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ORIGINAL ARTICLE

Benefits of using a self-expandable metallic stent as a bridge to surgery for right- and left-sided obstructive colorectal cancers

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Abstract

Purpose To assess the benefit of placing a self-expandable metallic stent (SEMS) as a bridge to surgery for obstructive colorectal cancer (OCRC) according to the tumor site.

Methods The subjects of this retrospective multicenter cohort study were 201 patients with OCRC, but without initial bowel perforation, who were treated either with a self-expandable metallic stent (SEMS) as a bridge to surgery ($n = 109$) or with primary surgery (PS; $n = 92$) between 2014 and 2016. The cohort consisted of 68 patients with right-sided and 133 left-sided OCRC. We evaluated the short-term surgical outcomes for each side.

Results The SEMS group of patients with left-sided OCRC had significantly higher rates of primary resection, primary resection with anastomosis, stoma-free surgery, and laparoscopic surgery than the PS group of patients with left-sided OCRC. In contrast, the SEMS group of patients with right-sided OCRC had only a significantly higher rate of laparoscopic surgery than the PS group of patients with right-sided OCRC, but they had a longer overall hospital stay. There were no significant differences between the two treatment groups in the rates of morbidity or mortality, for either right-sided or left-sided OCRC.

Conclusion The benefit of a SEMS as a bridge to surgery may be less for right-sided than for left-sided obstructions in colon cancer patients.

Keywords Self-expandable metallic stent (SEMS) · Bridge to surgery · Colorectal cancer

The members of "Clinical Study Group of Osaka University (CSGO), Colorectal Group" are listed in acknowledgement section.

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Introduction

Intestinal obstruction is the presenting manifestation in 15–20% of patients with colorectal cancers (CRCs) [1, 2]. Emergency surgery has been the standard treatment for obstructing colorectal cancer (OCRC); however, it is associated with high rates of mortality (15–20%), morbidity (40–50%), stoma formation, and poor long-term survival [3]. Although lower mortality rates of 1.3–6.9% were reported recently for emergency surgery, a stoma was still required in 38–60% of patients with left-sided OCRC [4, 5]. In recent years, the use of a self-expandable metallic stent (SEMS) as a bridge to surgery (BTS) has increased. Many authors have reported that SEMS placement as a BTS improved the short-term surgical outcomes for left-sided OCRC. A meta-analysis of seven randomized controlled trials comparing stenting as a BTS vs. emergency surgery for left-sided OCRC revealed significant reductions in the rates of permanent stoma and wound infection, and an increase in one-stage surgery rates, although, there was no significant difference in mortality rates [6]. While there are concerns about detrimental oncological effects from stenting, this continues to be an attractive alternative to emergency surgery [7, 8]. However, only a few reports have compared SEMS placement in the proximal colon as a BTS for OCRC vs. emergency surgery. Thus, we evaluated the benefit of a SEMS as a BTS according to the tumor site in a multicenter cohort of OCRC patients.

Methods

Patients

We reviewed, retrospectively, data from 4191 patients who underwent surgery for CRC at 24 hospitals that were part of the Clinical Study Group of Osaka University (CSGO) Colorectal Group. Surgical procedures were performed for 1952 patients at 19 hospitals in 2014, and for 2239 patients at 5 hospitals between 2014 and 2016. A total of 303 patients (7.2%) had OCRC diagnosed, based on imaging confirmation and the presence of several cancer-related acute obstructive symptoms, including obstipation, abdominal distention, nausea, and vomiting. Among them, 197 were treated for bowel decompression by SEMS ($n = 109$) or an intestinal tube ($n = 88$) as a BTS. One patient was treated initially with a SEMS, but not as a BTS, and eventually underwent surgery after the stent was occluded by tumor regrowth. Primary surgery (PS) was performed in 105 patients. 13 patients with perforation or penetration identified at their initial presentation were treated with PS. In this study, we examined 201 patients without initial perforation or penetration, 109 treated with SEMS as a BTS, and 92 with PS. There were 68 patients with right-sided OCRC (28 in the SEMS group and 40 in the PS group), and 133 with left-sided OCRC (81 in the SEMS group and 52 in the PS group).

Assessment

We evaluated the short-term surgical outcomes, including the rates of primary resection (PR), primary resection with anastomosis (PRA), stoma-free surgery, laparoscopic surgery, operation time, blood loss, mortality, and morbidity. The overall hospital stay, including admissions for SEMS insertion and surgery, and postoperative hospital stay were also compared. Details about the patient profiles, tumor demographics, and treatments were collected from the clinical databases or medical records of each institution. Clinical success of the SEMS was defined as successful decompression of the proximal bowel with confirmation of defecation within 3 days after placement.

Tumors in the colon proximal to the splenic flexure were considered right-sided, whereas those in the left colon and the rectum were considered left-sided. The severity of obstruction was evaluated according to the ColoRectal Obstruction Scoring System (CROSS) as follows: 0, requiring continuous decompression; 1, no oral intake; 2, liquid or enteral nutrient intake; 3, soft solids, low-residue, and full diet with symptoms of stricture; and 4, soft solids, low-residue, and full diet without symptoms of stricture [9]. Associated obstructive colitis was diagnosed comprehensively by clinical and pathological findings. When analyzing morbidity, ileus or small bowel obstruction was defined as enteral stasis requiring drainage or surgery. Overall morbidity was defined as the presence of any of the following: wound infection, intraabdominal abscess, ileus or small bowel obstruction, anastomotic leakage, and other complications of grade 3 or more in the Clavien-Dindo classification [10]. The differences in outcomes between the SEMS and PS groups were examined for the patients with right-sided and those with left-sided OCRC. The human ethics review committee of each institution approved the study.

Statistical analysis

The binomial and polynomial factors were compared using Fisher's exact test and Pearson's chi-squared test, respectively. Student's t test and Mann–Whitney U test were used for the comparison of age and the other continuous variables, respectively. A p value of less than 0.05 was considered significant.

Results

Clinical characteristics

Table 1 summarizes the clinical characteristics and tumor demographics of the 201 patients. The tumor locations differed significantly between the SEMS and PS groups in the patients with right-sided OCRC, as stenting was not performed for OCRC in the cecum. There were significantly more CROSS0 patients in the SEMS group (75%) than in the PS group (50%) among those with left-sided OCRC. There were no significant differences in the other factors between the SEMS and PS groups.

Stenting outcomes

Table 2 shows the stenting outcomes. A stent was not used in 3 of the 109 patients in the SEMS group because a guidewire could not be passed through the tumor stricture. A WallFlex (Boston Scientific Corporation, MA, USA) was placed in 72 patients and a Niti-S (TaeWoong MEDICAL, Gimposi, Korea) was placed in 34 patients. The technical success rates were 100 and 96% for the patients with right-sided and those with left-sided OCRC, respectively. The clinical success rates were 96 and 91%, respectively. There was no morbidity among the patients with right-sided OCRC, but it was 14% in the group of patients with left-sided OCRC, and included perforation ($n=2$), stent occlusion ($n=4$), and stent migration ($n=2$). There were no lethal adverse events.

Table 1 Patient and tumor characteristics

	Right-sided			Left-sided		
	SEMS	PS	*p*	SEMS	PS	*p*
	n = 28	*n* = 40		*n* = 81	*n* = 52	
Mean age ± SD (year)	74 ± 12	70 ± 14	0.30	70 ± 13	70 ± 11	0.91
Sex, *n* (%)						
Male	10 (36)	15 (38)	1.0	41 (51)	27 (52)	1.0
Female	18 (64)	25 (63)		40 (49)	25 (48)	
ASA class, *n* (%)						
ASA1	7 (25)	12 (30)	0.79	30 (37)	21 (40)	0.57
ASA2	19 (68)	24 (60)		38 (47)	19 (37)	
ASA3	2 (7.1)	4 (10)		11 (14)	11 (21)	
ASA4	0 (0)	0 (0)		2 (2.5)	1 (1.9)	
Tumor site, *n* (%)						
Cecum	0 (0)	9 (23)	0.026	–	–	
Ascending	11 (39)	13 (33)		–	–	
Transverse	17 (61)	18 (45)		–	–	
Descending	–	–		22 (27)	8 (15)	0.076
Sigmoid	–	–		34 (42)	26 (50)	
Rectosigmoid	–	–		15 (19)	6 (12)	
Upper rectum	–	–		9 (11)	7 (14)	
Lower rectum	–	–		1 (1.2)	5 (9.6)	
TNM stage, *n* (%)						
I	1 (3.6)	0 (0)	0.44	0 (0)	0 (0)	0.93
II	6 (21)	11 (28)		29 (36)	18 (35)	
III	10 (36)	18 (45)		27 (33)	19 (37)	
IV	11 (39)	11 (28)		25 (31)	15 (29)	
Severity of obstruction [9], *n* (%)						
CROSS0	22 (79)	26 (65)	0.40	61 (75)	26 (50)	0.011
CROSS1	6 (21)	13 (33)		17 (21)	21 (40)	
CROSS2	0 (0)	1 (3.0)		3 (3.7)	5 (9.6)	
Associated obstructive colitis, *n* (%)						
(+)	4 (14)	4 (10)	0.71	13 (16)	12 (23)	0.37
(−)	24 (86)	36 (90)		68 (84)	40 (77)	

SEMS self-expandable metallic stent; *PS* primary surgery; *ASA* American Society of Anesthesiologists; *CROSS* ColoRectal Obstruction Scoring System

Table 2 Stenting outcomes

	Right-sided $n=28$	Left-sided $n=81$	Total $n=109$
Technical success, *n* (%)	28 (100)	78 (96)	106 (97)
Clinical success, *n* (%)	27 (96)	74 (91)	101 (93)
Morbidity, *n* (%)	0 (0)	11 (14)	11 (10)
Perforation, *n* (%)	0 (0)	2 (2.5)	2 (1.8)
Stent occlusion, *n* (%)	0 (0)	4 (4.9)	4 (3.7)
Stent migration, *n* (%)	0 (0)	2 (2.5)	2 (1.8)
Other complications[a], *n* (%)	0 (0)	4 (4.9)	4 (3.7)

SEMS self-expandable metallic stent

[a]Includes two cases of hematochezia, one case of progression of anemia without identified causes and one case of fever of uncertain origin

The median interval from stenting to surgery was 18 days (range 0 to 84 days). Fifty patients with SEMS placement were discharged temporarily before surgery.

Surgical outcomes

Among the patients with left-sided OCRC, the SEMS group had significantly higher rates of PR, PRA, stoma-free surgery, and laparoscopic surgery than the PS group (99% vs. 81%; $p<0.001$; 77% vs. 52%; $p=0.0045$; 69% vs. 48%; $p=0.018$; and 58% vs. 21%; $p<0.001$, respectively; Table 3). In contrast, among the patients with right-sided OCRC, the SEMS group was superior to the PS group only in the rate of laparoscopic surgery (57% vs. 7.5%, respectively; $p<0.001$). Although the SEMS group had higher rates of PR, PRA, and stoma-free surgery than the PS group (100% vs. 93%, 96% vs. 85%, and 96% vs. 90%, respectively), the differences were not significant and were much less than in the patients with left-sided OCRC. The operation

Table 3 Surgical outcomes

	Right-sided			Left-sided		
	SEMS $n=28$	PS $n=40$	*p*	SEMS $n=81$	PS $n=52$	*p*
Surgery						
Primary resection, *n* (%)	28 (100)	37 (93)	0.26	80 (99)	42 (81)	<0.001
Primary resection with anastomosis, *n* (%)	27 (96)	34 (85)	0.23	62 (77)	27 (52)	0.0045
Ileo-colonic or ileo-rectal anastomosis	12 (44)	24 (71)		1 (1.6)	3 (11)	
Colocolonic or colorectal anastomosis	15 (56)	10 (29)	0.066	61 (98)	24 (89)	0.081
Stoma-free surgery, *n* (%)	27 (96)	36 (90)	0.64	56 (69)	25 (48)	0.018
Laparoscopic surgery, *n* (%)	16 (57)	3 (7.5)	<0.001	47 (58)	11 (21)	<0.001
Resectability, *n* (%)						
R0	16 (57)	28 (70)	0.094	56 (69)	32 (62)	0.17
R1	3 (11)	0 (0)		0 (0)	2 (3.8)	
R2	9 (32)	12 (30)		25 (31)	18 (35)	
Operation time, min, median (range)	207 (99–465)	167 (90–301)	0.085	221 (105–521)	185 (43–381)	0.059
Blood loss, ml, median (range)	119 (0–500)	94 (5–1550)	0.81	127 (0–4500)	138 (0–2010)	0.87
Mortality and morbidity						
In-hospital mortality, *n* (%)	0 (0)	1 (2.5)	1.0	1 (1.2)	2 (3.8)	0.56
Overall morbidity, *n* (%)	3 (11)	10 (25)	0.21	16 (20)	16 (31)	0.15
Wound infection, *n* (%)	3 (11)	7 (18)	0.51	9 (11)	6 (12)	1.0
Intraabdominal abscess, *n* (%)	1 (3.6)	2 (5.0)	1.0	5 (6.2)	4 (7.7)	0.74
Ileus or small bowel obstruction, *n* (%)	1 (3.6)	3 (7.5)	0.64	7 (8.6)	7 (14)	0.40
Anastomotic leakage, *n* (%)	0 (0)	1 (2.5)	1.0	2 (3.2)[a]	1 (3.7) [a]	1.0
Other complications (≥ grade 3)[b]	1 (3.6)	0 (0)	0.41	3 (3.7)	4 (7.7)	0.43
Reoperation, *n* (%)	0 (0)	0 (0)	–	3 (3.7)	2 (3.8)	1.0
Overall hospital stay, median days (range)	29 (13–66)	18 (7–86)	0.015	29 (14–199)	25 (9–101)	0.16
Postop hospital stay, median days (range)	13 (7–50)	15 (7–77)	0.41	15 (3–191)	19 (8–101)	0.030

SEMS self-expandable metallic stent; *PS* primary surgery; *Postop* postoperative

[a] Percentage of cases with primary anastomosis. [b] Complications of grade 3 or more in the Clavien-Dindo classification

time tended to be longer in the SEMS group than in the PS group for patients with right-sided and those with left-sided OCRC, probably because of the increased use of laparoscopic procedures. The operative blood loss was not significantly different between the two treatment groups for both tumor sites.

In-hospital deaths were relatively rare and there were no significant differences in the mortality rates of the SEMS and PS groups, for patients with right-sided or left-sided OCRC. The rates of overall morbidity were not significantly different between the SEMS and PS groups, for the patients with right-sided (11% vs. 25%, respectively) or left-sided (20% vs. 31%, respectively) OCRC. We did not observe significant differences between the SEMS and PS groups in the rates of wound infection, intraabdominal infection, ileus or small bowel obstruction, or other complications of grade 3 or more using the Clavien-Dindo classification system. Reoperation was done for three SEMS patients and two PS patients.

The overall hospital stay was significantly shorter for the PS group than for the SEMS group of patients with right-sided OCRC (median days: 18 vs. 29, respectively; $p=0.015$). In contrast, the postoperative hospital stay of the patients with left-sided OCRC was significantly shorter for the SEMS group than the PS group (median days: 15 vs. 19, respectively; $p=0.030$).

Discussion

Many reports have shown the benefits of a SEMS as a BTS, but there is little evidence of its benefits for a right-sided obstruction. Amelung et al. performed a population-based analysis of the Dutch surgical colorectal audit between January, 2009 and December, 2013, which included 44 patients treated with a SEMS as a BTS and 1774 patients who underwent acute resection for malignant obstruction of the proximal colon. They observed a significant reduction in the surgical morbidity rate (27% in the SEMS group and 40% in the PS group), as well as in the mortality rate (2.4% in the SEMS group and 8.8% in the PS group). They concluded that a SEMS as a BTS was a feasible alternative for some patients with right-sided OCRC [11]. Kye et al. compared the postoperative outcomes and long-term oncologic outcomes of stage II or III right-sided OCRC, between a SEMS group ($n=25$) and an emergency surgery group ($n=74$) from seven hospitals. They observed similar surgical results in the two groups, with no postoperative mortality and low morbidity rates (19% in the emergency group and 24% in the SEMS group), suggesting that a BTS method is an alternative treatment option. Perforation occurred after stenting in one patient (4%) [12].

In this study, stenting in the proximal colon did not seem to be technically difficult. The reported rates of technical and clinical success in the proximal colon were 86–96% and 78–96%, respectively, and the rates of perforation were low (0–5%) [13–16]. A recent prospective multicenter study in Japan showed a high clinical success rate of 96% (134/139) in the proximal colon [9]. We observed significant benefits from the SEMS in the rates of PR, PRA, stoma-free surgery, and laparoscopic surgery in the patients with left-sided OCRC in this study. On the other hand, we did not observe significant advantages of SEMS in relation to the rates of PR, PRA, and stoma-free surgery for the patients with right-sided OCRC, although, their rate of laparoscopic surgery was significantly higher. Furthermore, the right-sided OCRC SEMS group had a longer overall hospital stay than the corresponding PS group because of the prolonged preoperative period.

We speculate that the lower benefit of SEMS for right-sided OCRC was mainly due to the more favorable short-term outcomes of PS for right-sided OCRC than for left-sided OCRC. In the PS group, the rates of PR, PRA, and stoma-free surgery were all lower for the patients with right-sided OCRC than for those with left-sided OCRC, suggesting that fewer patients with right-sided OCRC benefit from stenting. In a systematic review of right-sided obstructions, the mean mortality of patients who underwent acute resection with primary anastomosis was 10.8% (8.1–18.5%), which was much higher than that in this study [17]. According to a report based on the National Clinical Database, the 30-day mortality rate of 1285 Japanese patients who underwent emergency right hemicolectomy in 2011 was 6.0% [18]. As SEMS placement in the proximal colon seems technically feasible with low morbidity, stenting might be a valid alternative for patients with right-sided OCRC at high risk of PS due to factors such as advanced age and a high ASA score, as recommended for left-sided obstructions [7].

The main limitation of this study is the small number of patients with right-sided OCRC undergoing SEMS placement as a BTS. Similarly, Amelung et al. could find only 44 patients treated with a BTS for right-sided OCRC in the Dutch surgical colorectal audit, which is a national CRC registry of 49,014 patients, treated between 2009 and 2013 [11]. This study may also have limitations common to retrospective studies, such as selection bias for the treatments.

In conclusion, our data suggest that using a SEMS as a BTS is of less benefit for patients with right-sided OCRC vs. for those with left-sided OCRC.

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Compliance with ethical standards

Conflict of interest Shunji Morita and his co-authors have no conflicts of interest to declare.

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