 7% to 29% have bowel obstruction and have an unfavorable prognosis compared with those without bowel obstruction.[3]

Abbreviations: ASA, American Society of Anesthesiologists; CRC, colorectal cancer; OS, overall survival; SEMS, self-expandable metal stent; TTP, time to progression.

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Since the first report of the palliative use of metal stents in 1991 by Dohmoto,[4] there has been an increasing use of self-expandable metal stents (SEMSs) as an initial therapy for malignant bowel obstruction.[5-7] SEMSs may be used for palliation or as a bridge to surgery to allow 1-stage surgery later. Because of the accumulating experience and innovations in stents, recent studies have reported clinical

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success rates of more than 90%.[8-10] A systematic review by Watt et al[8] suggested that stent placement had positive outcomes compared with surgery, including shorter hospital stays and lower rates of adverse events. Positive outcomes of SEMSs are especially prominent when SEMSs are used as a bridge to surgery. In 1 study, 84.6% of the patients were able to undergo 1-stage surgery with primary anastomosis.[11] However, the use of SEMSs exclusively for palliative purposes in patients with incurable CRC is still controversial.

Because of the initial success rate and low mortality rate comparable to those of surgery, palliative stenting seems to be a favorable therapeutic option in patients with unresectable CRC and a limited life expectancy. However, there have been some concerns about the long-term efficacy of SEMSs. Because of modern polychemotherapy combined with targeted agents, the survival of patients with unresectable CRC has been increasing from 11 to 13 months to 14.8 to 21.5 months.[12,13] Therefore, the long-term efficacy and safety are becoming important factors in the decisions regarding the therapeutic plan for palliation of malignant colorectal obstruction.

Although the initial decompression rate with SEMSs is very high, there is little information regarding the long-term outcomes of SEMSs in patients with obstructive incurable CRC.[14] Most of the recent studies on SEMSs have focused on their clinical efficacy and low rates of early complications.[8-10,15] The long-term efficacy and late complications of SEMSs have not been fully elucidated. The aim of this study was to compare the long-term efficacy and complications of SEMS with those of surgery for palliation of malignant colorectal obstruction in patients with incurable CRC.

Take-home Message

- The median patency of self-expandable metal stents (SEMSs) after a second stenting was comparable to that of the surgery group.
- Long-term efficacy and complications of SEMSs were comparable to those of surgery, and the stent-related complications during follow-up were manageable with endoscopic treatment.

PATIENTS AND METHODS

We collected a retrospective cohort of metastatic unresectable CRC patients with imminent obstruction from January 2000 to December 2008 at Yonsei University College of Medicine, Seoul, South Korea. The disease was considered unresectable when it was impossible to achieve a curative resection of the metastatic disease because of liver metastases (bilobar multiple lesions, involvement of the hilum or the 3 major hepatic veins, remnant liver volume <30% after hepatectomy) or extrahepatic disease. Colonic obstruction was diagnosed by clinical and radiologic means. Clinical suspicion of imminent obstruction was based on changes in the symptoms and signs of nausea, vomiting, abdominal discomfort, abdominal distention, or diarrhea.[16] After completion of imaging studies, the patients underwent endoscopic stenting or emergent surgery for the palliation of the obstruction. Patients with evidence of bowel perforation, peritonitis, and recurrent tumor were excluded from the study. Patients who underwent palliative surgery after successful stenting were also excluded from evaluation of the long-term outcomes of SEMSs. Informed consent was obtained from all patients before the procedures.

In patients undergoing palliative stenting, SEMSs were placed under fluoroscopy and through the endoscope methods by 3 expert endoscopists.[17] Balloon dilation was not used. Based on the length of stenosis, a Wallflex uncovered stent (25 mm in diameter; Boston Scientific), a Comvi covered stent (20 mm; Boston Scientific), or a Niti-S uncovered D-type stent (24 mm; Taewoong Medical Co, Gimpo, South Korea) was used.

In patients who underwent surgery, the type of operation was decided on by 2 expert colorectal surgeons, depending on the tumor location and patient's general condition. Palliative resection with primary anastomosis was attempted if possible.

In the SEMS group, technical success was defined as successful deployment of the stent across the stricture. Clinical success was defined as colonic decompression and relief of obstructive symptoms within 24 hours after stent placement.[18] In the surgery group, success was defined as colonic decompression and relief of obstructive symptoms within 24 hours after surgery.[10] In both groups, late success was defined as maintaining colonic decompression without the recurrence of intestinal obstruction after 30 days of procedures. Early complications were defined as those that occurred within 30 days of palliative stenting or surgery,[10] and late complications were defined as those that occurred after 30 days. Major complications were defined as events that led to surgical reintervention, required patient admission to the intensive care unit for 48 hours, or caused death.[16] Patient data were reviewed retrospectively. Time to progression (TTP) was calculated as the time of diagnosis until disease progression. Overall survival (OS) was calculated as the time of diagnosis to death or the last follow-up visit.

Statistical analysis

The primary outcomes of this study were to evaluate the success rates and complication rates between the SEMS group and the surgery group. OS and TTP in both groups and risk factors for late complications in the SEMS group were the secondary outcomes. Each patient's baseline characteristics were analyzed by descriptive statistics. Kaplan-Meier methodology was applied to estimate the

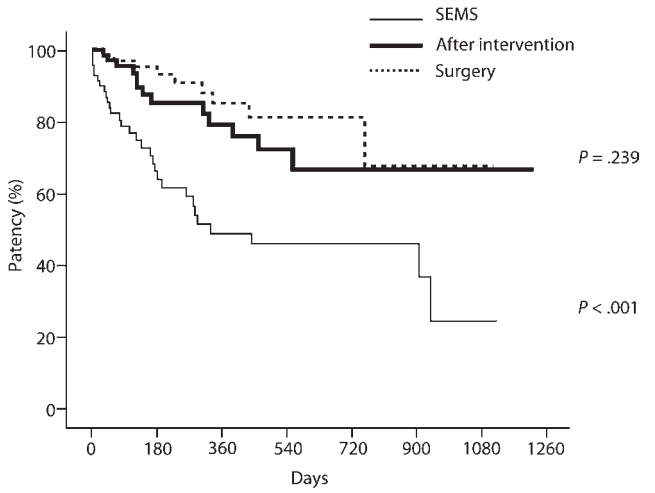

Figure 1. Kaplan-Meier curves of stent patency after self-expandable metal stent placement, reintervention, and palliative surgery.

median survival and progression-free survival for each group, and survival curves were compared by using the log-rank method. Risk factors for late complications of SEMSs were assessed by using univariate analysis and a forward stepwise multiple logistic regression model. To determine prognostic factors for OS, multivariate analysis using Cox proportional hazard models was performed. $P < .05$ was considered statistically significant. All values are presented as mean ± standard deviation, median (range), or percentage (number and percentage). All statistical analyses were performed by using the software package SPSS version 15.0 for Windows (SPSS Inc, Chicago, Ill).

RESULTS

Baseline characteristics of enrolled patients

A total of 169 patients were reviewed in this study, and 25 patients were excluded because of tumor recurrence (13 patients) and undergoing palliative surgery after successful stenting (12 patients). Finally, 71 patients were enrolled in the SEMS group and 73 patients were enrolled in the surgery group (Fig. 1). The patients' baseline characteristics are shown in Table 1. There were no statistically significant differences in sex, age, American Society of Anesthesiologists (ASA) classification, or metastatic sites between the 2 groups. The major obstruction site was the sigmoid colon (49.3%) in the SEMS group and the ascending colon (38.4%) in the surgery group ($P < .001$). The median follow-up period was 9.63 months (range 0.6-43.2 months) in the SEMS group and 9.83 months (range 0.6-37.1 months) in the surgery group ($P = .6$).

Early outcomes and complications

The rates of early technical and clinical success in the SEMS group were 95.8% and 95.8%, respectively, which were comparable to those of the surgery group (100% and 100%; $P = .12$; Table 2). In the SEMS group, stents were unable to be deployed in 3 patients (4.2%) because of the inability to pass the guidewire in 1 patient and colonic perforations during the procedure in 2 patients. All of these patients underwent emergent Hartmann operations. In the surgery group, resection of the tumor with anastomosis was performed in 36 patients (49.3%), resection without anastomosis was performed in 29 (39.7%), and bypass was performed in 8 (11.0%).

After the procedure, the SEMS group had a lower rate of early complications than the surgery group (15.5% vs 32.9%; $P = .015$; Table 2). However, the major complication rates were not significantly different between the 2 groups (7% vs 8.2%; $P = .790$). In the SEMS group, delayed colonic perforation developed in an additional 2 patients at days 10 and 18, respectively, after stenting, and they underwent emergent right hemicolectomy with colostomy and a Hartmann operation. The detailed early complications in the SEMS group are described in Table 3. The perforation rate was 5.6%. Stent reobstruction occurred in 5 patients (7.0%) because of stent migration (2.8%), tumor outgrowth (1.4%), and stool impaction (2.8%). Among these 5 patients, 4 underwent a successful second stenting and 1 patient refused further treatment. There were no stent-related deaths during the early period.

In the surgery group, 2 patients (2.7%) in whom pneumonia developed and 1 patient (1.4%) with pulmonary thromboembolism required intensive care unit admission, and 3 patients (4.1%) died, 2 of pneumonia and 1 of hepatic failure, in the postoperative period.

The median hospital stay was significantly shorter in the SEMS group (13.2 days) than in the surgery group (24.4 days; $P < .001$). The median time to chemotherapy administration was also shorter in the SEMS group (16.2 days) than in the surgery group (31.5 days; $P < .001$). Furthermore, the incidence of stoma creation was lower in the SEMS group (18.3%) than in the surgery group (50.7%; $P < .001$).

Late outcomes and complications

The late success rate was lower in the SEMS group (66.2%) than in the surgery group (87.7%; $P = .002$; Table 2). The median duration of first stent patency was 137 days (range 0-1117 days), which was shorter than in the surgery group (268 days; range 9-1107 days; $P < .001$). However, 18 of the 30 patients in whom stent failure developed were able to be managed by placement of a second stent. Including the successes achieved by the second stent, the median duration of stent patency was 229 days (range 14-1217 days) and was comparable to the patency of the surgery group ($P = .239$; Fig. 1).

During the follow-up period, although overall late complications were higher in the SEMS group than in the surgery group (33.8% vs 17.8%; $P = .028$; Table 2), the

TABLE 1. Patient demographics

	SEMSs	Surgery	*P* value
No. of patients	71	73	
Age, y, mean ± SD (range)	64.14 ± 14.38 (26-87)	62.00 ± 10.48 (29-88)	.31
Sex, no. (%)			.82
Male	47 (66.2)	47 (64.4)	
Female	24 (33.8)	26 (35.6)	
ASA class, no. (%)*			.49
I, II	66 (93.0)	70 (95.9)	
III	5 (7.0)	3 (4.1)	
Site of obstruction, no. (%)			<.001
Appendix	0	0	
Cecum	1 (1.4)	1 (1.4)	
Ascending colon	6 (8.5)	28 (38.4)	
Transverse colon	9 (12.7)	8 (11.0)	
Descending colon	7 (9.9)	3 (4.1)	
Sigmoid colon	35 (49.3)	18 (24.7)	
Rectum	13 (18.3)	15 (20.5)	
Site of metastasis, no. (%)			.97
Liver	44 (62.0)	48 (65.8)	
Lung	4 (5.6)	4 (5.5)	
Liver, lung	8 (11.3)	7 (9.6)	
Carcinomatosis	15 (21.1)	14 (19.2)	
Chemotherapy administration, no. (%)	49 (69.0)	54 (74.0)	.51
Chemotherapy regimen, no. (%)			.92
FU/LV + oxaliplatin	29 (59.2)	30 (55.6)	
FU/LV + irinotecan	12 (24.5)	15 (27.8)	
Others	8 (16.3)	9 (16.7)	
Follow-up, mo			.60
Median ± SD	9.63 ± 10.14	9.83 ± 8.93	
Range	0.60-43.17	0.57-37.10	

SEMSs, Self-expandable metal stents; *SD*, standard deviation; *FU/LV*, fluorouracil/leucovorin.
*American Society of Anesthesiologists (ASA) classification: class I, healthy patient, no medical problems; class II, mild systemic disease; class III, severe systemic disease, but not incapacitating; class IV, severe systemic disease that is a constant threat to life; class V, moribund, not expected to live for 24 hours irrespective of operation.

major complication rates were not different between the 2 groups (18.3% vs 8.2%; $P = .074$). In the SEMS group, 24 late complications (33.8%) were observed (Table 3). The most common complication was stent obstruction (29.6%) caused by stent migration (7 patients), tumor outgrowth (15 patients), and ingrowth (3 patients). Six patients in whom re-obstruction developed needed palliative surgery, but the remaining 15 patients (21.1%) were treated with a second stenting, which was a clinical success. There were 5 late colonic perforations (7.0%) at days 32, 70, 169, 307, and 323. All of these patients underwent emergent colectomy with the need for a colostomy in 2 patients. In the surgery group, 13 patients (17.8%) had late complications and 6 patients died of panperitonitis (n = 2), intestinal obstruction (n = 1), wound

TABLE 2. Analysis of outcomes and complications

	SEMSs (n = 71)	Surgery (n = 73)	*P* value
Efficacy, no. (%)			
Early			
Technical success	68 (95.8)	73 (100.0)	.12
Clinical success	68 (95.8)	73 (100.0)	.12
Late success	47 (66.2)	64 (87.7)	.002
Complications, no. (%)			
Early	11 (15.5)	24 (32.9)	.015
Major	5 (7.0)	6 (8.2)	.790
Minor	6 (8.5)	18 (24.7)	.009
Late	24 (33.8)	13 (17.8)	.028
Major	13 (18.3)	6 (8.2)	.074
Minor	11 (15.5)	7 (9.6)	.284
Acute mortality, no. (%)	0	3 (4.1)	.245
Hospital stay, d	13.24 ± 9.19	24.42 ± 9.73	<.001
Time to chemotherapy administration, d	16.20 ± 17.94	31.48 ± 16.16	<.001
Stoma, no. (%)	13 (18.3)	37 (50.7)	<.001
Curative resection, no. (%)*	7 (9.9)	2 (2.7)	.095
R0	6 (85.7)	2	
R1	0	0	
R2	1 (14.3)	0	

SEMSs, Self-expandable metal stents.
*R0, complete resection with no microscopic residual tumor; R1, microscopic residual tumor; R2, macroscopic residual tumor.

TABLE 3. Early and late complications of self-expandable metal stents

	Early, no. (%)	Late, no. (%)
Overall	11 (15.5)	24 (33.8)
Perforation	4 (5.6)	5 (7.0)
Stent migration	2 (2.8)	7 (9.9)
Tumor outgrowth	1 (1.4)	15 (21.1)
Tumor ingrowth	0	3 (4.2)
Stool impaction	2 (2.8)	0
Other	2 (2.8)*	2 (2.8)†

*Inability to pass the guidewire, deep venous thrombosis.
†Deep venous thrombosis (heparinization), intestinal obstruction (conservative care).

infection (n = 1), cancer bleeding (n = 1), and pulmonary thromboembolism (n = 1).

During the follow-up period, 6 patients (8.5%) in the SEMS group and 2 patients (2.7%) in the surgery group were down-staged to resectable metastatic disease by chemotherapy and underwent curative resection (P = .095).

Risk factors for late complications in the SEMS group

The risk factors influencing late complications in the SEMS group were analyzed (Table 4). Five patients who underwent emergent surgery because of initial stent failure (3 patients) and early colonic perforation (2 patients) were excluded from the analysis. ASA class (P = .035), stent diameter (P = .01), stent type (P = .03), and palliative chemotherapy (P = .003) were determined to be significant factors by univariate analysis. Multivariate analysis revealed that ASA class III (odds ratio, 16.737; 95% CI, 1.286-217.788; P = .031), stent diameter less than 20 mm (odds ratio, 5.382; 95% CI, 1.377-21.043; P = .016), and palliative chemotherapy (odds ratio, 10.434; 95% CI, 1.745-62.390; P = .01) were independent risk factors for late complications.

The risk factors influencing stent-related perforations during the follow-up period in the SEMS group were also analyzed. By univariate analysis, stent reinsertion (P = .035) was a significant predictive factor for perforation, but was not found to be significant in multivariate analysis. Age, sex, site of obstruction, stent diameter, stent type, and palliative chemotherapy were not significantly associated with perforation.

TTP, survival, and survival predictors

The median TTP was 7.97 months (95% CI, 3.334-12.599) in the SEMS group and 7.40 months (95% CI, 6.344-8.456) in the surgery group (P = .19; Fig. 2A). The median OS was 10.9 months (95% CI, 4.736-17.064) in the SEMS group and 13.0 months (95% CI, 8.659-17.341) in the surgery group (P = .771; Fig. 2B).

The predictive factors influencing OS were analyzed in the enrolled patients (Table 5). Univariate analysis revealed that curative resection (P = .005), palliative chemotherapy (P < .001), and targeted agent (P = .02) were significant factors. R0 resection (hazard ratio, 0.216; 95% CI, 0.052-0.892; P = .034) and palliative chemotherapy (hazard ratio, 0.329; 95% CI, 0.329-0.770; P = .002) were independent predictors of survival in multivariate Cox regression analysis.

TABLE 4. Risk factors for late complications

	No (n = 42)	Yes (n = 24)	*P* value
Age, y, mean ± SD	61.00 ± 14.42	65.60 ± 13.95	.844
Sex, no. (%)			.464
Male	26 (60.5)	17 (39.5)	
Female	16 (69.6)	7 (30.4)	
ASA class (I, II/III), no. (%)			.035
I, II	41 (67.2)	20 (32.8)	
III	1 (20.0)	4 (80.0)	
Carcinomatosis, no. (%)			.380
Yes	13 (56.5)	10 (43.5)	
No	29 (67.4)	14 (32.6)	
Colon/rectum, no. (%)			.345
Colon	32 (60.4)	21 (39.6)	
Rectum	10 (76.9)	3 (23.1)	
Right/left, no. (%)			.495
Right	10 (71.4)	4 (28.6)	
Left	32 (61.5)	20 (38.5)	
Sigmoid colon, no. (%)			.485
Yes	19 (59.4)	13 (40.6)	
No	23 (67.6)	11 (32.4)	
Stent reinsertion, no. (%)			.157
Yes	1 (4.3)	22 (95.7)	
No	1 (50.0)	1 (50.0)	
Diameter of stent, mm, no. (%)			.010
20	7 (38.9)	11 (61.1)	
≥24	35 (72.9)	13 (27.1)	
Type of stent, no. (%)			.030
Covered	7 (38.9)	11 (61.1)	
Uncovered	27 (69.2)	12 (30.8)	
R0 resection, no. (%)			.404
Yes	5 (83.3)	1 (16.7)	
No	37 (61.7)	23 (38.3)	
Palliative chemotherapy, no. (%)			.003
Yes	24 (52.2)	22 (47.8)	
No	18 (90.0)	2 (10.0)	
Bevacizumab, no. (%)			.645
Yes	4 (80.0)	1 (20.0)	
No	38 (62.3)	23 (95.8)	
Time to chemotherapy administration, d, median ± SD	9.00 ± 10.20	13.00 ± 24.10	.184

SD, Standard deviation; *ASA*, American Society of Anesthesiologists.

DISCUSSION

This study demonstrated that endoscopic stenting is safe and effective as initial palliative treatment and showed long-term outcomes comparable to those of palliative surgery in patients with unresectable metastatic CRC. Patients in the SEMS group had fewer acute complications than those in the surgery group, and stent-related complications during the follow-up period were manageable with endoscopic treatment.

Several studies have reported the effectiveness of SEMSs as initial therapy for the relief of obstructive symptoms in patients with unresectable CRC.[8-10,15] Previous studies indicated earlier recovery, shorter hospital stay, fewer early complications, no need for colostomy, and earlier chemotherapy administration as the advantages of SEMSs compared with surgery, all of which were confirmed in this study.[8-10] Our finding of technical and clinical success rates for SEMSs of 95.8% for both was comparable not only to those of previous reports but also to rates achieved with surgery in this study. Furthermore, there was no acute mortality in patients with SEMSs, whereas 3 patients died after surgery. Therefore, it is clear that use of an SEMS is a safe and effective therapy for palliation of malignant colorectal obstruction, especially in patients with a limited life expectancy.

It seems that SEMSs may have a short duration of patency because of a higher incidence of late complications. A meta-analysis showed that the re-obstruction rate was 12% (range 1%-92%), the migration rate was 11% (range 0%-50%), and the perforation rate was 4.5% (range 1%-92%).[8] A recent study reported that the late complication rate associated with SEMSs was as high as 51%, and the authors concluded that SEMSs were an ineffective therapy,

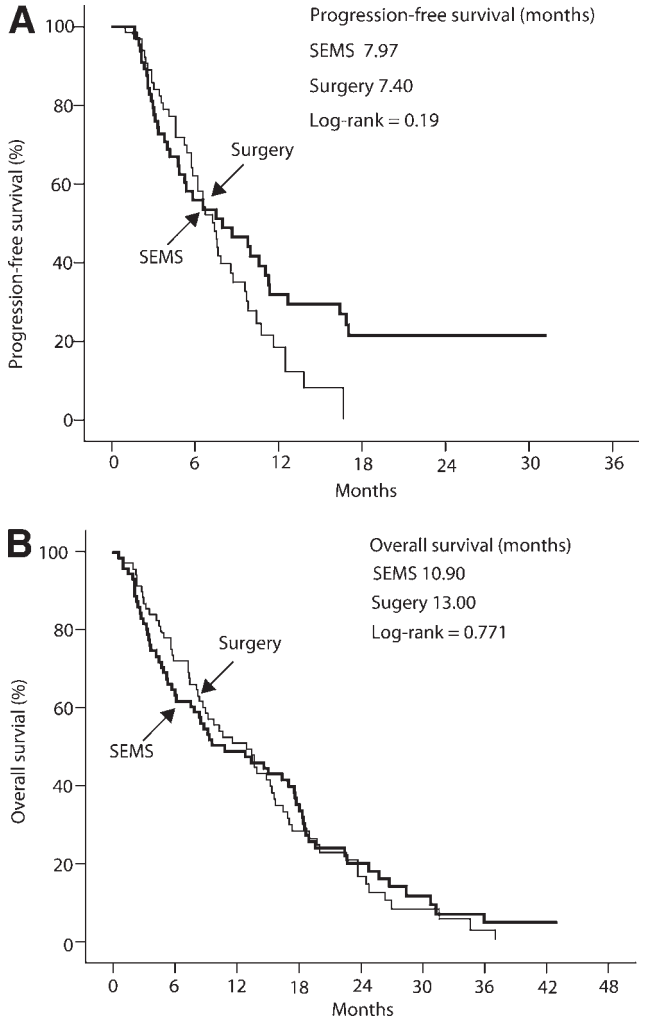

Figure 2. Kaplan-Meier curves of patient progression-free survival (**A**) and overall survival (**B**) after self-expandable metal stent placement or palliative surgery.

TABLE 5. Prognostic factors of overall survival

	Median survival time (mo)	95% CI	*P* value
Age, y			.822
<60	9.27	3.12-15.42	
≥60	13.43	8.98-17.89	
Sex			.637
Male	11.63	6.34-16.93	
Female	10.90	6.14-15.66	
ASA class			.226
I, II	12.87	9.05-16.69	
III	4.67	0-10.30	
Carcinomatosis			.770
Yes	11.63	6.24-17.03	
No	13.43	8.18-18.68	
Colon/rectum			.552
Colon	12.87	8.32-17.42	
Rectum	9.83	4.60-15.07	
Right/left			.878
Right	9.40	7.25-11.55	
Left	13.43	8.35-18.52	
Stent insertion			.771
Yes	10.90	4.74-17.06	
No	13.00	8.66-17.34	
R0 resection			.005
Yes	—	—	
No	9.83	6.03-13.46	
Palliative chemotherapy			<.001
Yes	15.07	12.55-17.59	
No	4.53	2.79-6.28	
Target agent			.020
Yes	18.40	11.66-25.14	
No	9.63	6.19-13.07	

CI, Confidence interval; *ASA*, American Society of Anesthesiologists.

especially in patients with incurable CRC, for a long life expectancy.[19] However, the incidence of complications in that study was fairly high, and the authors did not compare the complication rate of SEMSs with that of surgery. Although the patency duration of a first stent was shorter than that of surgery, our results demonstrated that the patency after a second stent was comparable to that of surgery, which means that the complications of SEMSs could be managed with endoscopic treatment. Furthermore, the OS of patients with SEMSs was not significantly different from that of patients who underwent surgery. Therefore, SEMSs could be considered as a palliative treatment option in patients with malignant colorectal obstruction who are expecting long-term survival. Because of the retrospective study design, our results should be confirmed by prospective, controlled study.

Nevertheless, major complications related to SEMSs are a main reason to reconsider the use of stents as a palliative therapy in patients expecting a long-term survival. Therefore, it is important to validate the risk factors for the complications of SEMSs. This study revealed that ASA class, stent diameter, and palliative chemotherapy were independent risk factors for the development of late complications. Because a previous study reported that prestent dilation was a significant factor affecting the outcomes of

SEMSs,[20] strictures were not dilated before stenting, and there were no dilation-related complications in this study. Several studies indicated that palliative chemotherapy might increase the risk of complications.[16,19] This association might be related to the direct effect of chemotherapy, which induces tumor shrinkage and tissue necrosis. However, it could also be explained by the fact that the patients survived longer after palliative chemotherapy and, therefore, had more chance of late complications developing. Focusing on the perforation, which was a main cause of morbidity in the SEMS group, our results demonstrated that perforation was not related to palliative chemotherapy. Furthermore, as mentioned previously, stent complications could be manageable with endoscopic treatment. Because of the small number of patients involved, this study failed to evaluate the effect of bevacizumab on stenting, which is known to increase the risk of perforation. Further study is needed to evaluate the exact effects of chemotherapy in patients with stenting.

This study had several limitations. First, because of the retrospective study design, the study population was not homogeneous. The patients with proximal colonic obstruction were enrolled more frequently in the surgery group. It has been found that the success rate of stenting is lower in the proximal colon than in the distal colon,[21] and the difference of obstruction site might have affected the outcome of this study. Second, various types of stents were used, although we thoroughly analyzed the effects of different types of stents on the outcomes. Third, the effect of different endoscopists and surgeons was not evaluated in this study. Finally, quality of life and the cost-effectiveness of palliative therapy, which are generally considered as advantages of stenting, were not evaluated in this study.

In conclusion, SEMSs were found to be effective and acceptable as initial palliative therapy for malignant colorectal obstruction because of an earlier recovery, shorter hospital stay, lower rate of early complications, and no need for colostomy compared with palliative surgery. Moreover, long-term outcomes and complications of SEMS were comparable to those of surgery, and the stent-related complications during follow-up were manageable with endoscopic treatment. Therefore, SEMSs could be recommended not only to patients with malignant colorectal obstruction and short life expectancy, but also to those with a longer life expectancy.

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