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Predictors of clinical outcomes of self-expandable metal stent treatment for malignant colorectal obstruction

A Honam Association for the Study of Intestinal Disease (HASID) multicenter study

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Abstract

There has been increased use of self-expandable metal stents (SEMS) in treating malignant colorectal obstruction (MCO). The aim of this study was to investigate factors that are associated with the outcomes of SEMS placement for MCO.

Clinical data from patients who underwent SEMS placement for MCO at 6 hospitals in Honam province of South Korea between 2009 and 2018 were reviewed retrospectively. Eight hundred two patients were identified and their data were analyzed. Technical success, clinical success, complications, and predictors of outcome were included as main outcome measures.

Technical and clinical success rates were 98.8% (792/802) and 90.1% (723/802), respectively. Complications including stent migration, stent occlusion due to tumor ingrowth and outgrowth, perforation, bacteremia/fever, and bleeding occurred in 123 (15.3%) patients. In multivariate regression analyses, procedure time was significantly associated with the technical success of SEMS placement ($P = .001$). Longer length of obstruction, the use of covered stent, and longer procedure time were significant independent predictive factors for the clinical success of SEMS placement (odds ratio [OR] 0.974 (95% confidence interval [CI] 0.950–0.990); $P = .043$, OR 0.255 (95% CI 0.138–0.471); $P < .001$, and OR 0.957 (95% CI 0.931–0.984); $P = .002$, respectively). Stage IV colorectal cancer and the use of covered stent were significant independent predictive factors for the development of complications after SEMS placement (OR 2.428 (95% CI 1.407–4.188); $P = .001$ and OR 3.329 (95% CI 2.060–5.378); $P < .001$, respectively).

Longer length of obstruction, the use of covered stent, and longer procedure time were associated with lower clinical success rates. Having stage IV colorectal cancer and the use of covered stents were associated with an increased risk of complications.

Abbreviations: BTS = bridge to surgery, CI = confidence interval, ESGE = European Society of Gastrointestinal Endoscopy, MCO = malignant colorectal obstruction, MD = moderate differentiated, MUC = mucinous carcinoma, NA = not assessed, OR = odds ratio, PD = poorly differentiated, SD = standard deviation, SEMS = self-expandable metal stents, SRCC = signet ring cell carcinoma, WD = well differentiated.

Keywords: colon cancer, obstruction, outcome, self-expandable metal stent

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1. Introduction

Colorectal cancer is one of the most common cancers worldwide, and its incidence has been increasing rapidly, especially in South Korea.[1–3] At the time of diagnosis approximately 8% to 13% of all colorectal cancer patients present with malignant colorectal obstruction (MCO). It is usually located in the left-sided colon and requires urgent decompression because MCO can lead to dehydration, electrolyte imbalance, shock, colorectal necrosis, bacterial translocation, organ failure, and death.[4–6]

Classically, emergency surgery was considered for a prompt decompression of MCO, but it is associated with a higher risk of mortality and morbidity compared to elective surgery.[7–9] Self-expandable metal stent (SEMS) placement is known to be effective and safe for palliation of MCO and subsequently an alternative to emergency surgery as a bridge to surgery (BTS).[10–13] SEMS placement helps the clinical stabilization of patients, preparation of clean bowel that allows investigation of the entire colon for synchronous lesions and the possibility of elective surgery without stoma creation.[10–13] However, several complications can occur after SEMS placement such as perforation, mal-position, re-obstruction, migration, bleeding, infection, and dissemination of cancer cells.[10–13] SEMS has been used commonly as a palliative treatment and has now gained acceptance. However, the results of previous reports supporting SEMS placement for MCO as a BTS or palliative treatment are quite conflicting.[10–18]

The aim of this study was to analyze the clinical outcomes of SEMS placement for MCO, either palliatively or preoperatively, and to identify predictive factors for its clinical outcomes including technical success, clinical success, and complications.

2. Materials and methods

2.1. Patients enrollment

We performed a retrospective multicenter study analysis of 802 patients who underwent SEMS placement for MCO at 6 hospitals (4 university hospitals and 2 community hospitals) in Honam Province of South Korea between January, 2009 and December, 2018. The hospitals are affiliated with the Honam Association for the Study of Intestinal Diseases. Medical records were collected and analyzed retrospectively to extract patient characteristics, clinical symptoms, tumor locations, and post-procedure clinical outcomes. Patients were followed up until they had curative surgery, died, or had a final clinical visit. After we explained to the patients about the procedure and related complications, informed consent was obtained and SEMS placement was performed. The study protocol was approved by the institutional review board of each participating hospital. Colorectal obstruction was diagnosed using a combination of overt clinical symptoms and radiological signs in all patients. Abdominal X-rays, computed tomography, and colonoscopy were performed in all patients to evaluate the stage of colorectal cancer and to identify the location, degree, and length of obstruction before the placement of SEMS was performed.

2.2. Procedure protocol

SEMS placement was performed by 6 gastrointestinal endoscopists (SWK, JL, GYH, HDK, HSK, and YEJ). Colonoscope (Olympus, Tokyo, Japan) or 2-channel therapeutic endoscope (Olympus, Tokyo, Japan) was advanced to the obstruction site under fluoroscopic guidance. Then, we passed an endoscopic retrograde cholangiopancreatography catheter (MTW Endoskopie, Wesel, Germany) through the obstruction. The catheter was advanced over the 0.038-inch angled or straight stiff-type guidewire (Glidewire; Terumo, Tokyo, Japan) to the proximal site of obstruction after passing through the obstruction. After we removed the guidewire, a contrast dye (Gastrografin; Schering, Berlin, Germany) was injected to identify the location, length, and morphology of obstruction. After replacing the catheter with a guidewire, we advanced SEMS delivery catheter over the guidewire and placed it through the obstruction. As we released SEMS delivery catheter, the stent was deployed from the proximal to the distal side of the obstruction as monitored under endoscopic and fluoroscopic guidance. After SEMS deployment, we removed the delivery system and guidewire. The type of stent was selected in accordance with each endoscopist's preference and experience. Length of obstruction was estimated using fluoroscopy by measuring the length of the catheter inserted from the distal margin of obstruction to the proximal margin of obstruction. The length of the stent was selected which has more than 2 cm distance from both proximal and distal margin of the obstruction. The diameter of the stent used was 20 to 25 mm and the length of the stent was 6 to 16 cm. Abdominal X-ray was taken 1 and 2 days after SEMS placement to assess the location and position of the stent in every patient. The technical success, clinical success, and the presence of complications were assessed in every patient during the hospital stay. After their discharge, the patients followed up at each institution until they were lost to follow up.

2.3. Definitions and outcomes

We defined technical success as the successful deployment of SEMS over all parts of the obstructed colon without any procedure-related adverse events.[19,20] We defined clinical success as the improvement of symptoms due to obstruction such as nausea, vomiting, abdominal pain/cramps, tenderness, abdominal distention, or failure to pass feces and gas, and radiologic relief of obstruction within 48 hours after technically successful SEMS deployment. The degree of obstruction was categorized into the subtotal and total obstruction.[19,20] If the colon was able to pass only liquid stool or gas, or had narrow stool caliber, we defined it as subtotal obstruction. If the colon was unable to pass any liquid or gas, or had decreased or absent bowel sounds, we defined it as total obstruction. Complications included perforation, migration of stent, stent occlusion due to tumor ingrowth and outgrowth, bleeding, and bacteremia/fever. We categorized the tumor location into 2 sites: proximal colon (transverse colon, ascending colon, and cecum) and distal colon (rectosigmoid colon and descending colon).

2.4. Statistical analysis

Data were analyzed using Statistical Packages for the Social Sciences, version 22.0 (SPSS Inc., Chicago, IL, USA). Normally distributed continuous variables were expressed as mean ± standard deviation. Categorical variables were expressed as frequency and percentage. We analyzed differences using the Student *t* test, chi-square test, or analysis of variance as appropriate. Using a logistic regression model, we determined the predictive factors that are associated with technical and clinical success rates, and the development of complications after

Table 1

Baseline characteristics of enrolled patients.

Variable		N = 802 (%)
Age (year)	Mean ± SD (range)	69.4 ± 13.0 (20.0–94.0)
Gender	Female/male	326/476 (40.6/59.4)
Abdominal operation history	Yes	183 (22.8)
Bacteremia/fever	Yes	46 (5.7)
Ascites	Yes	225 (28.1)
Tumor location	Ascending colon	26 (3.2)
	Hepatic flexure	43 (5.4)
	Transverse colon	37 (4.6)
	Splenic flexure	50 (6.2)
	Descending colon	38 (4.7)
	Sigmoid-descending junction	58 (7.2)
	Sigmoid colon	271 (33.8)
	Recto-sigmoid junction	206 (25.7)
	Rectum	73 (9.1)
Tumor location	Right/left	106/696 (13.2/86.8)
Tumor origin	Colon/extracolonic	766/36 (95.5/4.5)
Tumor histology	WD/MD/PD/SRCC/MUC/others	228/416/54/4/16/58 (29.4/53.6/7.0/0.5/2.1/7.5)
Stage	I/II/III/IV	7/165/198/432 (0.9/20.6/24.7/53.9)
Peritoneal metastasis	Yes	170 (21.2)
Length of obstruction (mm) (N = 581)	Mean ± SD (range)	35.9 ± 12.2 (10.0–100.0)
Completeness of obstruction	Subtotal/total obstruction	214/588 (26.7/73.3)
Use of antibiotics	Yes	479 (59.7)
Type of stent	Uncovered/covered	549/253 (68.5/31.5)
Length of the stent (mm)	Mean ± SD (range)	85.4 ± 15.9 (60.0–160.0)
Procedure time (min)	Mean ± SD (range)	20.0 ± 11.4 (4.0–91.0)
Treatment intent	Bridge to surgery/palliative	334/468 (41.6/58.4)

SEMS = self-expandable metal stent, SD = standard deviation, WD = well-differentiated, MD = moderate differentiated, PD = poorly differentiated, SRCC = signet ring cell carcinoma, MUC = mucinous carcinoma.

SEMS placement. All predictive factors were analyzed using univariate logistic regression analysis, and factors with a P value of <0.05 were included in the multivariate logistic regression model. A P value of <0.05 was considered statistically significant.

3. Results

3.1. Baseline characteristics of enrolled patients

A total of 802 patients were enrolled in this study, and their baseline characteristics are summarized in Table 1. The mean age of the patients was 69.4 ± 13.0 years (range, 20.0–94.0). The study group comprised 476 male (59.4%) and 326 female subjects (40.6%). Abdominal operation history, bacteremia/fever, and ascites were present in 183 (22.8%), 46 (5.7%), and 225 (28.1%) of 802 patients, respectively. The most common cause of MCO was colorectal cancer (766/802, 95.5%), with 86.8% (696/802) of the patients having left-sided MCO. Regarding the stages, 7 (0.9%), 165 (20.6%), 198 (24.7%), and 432 (53.9%) patients were in stages I, II, III, and IV, respectively. Peritoneal metastasis was present in 170 (21.2%) of 802 patients. Mean length of obstruction was 35.9 mm (range, 10.0–100.0), and total obstruction was present in 588 (73.3%) of 802 patients. The use of antibiotics was present in 479 (59.7%) patients. The proportion of patients in the BTS group and palliative group was 334 (41.6%) and 468 (58.4%), respectively. The use of a covered stent was present in 253 (31.5%) of 802 patients. The mean procedure time was 20.0 min (range, 4.0–91.0), and the mean length of the stent was 85.4 mm (range, 60.0–160.0).

3.2. Clinical outcomes and complications after SEMS placement

The details of clinical outcomes and complications after SEMS placement for MCO are summarized in Table 2. Technical and clinical success rates were 98.8% (792/802) and 90.1% (723/802), respectively. A total of 123 (15.3%) patients had complications, including stent migration (50/802, 6.2%), stent occlusion (40/802, 5.0%) due to ingrowth (32/802, 4.0%), outgrowth (9/802, 1.1%), perforation (31/802, 3.9%), bacteremia/fever (4/802, 0.5%), and bleeding (1/802, 0.1%) (Table 2).

Table 2

Clinical outcomes and complications after SEMS placement.

Variable	N = 802 (%)
Technical fail/success	10/792 (1.2/98.8)
Clinical fail/success	79/723 (9.9/90.1)
Complication	123 (15.3)
Stent migration	50 (6.2)
Stent occlusion	40 (5.0)
Ingrowth	32 (4.0)
Outgrowth	9 (1.1)
Perforation	31 (3.9)
Bacteremia/fever	4 (0.5)
Bleeding	1 (0.1)

SEMS = self-expandible metal stent.

Table 3

Univariate and multivariate logistic regression analyses of predictive factors for the technical success of SEMS placement.

	Univariate analysis			Multivariate analysis		
Variables	**Odds ratio**	**95% CI**	***P* value**	**Odds ratio**	**95% CI**	***P* value**
Age, mean ± SD (year)	0.994	0.947–1.044	.816	1.000	0.940–1.063	.991
Male	0.361	0.076–1.712	.199	0.590	0.102–3.419	.556
Abdominal operation history	1.185	0.249–5.630	.831	0.766	0.129–4.539	.769
Bacteremia/fever	0.235	0.049–1.141	.072	0.230	0.029–1.793	.161
Ascites	0.909	0.233–3.546	.890	0.961	0.160–5.766	.965
Left-sided colon	NA	NA	.997	NA	NA	
Extracolonic	NA	NA	.998	NA	NA	
PD/SRCC/MUC	1.035	0.129–8.283	.974	NA	NA	
Stage IV	1.170	0.336–4.073	1.170	0.569	0.108–2.998	.506
Peritoneal metastasis	NA	NA	.996	NA	NA	
Length of obstruction, mean ± SD (mm)*	1.046	0.966–1.131	.267	1.017	0.936–1.106	.691
Total obstruction	0.302	0.038–2.398	.257	0.483	0.051–4.539	.524
Use of antibiotics	1.491	0.428–5.191	.531	1.490	0.311–7.144	.618
Covered stent	0.688	0.192–2.459	.565	0.499	0.107–2.334	.377
Length of stent, mean ± SD (mm)	1.050	0.999–1.103	.055	1.058	0.992–1.129	.085
Procedure time, mean ± SD (min)	0.956	0.925–0.988	**.007**	0.917	0.872–0.965	**.001**

SEMS = self-expandable metal stent, CI = confidence interval, SD = standard deviation, PD = poorly differentiated, SRCC = signet ring cell carcinoma, MUC = mucinous carcinoma, NA = not assessed.
* Evaluated in 581 patients whose data were available.

3.3. Univariate and multivariate logistic regression analyses of predictive factors for the technical success of SEMS placement

The results of univariate and multivariate logistic regression analyses of the predictive factors associated with the technical success of SEMS placement for MCO are summarized in Table 3. Univariate and multivariate logistic regression analyses revealed that there was no significant difference between technical success and failure in terms of age, sex, abdominal operation history, bacteremia/fever, ascites, tumor location, tumor origin, tumor histology, tumor stage, the presence of peritoneal metastasis, length of obstruction, completeness of obstruction, use of antibiotics, type of stent, and length of the stent. Procedure time was significantly associated with the technical success of SEMS placement (odds ratio [OR] 0.956 (95% confidence interval [CI] 0.925–0.988); $P = .007$ and OR 0.917 (95% CI 0.872–0.965); $P = .001$, respectively).

3.4. Univariate and multivariate logistic regression analyses of predictive factors for clinical success of SEMS placement

The results of univariate and multivariate logistic regression analyses of the predictive factors associated with clinical success of SEMS placement for MCO are summarized in Table 4. Univariate logistic regression analysis revealed that left-sided tumor location, the longer length of obstruction, and the use of

Table 4

Univariate and multivariate logistic regression analyses of predictive factors for clinical success of SEMS placement.

	Univariate analysis			Multivariate		
Variable	**Odds ratio**	**95% CI**	***P* value**	**Odds ratio**	**95% CI**	***P* value**
Age, mean ± SD (year)	0.995	0.977–1.013	.557	0.994	0.971–1.017	.611
Male	0.937	0.583–1.507	.788	0.781	0.423–1.440	.428
Abdominal operation history	1.292	0.717–2.326	.394	1.991	0.857–4.628	.109
Bacteremia/fever	0.890	0.341–2.321	.811	0.746	0.244–2.282	.607
Ascites	0.726	0.444–1.189	.204	0.975	0.496–1.919	.943
Left sided colon	0.325	0.116–0.907	**.032**	0.288	0.083–0.999	.050
Extracolonic	0.527	0.212–1.307	.167	0.539	0.115–2.525	.433
PD/SRCC/MUC	0.633	0.309–1.300	.213	0.789	0.278–2.241	.656
Stage IV	0.870	0.545–1.391	.561	0.686	0.350–1.345	.273
Peritoneal metastasis	1.277	0.698–2.337	.427	1.921	0.737–5.005	.182
Length of obstruction, mean ± SD (mm)*	0.975	0.956–0.994	**.009**	0.974	0.950–0.999	**.043**
Total obstruction	0.994	0.588–1.682	.983	1.093	0.559–2.137	.795
Use of antibiotics	1.135	0.709–1.815	.598	1.017	0.566–1.826	.956
Covered stent	0.271	0.168–0.437	**<.001**	0.255	0.138–0.471	**<.001**
Uncovered stent	3.690	2.289–5.952	**<.001**	3.922	2.123–7.245	**<.001**
Length of stent, mean ± SD (mm)	0.991	0.977–1.005	.216	1.018	0.993–1.042	.157
Procedure time, mean ± SD (min)	0.984	0.966–1.001	.067	0.957	0.931–0.984	**.002**

SEMS = self-expandable metal stent, CI = confidence interval, SD = standard deviation, PD = poorly differentiated, SRCC = signet ring cell carcinoma, MUC = mucinous carcinoma, NA = not assessed.
* Evaluated in 581 patients whose data were available.

Table 5

Univariate and multivariate logistic regression analyses of predictive factors for development of complications after SEMS placement.

	Univariate analysis			Multivariate analysis		
Variable	**Odds ratio**	**95% CI**	***P* value**	**Odds ratio**	**95% CI**	***P* value**
Age, mean ± SD (year)	0.997	0.982–1.011	.664	1.005	0.987–1.024	.575
Male	0.821	0.558–1.210	.319	0.743	0.465–1.189	.216
Abdominal operation history	0.841	0.524–1.351	.474	0.636	0.345–1.172	.147
Bacteremia/fever	1.807	0.892–3.663	.101	1.724	0.732–4.063	.213
Ascites	1.231	0.812–1.865	.328	0.959	0.559–1.646	.880
Left sided colon	2.111	1.036–4.302	**.040**	1.971	0.901–4.308	.089
Extracolonic	1.906	0.874–4.160	.105	2.204	0.708–6.858	.172
PD/SRCC/MUC	1.187	0.628–2.243	.597	0.699	0.281–1.738	.441
Stage IV	1.802	1.206–2.694	**.004**	2.428	1.407–4.188	**.001**
Peritoneal metastasis	1.379	0.884–2.149	.156	0.934	0.485–1.798	.839
Length of obstruction, mean ± SD (mm)*	1.007	0.990–1.024	.433	1.005	0.983–1.027	.664
Total obstruction	1.214	0.775–1.902	.398	1.118	0.647–1.930	.689
Use of antibiotics	0.943	0.639–1.394	.770	1.210	0.757–1.932	.425
Covered stent	3.046	2.058–4.510	**<.001**	3.329	2.060–5.378	**<.001**
Uncovered stent	0.328	0.2217–0.486	**<.001**	0.300	0.186–0.485	**<.001**
Length of stent, mean ± SD (mm)	1.008	0.996–1.020	.196	0.989	0.969–1.008	.251
Procedure time, mean ± SD (min)	1.004	0.988–1.020	.651	1.015	0.991–1.040	0.216

SEMS = self-expandable metal stent, CI = confidence interval, SD = standard deviation, PD = poorly differentiated, SRCC = signet ring cell carcinoma, MUC = mucinous carcinoma, NA = not assessed.
* Evaluated in 581 patients whose data were available.

covered stent were significant independent predictive factors for the clinical success of SEMS placement (OR 0.325 (95% CI 0.116–0.907); $P = .032$, OR 0.975 (95% CI 0.956–0.994); $P = .009$, and OR 0.271 (95% CI 0.168–0.437); $P < .001$, respectively). According to multivariate logistic regression analysis, the longer length of obstruction, of the use of covered stent, and longer procedure time were significant independent predictive factors for the clinical success of SEMS (OR 0.974 (95% CI 0.950–0.990); $P = .043$, OR 0.255 (95% CI 0.138–0.471); $P < .001$, and OR 0.957 (95% CI 0.931–0.984); $P = .002$, respectively). No significant difference was found between clinical success and failure in terms of age, sex, abdominal operation history, bacteremia/fever, ascites, tumor location, tumor origin, tumor histology, tumor stage, the presence of peritoneal metastasis, completeness of obstruction, use of antibiotics, and length of the stent.

3.5. Univariate and multivariate logistic regression analyses of predictive factors for the development of complications after SEMS placement

The results of univariate and multivariate logistic regression analyses of the predictive factors for the development of complications after SEMS placement for MCO are summarized in Table 5. According to univariate logistic regression analysis, left-sided tumor location, stage IV colorectal cancer, and the use of covered stent were significant independent predictive factors for the development of complications (OR 2.111 (95% CI 1.036–4.302); $P = .040$, OR 1.802 (95% CI 1.206–2.694); $P = .004$, and OR 3.046 (95% CI 2.058–4.510); $P < .001$, respectively). According to multivariate logistic regression analysis, stage IV colorectal cancer and the use of covered stent were significant independent predictive factors for the development of complications after SEMS placement (OR 2.428 (95% CI 1.407–4.188); $P = .001$ and OR 3.329 (95% CI 2.060–5.378); $P < .001$, respectively). No significant difference was found between technical success and failure in terms of age, sex, abdominal operation history, bacteremia/fever, ascites, tumor location, tumor origin, tumor histology, the presence of peritoneal metastasis, length of obstruction, completeness of obstruction, use of antibiotics, length of the stent, and procedure time.

4. Discussion

SEMS has been used as an alternative to emergency surgery for MCO either palliatively or preoperatively. Many studies reported that SEMS placement for MCO is effective and safe compared to surgery on a short-term basis.[10–17]

According to the clinical guideline published by ESGE in 2020, SEMS placement for MCO is recommended as a BTS in patients with potentially curable left-sided MCO, as an alternative treatment to emergency surgery and as a palliative treatment. In addition, SEMS placement is weakly considered for proximal MCO either as BTS or as a palliative treatment.[18] However, the results of previous reports supporting SEMS placement for MCO as a BTS or palliative treatment are quite conflicting.[10–18]

First, we analyzed the clinical outcomes of SEMS placement for MCO either palliatively or preoperatively. In this study, technical and clinical success rates were 98.8% and 90.1%, respectively, with a 15.3% complication rate. Previous large, prospective, multicenter studies showed that clinical outcomes and complication rates reported were similar to our data.[10–17] These results indicate that SEMS placement for patients with MCO is an effective and safe treatment option, in terms of technical, clinical success, and complication rates.

Next, we investigated the predictive factors associated with the technical, clinical success rates, and development of complications of SEMS placement for MCO. Technical success in our study was defined as accurate SEMS placement over all parts of the obstructed colon without procedure-related adverse events. There was no significant independent predictive factor for the technical success of SEMS placement in multivariate logistic regression analysis except for procedure time.

A longer surgery time is a predictor of mortality and morbidity under an emergency circumstance such as MCO.[21] A large quantity of air insufflation consequent to prolonged procedure time is considered a risk factor for bowel perforation in SEMS placement.[22] However, a longer procedure time could be the result of technical failure. And so, it is not a rationale to conclude that the longer procedure time is a predictive factor for the technical success of SEMS placement. Clinical success was defined as clinical and radiological relief of obstruction within 48 hours after technically successful SEMS placement. Length of obstruction, type of stent, and procedure time were significant independent predictive factors for the clinical success of SEMS placement in multivariate logistic regression analysis. Previous studies showed that a longer length of obstruction was associated with more clinical and technical failure, and this is consistent with our results.[23–26] A possible explanation for this result is that a longer length of obstruction makes it more difficult to perform efficient passage of guidewires and devices through the obstructive lesion and to get efficient stent expansion because of a long stricture and the possibility of angular positioning of SEMS leading to longer procedure time. A comparative study of the surgery and SEMS placement in patients with long obstruction may be needed.

Stage of disease and type of stent were found to be significant independent predictive factors for developing complications after SEMS placement in multivariate logistic regression analysis. In previous studies, it was reported that incurable patients undergoing palliative treatment, and with stage IV colorectal cancer, had increased complications after SEMS.[27,28] MCO can result from a primary tumor obstructing the bowel lumen or from the extrinsic compression of the bowel by metastasis such as peritoneal metastasis. In addition, an impairment of intestinal mobility occurs frequently in patients with tumor infiltration of the peritoneum or mesentery. It is difficult to insert the colonoscope and position SEMS at the accurate site of obstruction.

SEMS can be classified into 2 types: covered and uncovered. Both types of stents have benefits and limitations. Stent migration is more common in covered stents and SEMS obstruction by tumor ingrowth or overgrowth is usually less common in covered stents compared to uncovered stents. Covered stents can prevent stent ingrowth, but a major concern is a migration. Previous studies showed that covered stents are more frequently associated with a lower success rate of preoperative colonoscopy proximal to the obstruction and a higher rate of complications in the management of MCO than that of the uncovered stent.[29–31] According to our data, the uncovered stent may be preferred as a covered stent was associated with developing complications. However, there are some limitations to our study. First, the major concern of our study is that the study design was a retrospective and nonrandomized observation, and selection biases were inevitable. Second, it was unavoidable that enrolled patients were heterogeneous. And so, a large prospective, multicenter, randomized control trial evaluating the efficacy of SEMS placement for MCO is required to provide more definitive evidence. Nevertheless, points of strength of our study were the inclusion of a large number of consecutive patients, who underwent SEMS placement for MCO, and our analyses extended to areas of interest such as predictors for technical success, clinical success, and development of complications.

5. Conclusion

Longer length of obstruction, the use of covered stent, and longer procedure time were associated with lower clinical success rates. Having stage IV colorectal cancer and the use of covered stents were associated with an increased risk of complications. SEMS placement for patients with MCO is an effective and safe treatment option, with high technical and clinical success rates.

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