Clinical Outcomes and Risk Factors for Technical and Clinical Failures of Self-Expandable Metal Stent (SEMS) Insertion for Malignant Colorectal Obstruction

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Clinical Outcomes and Risk Factors for Technical and Clinical Failures of Self-Expandable Metal Stent (SEMS) Insertion for Malignant Colorectal Obstruction

Directed by Professor Jae Hee Cheon

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Jin Young Yoon

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PURPOSE: Although self-expanding metal stent (SEMS) insertion is widely used for relief of malignant colorectal obstructions, immediate technical and clinical failure rates of SEMS and the associated risk factors remain largely unknown. The aim of this study was to identify rates and factors predictive of technical and clinical failure of SEMS when attempted for the decompression of malignant colorectal obstruction.

METHODS: A total 412 patients, including 276 as an approach of palliation in advanced disease and 136 as a bridge to curative surgery, were attempted to receive SEMSs insertion at Severance Hospital between November 2005 and December 2009. The definition of technical failure was incapablility to deploy a stent across the stricture. Clinical failure was defined as absence of the relief of obstructive symptoms.

RESULTS: Technical and clinical failures were found in 36 of 276 (13.0%) and 39 of 240 patients (16.3%) in the palliative group and in 3 of 136 (2.2%) and 7 of 133 (5.3%) of patients in the preoperative group, respectively. Factors associated with technical failure were extracolonic origin of tumor, presence of carcinomatosis, and proximal obstruction site. Factors associated with long-term clinical failure in the palliative group were combined dilation procedure, no additional chemotherapy, and extracolonic origin of tumor. In the preoperative group, only older patients had both higher technical and clinical failures rates.

CONCLUSIONS: Although colorectal SEMS placement is generally safe and effective, it is associated with clinically important technical and clinical failure rates. The identification of risk factors for the failure of colorectal SEMS found in this study might help physicians decide between surgical decompression and endoscopic stenting in patients with malignant colorectal obstruction.

Key words: self-expandable metal stent, colorectal obstruction, technical failure, clinical failure

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I. INTRODUCTION

The use of self-expanding metal stents (SEMS) as a non-surgical alternative for relief of obstructing colorectal cancer has increased. The two major indications for intervention are palliation of advanced disease and preoperative decompression.[1] Most studies have focused on the effectiveness and safety of SEMS, and have shown that stenting provides a safe single-stage surgical procedure while avoiding colostomy for patients who had received SEMS preoperatively.[2,3] SEMS also improves clinical outcomes and quality of life for patients undergoing palliative treatment.[4,5] Therefore, placement of SEMS as a tool for the initial management of obstructive colorectal cancer has been universally accepted.

Despite being generally accepted, evidence of the benefits from placement of

SEMS for malignant colorectal obstruction originated from uncontrolled trials and the serial collection of cases. A recent multicenter randomized clinical trial comparing endoscopic stenting and surgery was stopped early due to high complication rates for SEMS.[6] Other recent reports have shown that placement of SEMS was ineffective as an initial approach for malignant colorectal obstruction,[7-9] and other negative aspects have been demonstrated.[10] Although the success rate for stenting was relatively high, these data suggest that failures are not negligible in patients with obstructive colorectal cancer. Clearly both the positive and negative aspects of SEMS need to be further scrutinized. It is crucial to select an appropriate patient population that will potentially benefit from SEMS insertion for such studies. Unfortunately, these are no reports meeting these requirements in the literature. Predictive factors of colorectal SEMS failure are hard to detect in small-scale studies due to low failure rates. Thus, numerous reports dealing with successful SEMS have been published, while few reports exist on their failure.

Here we focus on aspects of stent failure in a large number of SEMS placements over the past five years. The aim of this study was to evaluate clinical outcomes including both technical and clinical failure rates (both immediate and long-term), and to identify risk factors associated with the failure of SEMS placement attempted for the decompression of malignant colorectal obstruction in a large sample of patients.

II. PATIENTS AND METHODS

Patients

An endoscopy database and clinical records from Yonsei University College of Medicine, Seoul, Korea were retrospectively reviewed. A total of 580 patients who were suspected of having acute colorectal obstruction underwent colonoscopic examination for stent insertion under fluoroscopic guidance between November 2005 and December 2009. Of these, 109 patients did not undergo SEMS insertion due to open lumina or multifocal strictures. Another 54 patients were excluded from the study because of benign lesions, and five patients were excluded because of a previous SEMS placement at another hospital. The remaining 412 patients were enrolled in our study, and had attempted stent placement for malignant colorectal obstruction. Patients receiving SEMS placement for palliative decompression were followed until their last visits or death, and those with preoperative decompression were observed until curative surgery was performed.

Data were sorted by three methods as follows: 1) patient-related variables including age, sex, occlusive degree, site of obstruction, etiology, drug (laxative, chemotherapy) use, and disease stage; 2) procedure-related variables including stent characteristics (type, length, and manufacturer), operator, and additional dilation therapy; and 3) outcome variables including technical failure, immediate and long-term clinical failures.

This study was approved by the institutional review board of the Severance

Hospital.

Endoscopic technique

Before placement of the colonic stent, all patients underwent a CT scan to evaluate the extent of the tumor and to assess the site, degree, and length of the obstruction. Stent placement was performed by one of nine endoscopists from our hospital as previously described.[1] When a placed stent did not expand, simultaneous additional dilation was occasionally performed using 8 or 10 mm balloons, according to the endoscopist's preference. Simple abdominal X-rays were obtained on the same day as well as the next day to confirm correct positioning and expansion.

Stent type was selected according to the preference and experience of each endoscopist. Stent length was selected by allowing for at least an additional 2 cm to be exposed distal and proximal to the obstructing lesion. The four types of stents used in our study were: 1) covered Niti-s colonic stent (Taewoong Medical, Seoul, Korea); 2) newly developed, covered Comvi stent (Taewoong Medical); 3) uncovered WallFlex colonic stent (Boston Scientific, Denver, CO, USA); and 4) uncovered Niti-s colonic D type stent (Taewoong Medical). The available lengths of WallFlex colonic stent were 6, 9, and 12 cm with expansion to a mid-body diameter of 22 or 25 mm. The available lengths of the other stents were 6, 8, 10, and 12 cm with expansion to 18, 20, or 22 mm.

Definitions

Technical failure was defined as failure to deploy the stent across the entire length of the colon stricture.[1] Immediate clinical failure was defined as the absence of resolution of obstructive symptoms (abdominal distension, vomiting, and abdominal pain) and passage of gas and stool within 96 hours despite achievement of technical success.[11] Long-term clinical failure was designated as the recurrence of obstructive symptoms necessitating reintervention after initial relief of obstructive symptoms and recovery of normal bowel function.[7,10]

The degree of obstruction was divided into two groups; total or subtotal obstruction.[1,12] Subtotal obstruction was defined as a state with narrow stool caliber or the ability to only pass small amounts of liquid stool or gas, and total obstruction was decreased or absent bowel sounds, or the inability to pass any stool or gas.

Operators were classified as colonoscopists or non-colonoscopists. Colonoscopists were defined as endoscopists whose major endoscopic procedure was colonoscopy. We determined whether carcinomatosis was present based on the CT scan results. Carcinomatosis was defined as the implantation of tumor nodules along the peritoneal surface and contrast enhancement of the parietal peritoneal lining, or loculated and/or septated ascitic fluid.[13]

Statistical analysis

Continuous variables were presented as the mean (±SD) or median (range) and compared using two-sample t-tests. Categorical variables were compared by chi-square tests or Fisher's exact tests. The binary logistic regression method was performed to identify risk factors for technical and immediate clinical failures of SEMS placement for multivariate analysis. The Kaplan-Meier method was used to generate the curve and identify the predictive factors of long-term clinical failure. Multiple risk variables of long-term clinical failure were assessed using the Cox regression analysis. P values of less than 0.05 were considered significant. Statistical analyses were performed using the statistical software package SPSS 12.0 for Windows (SPSS Inc., Chicago, IL, USA).

III. RESULTS

Patient characteristics

SEMS insertion was attempted in a total of 412 patients. Of these, 276 patients received SEMS as palliation in advanced disease and 136 patients received SEMS as bridge therapy before curative surgery. Baseline clinical and endoscopic characteristics are summarized in Table 1.

Table 1. Baseline characteristics of patients with acute malignant colorectal obstruction considered for self-expandable metal stent (SEMS) insertion.

	Palliative group n=276	Preoperative group n=136	Total n=412
Sex (M/F)	165/111 (59.8%/40.2%)	85/51 (62.5%/37.5%)	250/162 (60.7%/39.3%)
Age (years)	60.8 ± 0.8 (22-92)	60.9 ± 1.0 (26-86)	60.8 ± 0.7 (22-92)
Obstruction at diagnosis			
Yes	124 (44.9%)	133 (97.8%)	257 (62.4%)
No	152 (55.1%)	3 (2.2%)	155 (37.6%)
Degree of obstruction			
Total	190 (68.8%)	111(81.6%)	301 (73.1%)
Subtotal	86 (31.2%)	25 (18.4%)	111 (26.9%)
Obstruction site			
Left colon	208 (75.4%)	119 (87.5%)	327 (79.4%)
Right colon	68 (24.6%)	17 (12.5%)	85 (20.6%)
Procedure operator			
Colonoscopist	162 (58.7%)	98 (72.1%)	276 (67.0%)
Non-colonoscopist	114 (41.3%)	38 (27.9%)	136 (33.3%)
Stage			
No metastasis	0 (0.0%)	98 (72.1%)	98 (23.8%)
Single organ metastasis*	51 (18.5%)	33 (24.3%)	84 (20.4%)
Multiple metastasis	225 (81.5%)	5 (3.7%)	230 (55.8%)
Carcinomatosis			
Presence	170 (61.6%)	0 (0.0%)	173 (42.0%)
Absence	106 (38.4%)	136 (100%)	239 (58.0%)
Etiology			
Intrinsic	162 (58.7%)	136 (100%)	298 (72.3%)
Extrinsic	114 (41.3%)	0 (0.0%)	114 (27.7%)
Gastric	82 (71.9%)		
Gynecologic	13 (11.4%)		
Pancreatobiliary	12 (10.5%)		
Urogenital	6 (5.3%)		
Head and neck	1 (0.9%)		
Follow-up period (days)	135 (1-1160)	9 (1-352)**	

*** Liver or lung metastasis**

**** Until curative surgery was performed**

There were 250 male patients and the mean patient age was 60 years (range 22-92 years). The mean time between diagnosis of the underlying disease and stent placement in palliated patients with no obstruction at the time of diagnosis was 28.2±34.1 months. Primary colorectal cancer was present in

298 patients (72.3%) and 114 (27.7%) had metastatic lesions in the colorectum. The location of the obstruction was in the left colon in 327 patients (79.4%) and in the right colon in 85 (20.6%). Nine patients received two overlapping SEMS for long strictures.

Technical failure

Appropriate SEMS deployment technically failed in 36 of 276 patients (13.0%) in the palliative group and in 3 of 136 patients (2.2%) in the preoperative group. The etiologies of technical failure in the palliative group were the inability to pass the guidewire through the obstruction site in 27 patients (75%), difficulty in approaching the obstruction site due to colonic immobilization and severe pain in 8 patients (22%), and failure of dye passing because of non-expansion of SEMS in one patient (3%). Of these 36 patients with technical failure in the palliative group, 28 underwent palliative surgery, five underwent conservative management and four died of infections originating from the gastrointestinal tract. The only cause of technical failure in the preoperative group was inability to pass the guidewire in three patients. All three of these patients ultimately received emergency curative surgery.

Immediate clinical failure

In the palliative group, 39 of 240 patients (16.3%) experienced immediate clinical failure. The cause of immediate clinical failure was perforation in

seven patients (18%), serious pain related to stent insertion in two (5%), and unsuccessful decompression with fever, abdominal rigidity, or rebound tenderness due to recurrent colorectal obstruction originating from stent migration in two patients (5%). The remaining 28 patients with immediate clinical failure had no resolution of obstructive symptoms due to stent failure. Of these, there were seven cases of stent failure due to a very tight waist in the stent, which did not improve upon follow-up x-ray. Subsequent palliative surgery was performed in 29 of the patients, and 8 patients were closely observed only conservative care. The remaining two patients were lost to follow-up after discharge. In the preoperative group, immediate clinical failure occurred in 7 of 133 patients (5.3%). These patients underwent emergency curative surgery.

Long-term clinical failure

We evaluated the recurrence rates of clinically obstructive symptoms, namely long-term clinical failure, in patients who initially underwent clinically successful stent placement. Seventy-three (36.3%) of the 201 patients who achieved early clinical success with palliative SEMS insertion suffered long-term clinical failure. The most common causes of late clinical failure were tumor ingrowth and overgrowth (46 patients, 22.9%), followed by stent migration (18 patients, 9.0%). Eight patients (4.0%) suffered delayed perforation, and there was one case of bleeding originating from the SEMS

placement site. By the Kaplan-Meier method, cumulative rates of late clinical failure at 30, 90, and 180 days were 12.3%, 28.3%, and 37.9%, respectively (Fig. 1). The median duration from the time of SEMS insertion to the occurrence of long-term clinical failure was 287 days (range: 4-507 days).

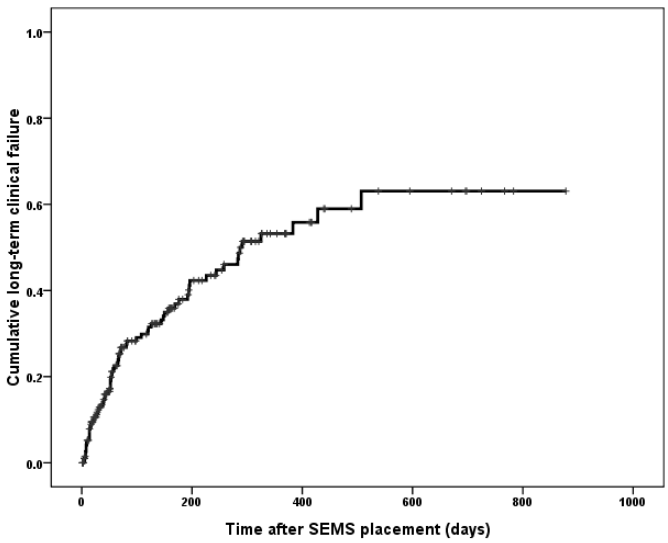

Figure 1. Cumulative rate of long-term clinical failure in the palliative group that achieved immediate clinical success of SEMS placement.

Of the 126 patients who initially achieved clinical success for preoperative SEMS insertion, four (3.2%) experienced long-term clinical failure at 6, 11, 84, and 92 days respectively. One case of long term clinical failure occurring at 6 days was due to insufficient deployment of SEMS, and the other three cases were due to stent migration.

Risk factors for stent failure

Significant variables predicting technical failure by univariate analysis were proximal obstruction site (right colon), presence of carcinomatosis, and extrinsic invasion from cancers other than colorectal cancer in the palliative group, but only older age (≥70 years) in the preoperative group (Table 2).

Table 2. Comparison of the risk factors between technical success and failure group

	Palliative group (n=276)			Preoperative group (n=136)		
	Success n=240 no. (%)	Failure n=36 no. (%)	P-value	Success n=133 no. (%)	Failure n=3 no. (%)	P-value
Sex (M/F)	141/99 (58.8/41.3)	24/12 (66.7/33.3)	0.366	83/50 (62.4/37.6)	2/1 (66.7/33.3)	1.000
Age (years)	61.1±13.8	58.8±14.0	0.338	60.5±12.0	76.7±4.9	0.022
Obstruction at diagnosis			0.254			1.000
Yes	111 (46.3)	13 (36.1)		130 (97.7)	3 (100)	
No	129 (53.8)	23 (63.9)		3 (2.3)	0 (0.0)	
Degree of obstruction			0.214			0.459
Total	162 (67.5)	28 (77.8)		109 (82.0)	2 (66.7)	
Subtotal	78 (32.5)	8 (22.2)		24 (18.0)	1 (33.3)	
Obstruction site			0.033			0.332
Left colon	186 (77.5)	22 (61.1)		117 (88.8)	2 (66.7)	
Right colon	54 (22.5)	14 (38.9)		16 (12.0)	1 (33.3)	
Procedure operator			0.051			1.000
Colonoscopist	160 (66.7)	18 (50.0)		96 (72.2)	2 (66.7)	
Non-colonoscopist	80 (53.8)	18 (50.0)		37 (27.8)	1 (33.3)	
Pathology			0.004			1.000
Differentiated	153 (63.8)	14 (38.9)		127 (95.5)	3 (100)	
Undifferentiated	87 (36.3)	22 (61.1)		6 (4.5)	0 (0.0)	
Stage			0.764			0.552
No metastasis	0 (0.0)	0 (0.0)		95 (71.4)	3 (100)	
Single organ metastasis	6 (16.7)	45 (18.8)		33 (24.8)	0 (0.0)	
Multiple organ metastasis	30 (83.3)	195 (81.3)		5 (3.8)	0 (0.0)	
Carcinomatosis			0.012			1.000
Presence	141 (58.8)	29 (80.6)		0 (0.0)	0 (0.0)	
Absence	99 (41.3)	7 (19.4)		133 (100)	3 (100)	
Etiology			0.010			1.000
Intrinsic	148 (61.7)	14 (38.9)		133 (100)	3 (100)	
Extrinsic	92 (38.3)	22 (61.1)		0 (0.0)	0 (0.0)	
Gastric	64 (70.0)	18 (81.9)				
Gynecologic	12 (13.0)	1 (4.5)				
Pancreatobiliary	10 (10.9)	2 (9.1)				
Urogenital	5 (5.4)	1 (4.5)				
Head & Neck	1 (1.1)	0 (0.0)				

Immediate clinical failure was found to be associated with older age (≥60 years) in the preoperative group and no related factors were found in the palliative group (Table 3). Any variables related to stent characteristics were not identified as predictive factors of immediate clinical failure in both groups.

Table 3. Comparison of the risk factors between immediate clinical success and failure group

	Palliative group (n=240)			Preoperative group (n=133)		
	Success n=201 no. (%)	Failure n=39 no. (%)	P-value	Success n=126 no. (%)	Failure n=7 no. (%)	P-value
Sex (M/F)	116/85 (57.7/42.3)	25/14 (64.1/35.9)	0.458	78/48 (61.9/38.1)	5/2 (71.4/28.6)	0.710
Age (years)	61.2±13.9	60.8±12.8	0.875	60.1±12.2	66.9±5.9	0.023
Obstruction at diagnosis			0.157			1.000
Yes	97 (48.3)	14 (35.9)		103 (81.7)	6 (85.7)	
No	104 (51.7)	25 (64.1)		23 (18.3)	1 (14.3)	
Degree of obstruction			0.621			1.000
Total	137 (68.2)	25 (64.1)		103 (81.7)	7 (100)	
Subtotal	64 (31.8)	14 (35.9)		23 (18.3)	0 (0.0%)	
Obstruction site			0.245			1.000
Left colon	153 (76.1)	33 (84.6)		111 (88.1)	6 (85.7)	
Right colon	48 (23.9)	6 (15.4)		15 (11.9)	1 (14.3)	
Procedure operator			0.265			0.673
Colonoscopist	137 (68.2)	23 (59.0)		90 (71.4)	6 (85.7)	
Non-colonoscopist	64 (31.8)	16 (41.0)		36 (28.6)	1 (14.3)	
Pathology			0.960			0.282
Differentiated	128 (63.7)	25 (64.1)		121 (96.0)	6 (85.7)	
Undifferentiated	73 (36.3)	14 (35.9)		5 (4.0)	1 (14.3)	
Stage			0.556			0.664
No metastasis	0 (0.0)	0 (0.0)		89 (70.6)	6 (85.7)	
Single organ metastasis	39 (19.4)	6 (15.4)		32 (25.4)	1 (14.3)	
Multiple organ metastasis	162 (80.6)	33 (84.6)		5 (4.0)	0 (0.0)	
Carcinomatosis			0.986			1.000
Presence	119 (59.2)	24 (61.5)		0 (0.0)	0 (0.0)	
Absence	82 (40.8)	15 (38.5)		126 (100)	7 (100)	
Etiology			0.986			1.000
Intrinsic	124 (61.7)	24 (61.5)		126 (100)	7 (100)	
Extrinsic	77 (38.3)	15 (38.5)		0 (0.0)	0 (0.0)	
Gastric	54 (70.1)	10 (66.7)				
Gynecologic	11 (14.3)	1 (6.7)				
Pancreatobiliary	8 (10.4)	2 (13.3)				
Urogenital	4 (5.2)	1 (6.7)				
Head & Neck	0 (0.0)	1 (6.7)				
Stent type			0.664			0.212
Covered	55 (27.4)	12 (30.8)		39 (31.0)	4 (57.1)	
Uncovered	146 (72.6)	27 (69.2)		87 (69.0)	3 (42.9)	
Stent manufacturer			0.354			0.374
Niti-s	41 (20.4)	6 (15.4)		22 (17.5)	3 (42.9)	
Niti-s D type	87 (43.3)	16 (41.0)		45 (35.7)	2 (28.6)	
Comvi	14 (7.0)	6 (15.4)		17 (13.5)	1 (14.3)	
WallFlex	59 (29.4)	11 (28.2)		42 (33.3)	1 (14.3)	
Length of stent (cm)			0.992			0.052
< 10cm	139 (69.2)	27 (69.2)		111 (88.1)	4 (57.1)	
≥ 10cm	62 (30.8)	12 (30.8)		15 (11.9)	3 (42.9)	

Combined balloon dilation			1.000		0.151
Without	190 (94.5)	37 (94.9)		124 (98.4)	6 (85.7)
With	11 (5.5)	2 (5.1)		2 (1.6)	1 (14.3)

Predictive factors for long-term clinical failure in the palliative group were identified through univariate analysis by the Kaplan-Meier method. Extrinsic invasion from extracolonic cancer, combined dilation therapy, and no additional chemotherapy were associated with long-term clinical failure (Fig. 2).

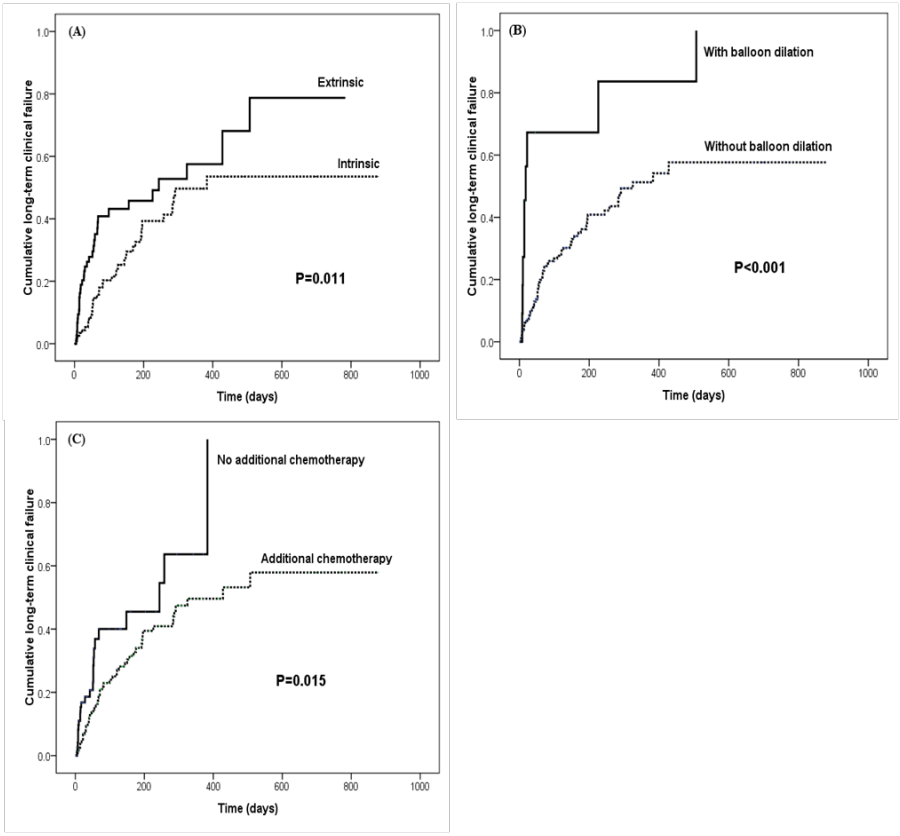

Figure 2. Kaplan-Meier curve of significant risk factors for long-term clinical failure in the palliative group. (A) Origin of colorectal malignancy, (B) combined balloon dilation, and (C) additional chemotherapy.

Other factors, including stent type (covered vs. uncovered), degree of obstruction (subtotal vs. total), obstruction site, and carcinomatosis, were not identified as predictive factors of long-term clinical failure. Also, there was no difference in long-term outcomes according to type of underlying cancer (colorectal cancer, gastric cancer, gynecologic cancer, and pancreatobiliary cancer). However, there was a significant difference not in perforation or stent occlusion but in the migration rate between the covered and uncovered stents (15% vs. 4.6%, p <0.001). Using a Cox multivariate regression model, combined dilation therapy and no additional chemotherapy were confirmed to be associated with higher potential to progress to clinical failure after SEMS placement (Table 4).

Table 4. Multivariate analysis of the risk factors for the failure of SEMS placement in palliative group

Risk factor	Odds ratio (95% CI)	P-value
Risk factors of technical failure*		
Obstruction site (right colon)	2.246 (1.063-4.745)	0.034
Origin of malignancy (extrinsic)	2.574 (1.245-5.318)	0.011
Carcinomatosis	2.831 (1.187-6.751)	0.019
Pathology (undifferentiated)	2.731 (1.322-5.642)	0.007
Risk factors of long-term clinical failure **		
Origin of malignancy (extrinsic)	1.134 (0.506-2.541)	0.761
Pathology (undifferentiated)	1.360 (0.609-3.036)	0.453
Combined balloon dilation	3.579 (1.678-7.636)	<0.001
Additional chemotherapy	0.518 (0.306-0.878)	0.015

*** Binary logistic analysis**
**** Cox regression analysis**

IV. DISCUSSION

To the best of our knowledge, this is the largest study focusing on the failure rates and associated predictive factors of SEMS with acute malignant colorectal obstruction ever performed at a single institution. The technical success rate was 87.0% in the palliative group and 97.8% in the preoperative group. The technical success rate of palliative SEMS placement was slightly lower, but that of preoperative SEMS placement seemed to be slightly higher than those found in previous colorectal stent studies, where the median success rate was 96.2% (ranging from 66.6% to 100%).[13] In our study, the immediate clinical success rate was 83.7% in the palliative group and 94.7% in the preoperative group, which is also slightly lower in the palliative group and higher in the preoperative group compared with previous reports of a median clinical success rate of 92% (ranging from 46% to 100%).[13] In contrast, Sebastian et al. reported a 91.9% technical success rate of stent insertion in the preoperative group, which was slightly lower than that in the palliative group (93.4%). However, this report was a pooled analysis of studies conducted between January 1990 (when the SEMS was first introduced) and May 2003.[2] In the early period, SEMS placement was more frequently performed for bridge operation than for palliation. Thus, the higher technical failure rate in the preoperative group than palliative group may be a time-dependent bias owing to the differences in stent indications and

population selection, as well as the less developed techniques and tools at that time. Along with advances in stenting technology, later published reports confirmed that the preoperative group had a significantly lower or similar failure rate compared to the palliative group.[1,13,32,33] The results from our article concerning stents performed between November 2005 and December 2009 were comparable to the recent data. Moreover, our excellent success rate for preoperative stenting may be partly attributed to the fact that colorectal surgeons in our hospital perform stent insertion even on patients in relatively good condition. One report noted that one limitation of retrospective studies is that clinics with high volumes of emergency referrals tend to perform emergency surgery on patients in relatively good condition and refer only patients in generally poor condition for SEMS.[7] The inferior rate of immediate clinical success could be explained by the larger percentage (41.3%) of patients who received palliative SEMS with extrinsic origin in this study compared to the portions in other reports (ranging from 23% to 32%).[1,2,10,14-16] Our study is in agreement with a considerable number of previous reports which found lower clinical success rates of colorectal obstruction for extracolonic malignancy compared to intracolonic malignancy.[2,15,16] Overall, despite the relatively small differences we found, our results for SEMS placement were comparable with those of previously published studies considering various conditions.

In our study, symptoms improved within 24 hours in 288 patients (88.1%),

48 hours in 26 (8.0%), 72 hours in 10 (3.1%), and 96 hours in three (0.9%). Surgery can be postponed until 96 hours after stent insertion. If obstructive symptoms do not disappear in 24 hours despite appropriate stent deployment, we may consider rectal tube placement for the management of ileus.

Previously published long-term clinical failure rates of SEMS placement are 9% at 1 month, 19-51% at about 3 months, and 23-47% at 6 months.[7,10,17] Our numbers for long term clinical failure rates of palliation at 1, 3, and 6 months were 12.3%, 28.3%, and 37.9% respectively, which correspond well with previous results. The median duration until long-term clinical failure was referred to as stent patency in other studies, and was estimated to be 106 days (range, 68-288 days).[4,13] We found a longer median duration of 287 days, possibly because our analysis targeted only those patients who already showed immediate clinical success. In addition, stent deployment was conducted by experts who were experienced in a large volume of cases, which may have exerted a favorable effect.

We sought to identify risk factors associated with immediate and long-term failures after SEMS placement. Risk factors for technical failure were proximal obstruction site, presence of carcinomatosis, and extracolonic origin. We did not identify predictive factors for immediate clinical failure in the palliative setting. The lack of factors associated with clinical failure in our study suggests that appropriate deployment of SEMS through the entire stricture lesion has a far greater effect on SEMS function than clinical factors.

Another report also mentioned the possibility that clinical failure was not associated with any patient or tumor-related factors.[7]

Notably, no stent characteristics, including stent type, manufacturer, and length, appeared to affect either immediate or long-term clinical failures in our study. Covered stent are generally associated with a higher chance of immediate failure due to poor prevention of stent migration, and uncovered stents may cause long-term failure due to ingrowth of tumors.[19,28,29] However, there have been several studies reporting no significant effects on overall outcomes by different stent types.[2,20,30] In our study, the immediate and long-term failures of SEMS placement were not associated with stent type (covered vs. uncovered). Also, the four different brands of SEMS used in this study had similar rates of clinical failure. Previous reports found a correlation between stent length or diameter and outcome.[10,13,31] It was reported that the larger the diameter of the SEMS, the higher the chance of perforation,[27] and the shorter the length of the SEMS (<10 cm), the better the long-term outcomes.[14] Nevertheless, neither immediate nor long-term failures were affected by the length of SEMS in this study.

The most common cause of technical failure in our study was the inability to pass the guidewire through the obstruction site and the second most common cause was a difficult approach to the obstruction site. Peritoneal carcinomatosis resulting in bowel immobilization may have contributed to increased technical failure of SEMS placement in patients with malignant

colorectal obstructions.[3,18] In addition, extracolonic origin may also have caused increased probability of carcinomatosis.[15] These findings are important, as they provide concrete evidence regarding predictive factors associated with stent failure, as opposed to conjecture. There have been various reports comparing the success rates of SEMS placement for intrinsic and extrinsic malignancies. Some reports found little difference in the success or complication rates between these two groups,[10,19,20] while others found lower success rates and higher complication rates for SEMS placement for extrinsic colorectal obstructions.[2,15,16] Keswani et al.[15] recently reported an 80% technical and 20% clinical success rate for SEMS placement for extrinsic colorectal malignancy, and concluded that SEMS placement for extrinsic colorectal malignancy was less successful. On the contrary, Shin et al.[19] found an 87% technical and 82% clinical success rate for extrinsic colorectal malignancy, which was comparable to those of intrinsic colorectal malignancy. Our study revealed an 80.7% (92/114) technical and 83.7% (77/92) clinical success rate of SEMS placement for colorectal obstruction caused by extrinsic tumors. These data were similar to previously reported success rates. We also identified extrinsic colorectal obstruction as a risk factor not of immediate but of long-term clinical failure. Since the successful deployment of SEMS impacts technical failure rates, the extrinsic effect might not be important for immediate clinical outcomes. However, for long-term clinical outcomes, the clinical success of SEMS placement could be affected by the luminal mucosa

of extrinsic colorectal obstructions being less friable than that of intrinsic obstructions.

The influence of the obstruction site on clinical outcomes of colonic stenting has also been investigated. There have been reports indicating that the proximal colon is less amenable to stenting,[14,21] and others indicating that the distal colon hosts more frequent complications.[10] Another report found no difference between proximal and distal obstruction of colorectal malignancy in terms of technical and clinical success rates.[12] Our study showed that SEMS implantation within the proximal colon achieved 79.4% technical success in the palliative group and 88.9% in the preoperative group, which are comparable to previous studies.[12,14] However, compared with the higher number of distal obstructions with a higher technical success rate of 89.4% in the palliative group and 98.3% in the preoperative group, obstruction of the proximal hemicolon was found to be a risk factor for technical failure in the palliative group.

Earlier studies found that SEMS placement in older patients is as safe and effective as in young patients.[10,22] Our study confirmed that failure of SEMS placement was not related to age in a palliative setting. However, in a preoperative setting, older patients had higher technical and clinical failure rates. One explanation may be that the passage of the guidewire through the obstruction site was difficult because of severe angulation due to bowel redundancy in elderly patients.[23]

In terms of the operator effect, higher complication rates have been found for endoscopists lacking experience with pancreaticobiliary endoscopy.[10] Thus, learning of the basic skills required to perform complex strictures under fluoroscopy guidance has been helpful in manipulating colonic stents. Our study differed from previous studies in that all operators had already been trained in endoscopic skills under fluoroscopy. They also specialized in specific organs (upper GI, lower GI, pancreatobiliary, and hepatology) in our center. Since the main difference among operators in our study was the proportion of colonoscopic procedures performed during their routine endoscopic workload, we divided them into two groups: colonoscopists and non-colonoscopists. Colonoscopic endoscopists perform a larger number of colorectal stent insertions and are considered to be the most experienced with colorectal stent insertion in our clinic. Palliative SEMS placement by colonoscopists showed a tendency towards lower rates of technical failure than that by non-colonoscopists ($p=0.051$), reflecting that technical failures are mostly influenced by the operator's expertise. We hypothesize that the colonoscopists were more skilled at the colonoscopic approach and at manipulation of the guidewire, given their extensive experience.[24,25]

In the palliative group with immediate clinical success of SEMS placement, we showed that combined dilation therapy and no additional chemotherapy were predictive factors of long-term clinical failure. A higher rate of long-term clinical failure in SEMS deployment with dilation was previously shown to

occur due to delayed perforation.[1,10,26] Recent recommendations are to avoid combined dilation before or after SEMS insertion is performed.[26,27] Early in our study, we occasionally employed combined balloon dilation if SEMS was deployed incompletely. Our results confirmed that combined dilation was unfavorable in terms of long-term outcome for SEMS placement. However, combined balloon dilation may have been associated with poor prognosis because it was generally performed for more severe strictures.

The effects of chemotherapy after SEMS placement are controversial. One study was closed prematurely because chemotherapy induced colonic perforation in 54% (6/11) of patients.[6] Another report found, in contrast, that complications including perforation and stent migration were not associated with additional chemotherapy.[7] However, these results were limited by the small numbers of patients included. In our study of 126 patients who achieved immediate clinical success of palliative SEMS placement, cumulative long-term clinical failure occurred more frequently in patients who did not receive post-stent chemotherapy than in those who received chemotherapy. In other words, receiving additional chemotherapy after palliative stenting contributed to long-term clinical success. This may have been caused by the effects of tumor shrinkage from chemotherapy.[17] This hypothesis was indirectly supported by our sub-analysis. Although there was no difference in the long-term clinical failure rate according to cancer subtype, differentiated ones (well- and moderately-differentiated adenocarcinoma) had a lower

long-term clinical failure rate than undifferentiated ones (poorly differentiated adenocarcinoma, signet-ring cell carcinoma, etc.), which are generally regarded as rapidly progressive and less chemo-responsive tumors.

Our study has several limitations. First, its retrospective nature and location at a single tertiary center could introduce bias affected by such study designs. Second, nine different operators with various levels of experience participated in SEMS placement. Third, because only three technical failures and seven clinical failures occurred in preoperative group, we could not completely exclude the possibility that actually significant variables may have been shown to be insignificant in our analysis due to the small number of events.

V. CONCLUSION

Our study involved the largest number of patients with malignant colorectal obstruction attempting to receive endoscopic SEMS placement at a single center ever included in a single study. This ensured an adequate number of failed SEMS placements, allowing us to assess clinical outcomes and predictive factors for the failure of SEMS despite its generally low failure rate. Although colorectal SEMS placement is safe and effective overall, it involves technical and clinical failure rates that should not be ignored. The identification of risk factors for the failure of colorectal SEMS found in this study might help physicians to make individualized decisions between surgical decompression and endoscopic stenting.

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< ABSTRACT (IN KOREAN)>

악성 대장 폐쇄에서 자가 팽창형 금속 스텐트 삽입시 임상 경과와 기술적 및 임상적 실패에 대한 인자 분석

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<목적> 자가 팽창형 금속 스텐트는 악성 대장 폐쇄의 치료로 널리 사용되고 있지만 기술적 실패 및 임상적 실패와 관련된 인자들에 대해서는 알려져 있지 않다. 본 연구는 악성 대장 폐쇄 증상을 보이는 환자들에게 스텐트 삽입을 시도한 후 실패율과 그에 관련된 인자를 분석하고자 하였다.

<대상 및 방법> 2005년 11월부터 2009년 12월까지 신촌 세브란스 병원에서 진행성 병변으로 인해 완치가 불가능한 고식적 목적으로 스텐트를 삽입한 276명의 환자와 완치 목적의 수술을 시행하기 전 스텐트 삽입을 받은 136명을 포함하여 총 412명의 환자를 대상으로 후향적으로 분석하였다. 기술적 실패는 폐쇄 부위 전체를 통과하는 스텐트의 배치가 불가능할 경우로 정의하였고, 단기 임상적 실패는 기술적으로 스텐트 삽입을 시행한 후 폐쇄 증상에 대한 호전이 없을 경우로 정의하였으며, 장기 임상적 실패는 단기 임상적 성공 후 대장 폐쇄가 다시 발생하는 경우로 정의하였다.

<결과> 고식적 목적의 스텐트 삽입시 기술적 실패율은 13.0% (36/276), 임상적 실패율은 16.3% (39/240) 이었다. 수술 전 목적인 경우 기술적 실패율은 2.2% (3/136), 임상적 실패율은 5.3% (7/133) 이었다. 고식적 목적인 경우 기술적 실패와 관련된 인자는 대장 외에서 기원한 암인 경우, 복막 암종증이 존재하는 경우, 대장의 근위부인 경우였다. 단기 임상적 실패와 관련된 인자는 없었으며, 장기 임상적 실패와 관련된 인자는 풍선 확장술을 동시에 시행한 경우, 추가적인 항암치료가 없었던 경우, 그리고 대장 외에서 기원한 암인 경우이었다. 수술 전 목적인 경우 기술적 및 임상적 실패와 관련된 인자는 모두 고령인 경우이었다.

<결론> 악성 대장 폐쇄에서 자가 팽창형 금속 스텐트는 일반적으로 안전하고 효과적으로 알려져 있지만 기술적 및 임상적 실패에 대한 분석은 실제 임상에서 중요한 부분이다. 본 연구를 통하여 스텐트 삽입시 실패에 대한 인자들을 분석하여 임상의 들에게 스텐트와 수술 사이에서 치료 방법을 결정하는데 중요한 정보를 제공할 수 있다.

핵심되는 말 : 자가 팽창형 금속 스텐트, 대장 폐쇄, 기술적 실패, 임상적 실패