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Elective Surgery After Endoscopic Self-Expandable Metallic Stent Placement for Patients With Obstructive Colon Cancer: Preoperative Systemic Evaluation and Management

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One-stage curative surgical resection for obstructive colon cancer is challenging. Self-expandable metallic stents (SEMSs) are known as an alternative treatment used to avoid emergency operation. We aimed to evaluate the significance of SEMS placement as a bridge to surgery and the surgical outcomes of the elective operation. A consecutive 20 patients with obstructive colon cancer undergoing SEMS placement between June 2014 and February 2016 were included. The technical outcomes of the SEMS placement, surgical procedures, and surgical outcomes were evaluated retrospectively. Among them, 2 patients were treated with a SEMS palliatively, and the others were treated with a SEMS as a bridge to surgery. All SEMS were placed successfully at the first attempt, and there was no SEMS-related complication. Before surgery, all patients could be diagnosed histologically, and they were evaluated systemically including proximal colon or distant metastasis. The median time to operation after SEMS placement was 14 days (range 9–20

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days). Seven of the 18 patients underwent a laparoscopic colectomy without conversion to laparotomy. All patients with stage II or III colon cancer underwent curative surgery, and 2 patients with stage IV colon cancer underwent a one-stage resection of the primary colon cancer and simultaneous liver metastasis after the evaluation of hepatic functional reserve. There was no mortality or SEMS-related complication in the perioperative period. SEMS placement as a bridge to surgery for patients with obstructive colon cancer is safe and effective to provide an adequate amount of time for a preoperative systemic management and evaluation.

Key words: Colorectal cancer – Malignant colonic obstruction – Self-expandable metallic stent – Bridge to surgery – Palliation

Colorectal cancer is a common malignancy, and more than 1 million cases are diagnosed annually worldwide.[1] Although the use of screening programs has spread, 8%–29% of colorectal cancer patients are diagnosed in emergency status due to a large bowel obstruction.[2,3] The treatment for obstructive colorectal cancer is still controversial.[4] Emergency operations such as Hartman's procedure and colostomy have conventionally been performed for patients with obstructive colorectal cancer, but high mortality and morbidity rates remain for this malignancy.[5,6]

There are 2 important problems regarding the preoperative evaluation of obstructive colorectal cancer: synchronous colon cancer and liver metastasis. The incidence of synchronous colon cancers in patients diagnosed with colorectal cancer has been reported to be 2% to 10.7%,[7,8] and synchronous liver metastasis has been identified in 20%–30% of patients with primary colorectal cancers.[9,10] The preoperative evaluation of the total colon to the proximal part of the obstruction and systemic evaluation using computed tomography (CT) scanning and magnetic resonance imaging (MRI) are thus important to determine the extent of surgical resection.

Since Dohmoto[11] first reported metallic colon stent placement in 1991, the self-expandable metallic stent (SEMS) has been widely applied as a palliative management for obstructive colorectal cancer. In June 2014, we started SEMS placement as a bridge to surgery for patients with obstructive colon cancer and performed the curative resection after SEMS placement. The aims of the present study were to: (1) evaluate the significance of SEMS placement as an initial treatment for patients with obstructive colon cancer and (2) determine the outcomes of elective surgery.

Methods

Patients and study design

A consecutive 20 patients who underwent emergency SEMS placement for obstructive colon cancer in Nagasaki Rousai Hospital between June 2014 and February 2016 were enrolled in the present study. Obstructive colon disease was diagnosed using abdominal and pelvic CT scans before a SEMS placement. The placement of the SEMS was performed for the patients who had clinical features of abdominal distension and for patients with colonic stenosis through which a colonoscope could not be passed. The SEMS placement was performed as a bridge to surgery or as a palliative treatment. We retrospectively investigated the feasibility and safety of the SEMS placements for these patients with obstructive colon cancer, including the technical and clinical outcomes of the SEMS placement and elective surgeries.

SEMS placement

All the SEMS placement procedures were performed by endoscopy-experienced physicians (TY, HI, TG) after informed consent was obtained from each patient. The bowel preparation was conducted depending on the degree of the obstruction. The colonoscope (PCF-Q260AI, Olympus Corp, Tokyo, Japan) was introduced to the obstructive site, and then a guidewire was passed through the stricture under endoscopic and fluoroscopic guidance. After the length of the stricture was measured with a soluble contrast medium [gastrografin (Bayer HealthCare, Osaka, Japan) or 60% urografin (Bayer HealthCare)], a colonic uncovered stent (Niti-S, Taewoong Medical Co, Seoul, South Korea) was placed over the guidewire. Technical success was

defined as successful placement and deployment of the SEMS across the stricture.

Preoperative systemic examination

The pathologic diagnosis was based on the results of biopsies obtained during the colonoscopy procedure in all patients. After the insertion of the SEMS, chest CT scans were obtained to evaluate the presence of lung metastases. Gadolinium ethoxybenzyl diethylenetriamine pentaacetic acid (Gd-EOB-DTPA) MRI (i.e., EOB-MRI) was also performed for the patients with synchronous liver metastases identified by abdominal CT scan. The presence of synchronous colon cancers located in the proximal part of the obstruction was defined by gastrografin enema or a relatively thin endoscopy (9-mm outer diameter, GIF-XQ260, Olympus) after the inserted SEMS was fully expanded. The presence of synchronous upper-GI tract cancer was ruled out by upper-GI endoscopy. The cancer was staged according to the American Joint Committee on Cancer (AJCC) 7th edition TNM classification.

Surgical procedures

The patients with a resectable obstructive colon cancer were treated with a surgical resection after the SEMS placement. A standard bowel preparation was performed on the day before the resection in all patients. Laparoscopic surgery was performed for the patients without massive regional lymph node swelling or serosal exposure on preoperative radiologic findings, and the other patients were treated by conventional laparotomy with a midline incision. Both procedures were performed under general anesthesia.

For the laparoscopic procedure, we used 5 ports: one 12-mm port for a scope (umbilicus) and four 5- or 12-mm working ports. The pneumoperitoneum was created through the 12-mm camera port with 10–12 mmHg. After the dissection of regional lymph nodes along the root of the superior or inferior mesenteric artery, complete mobilization was performed laparoscopically. The umbilical incision was then extended 4 to 6 cm for resection and anastomosis. Bowel resection was performed using a surgical staple (Endo-GIA with Tri-Staple technology, Covidien, Medtronic, Minneapolis, Minnesota). The anastomosis was carried out as a functional end-to-end anastomosis using the surgical staple (Covidien). In the case of an anterior resection, a bowel anastomosis was performed by a double stapling technique using a circular stapler (EEA, Johnson & Johnson, Somerville, New Jersey). For left sided-colon cancers, a pelvic drain was placed at the end of the surgery.

Results

Patient characteristics

The characteristics of the patients are summarized in Table 1. There were 14 males and 6 females with a median age of 69 years (range 44–96 years). The median preoperative hemoglobin concentration, white blood cell count, and carcinoembryonic antigen level (CEA) were 12.4 g/dL (range, 5.9–16.9 g/dL); 7210/mm^3 (range: 3180–14,260/mm^3); and 6.4 ng/mL (1.1–207 ng/mL), respectively. The location of obstructive colon cancer included 2 cases of cecum, 1 case of ascending colon, 6 cases of transverse colon, 5 cases of descending colon, and 6 cases of sigmoid colon. A total of 18 patients underwent surgical operations after their SEMS placement. The patient with synchronous liver, lung, and bone metastases and the aged patient with multiple liver metastases underwent SEMS placement palliatively.

Technical outcomes of SEMS placement and the subsequent systemic management

The SEMS placements succeeded technically in all of the patients at the first attempt, and there were no SEMS-related complications such as perforation, stent migration, bleeding, and inappropriate expansion. The median time for the SEMS placement procedure was 28 minutes (range: 7–84 minutes). The median time to meals after SEMS placement was 2 days (range: 1–4 days). The median time to operation after the SEMS placement was 14 days (range: 9–20 days). After their SEMS placement, 2 patients with ischemic heart disease were able to undergo preoperative anticoagulant therapy, and 1 of them underwent a coronary angiogram. The blood glucose level was controlled by insulin administration in 2 patients with diabetes mellitus. Two patients with preoperative hemoglobin <8 g/dL received a preoperative blood transfusion. There were no patients with a preoperative reobstruction after SEMS placement. The results described above and the preoperative evaluations are summarized in Table 2.

Preoperative examination

The pathologic diagnosis was obtained preoperatively in all patients. Three patients who were

Table 1 Characteristics of patients who underwent (SEMS) placement (n=20)

Sex, male:female	14:6
Median age, y (range)	69 (44–96)
Laboratory findings	
Hemoglobin, g/dL (range)	12.4 (5.9–16.9)
White blood cells, /mm^3 (range)	7,210 (3180–14,260)
CEA, ng/mL (range)	6.4 (1.1–207)
TNM stage of tumor, n	
II	8
III	6
IV	6
Site of obstruction, n	
Cecum	2
Ascending colon	1
Transverse colon	6
Descending colon	5
Sigmoid colon	6
Comorbid diseases, n	
Diabetes	1
Cardiovascular	4
Pulmonary disease	1
Others	7
Stent placement, n	
Palliation	2
Bridge to surgery	18

Table 2 Systemic evaluation and management after SEMS placement

Time to meals, d (range)	2 (1–4)
Time to operations, d (range)	14 (9–20)
Preoperative examination, n	
Pathologic diagnosis	20
Systemic CT scan	20
Gd-EOB-DTPA MRI	3
Gastrografin-enema	18
Total colonoscopy	2
99mTc-GSA scintigraphy	3
ICG test	3
Upper GI endoscopy	19
Coronary angiogram	1
Preoperative management, n	
Anticoagulant therapy	2
Insulin administration	2
Blood transfusion	2

candidates to undergo a curative simultaneous liver resection underwent EOB-MRI; ^{99m}Tc-galactosyl human serum albumin (GSA) scintigraphy; and an indocyanine green clearance (ICG) test. Consent to the simultaneous liver resection was obtained from 2 of these 3 patients. A gastrografin enema was performed for all patients, and 2 patients underwent a total colonoscopy. Synchronous proximal colon cancer was detected by the gastrografin enema in the patient with liver metastasis (Fig. 1A and 1B).

Surgical outcomes following SEMS placement

Among 18 patients who underwent surgery, 11 patients underwent open surgery and the other 7 patients underwent laparoscopic colectomy. All laparoscopic procedures were technically successful and carried out without conversion to open surgery. The median operation time was 216 minutes (range: 117–468 minutes) and estimated blood loss was 100 mL (range: 10–320 mL). The resection margins were pathologically negative for malignancy in all 18 patients. The median number of dissected lymph nodes was 22 (range: 5–43). One patient could not avoid undergoing a definitive colostomy due to a previous operation for rectal cancer.

All of the patients with stage II or III colon cancer underwent curative surgery. One patient with an obstructive descending colon cancer (demonstrated in Fig. 1) underwent a segmental colectomy for proximal colon cancer and liver resection for synchronous liver metastasis in addition to a left hemicolectomy. Another patient with synchronous liver metastasis underwent an anterior resection and partial hepatectomy. Two patients with multiple liver metastases underwent a primary colon resection alone.

Regarding postoperative complications, pneumonia occurred in 1 patient and wound infection was seen in 2 patients. One patient was treated by laparotomy on the 7th day after the initial operation because of ileus due to the internal hernia through the mesenteric defect, but there was no mortality and no SEMS-related complication. Although anastomotic leakage was seen in 2 patients, they could be treated without operation. The results described above are summarized in Table 3.

Discussion

SEMS placement was initially attempted for patients diagnosed with malignant disease in whom curative resection was not possible, to avoid the need for a diverting proximal colostomy.[12,13] It was reported that there was no significant difference in the long-term prognoses of obstructing stage IV colorectal cancer patients between those who underwent SEMS placement and those who underwent a colostomy.[13] In recent years, preoperative SEMS placement has been introduced as a bridge to surgery for malignant colorectal obstruction, and it has improved not only the preoperative clinical condition of the patients, but also the mortality and

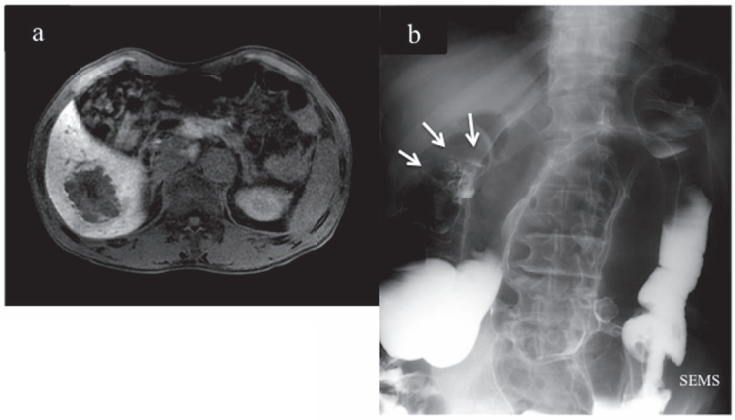

Fig. 1 The patient with synchronous liver metastasis and proximal colon cancer. (A) The synchronous liver metastasis located in the right lateral segment was identified on Gd-EOB-DTPA MRI (EOB-MRI). (B) In the patient with obstructive descending colon cancer, the synchronous colon cancer located on the hepatic flexure (white arrows) was identified by gastrografin enema.

morbidity rates and the rate of colostomies.[14–17] The results of the present study demonstrated that the SEMS placement allowed sufficient time for preoperative systemic evaluations and management, and as a result, the safe and curative surgery could be performed even for the patients with liver metastasis.

Synchronous colon cancers are usually detected by a total colonoscopy. However, in patients with obstructive colorectal cancer, the colonoscope cannot pass through the obstruction and the synchronous colon cancer(s) located in proximal sites cannot be detected preoperatively. In recent years, CT colonography or total colonoscopy following SEMS placement were reported to be helpful to evaluate the proximal site of obstructive colorectal cancer.[18–23] However, these techniques have not yet been standardized due to the high cost of using them. In our hospital, a double-contrast gastrografin enema has been used to identify the presence of synchronous colon neoplasms after SEMS placement. In the present study, 1 synchronous colon cancer could be detected preoperatively by gastrografin enema, and the surgical plan was changed. Therefore, the screening of the proximal colon to the obstructive colorectal cancer should be performed at least by gastrografin enema.

The reported 5-year overall survival rates of patients with colorectal cancer who underwent R0 resection of all metastasis are approximately 30% to 50%.[24] The liver is the most common metastatic site in colorectal cancer patients, and hepatectomy for patients with metastatic colorectal cancer has demonstrated a survival benefit.[25,26] However, the optimal timing for the management of synchronous liver metastasis has long been a matter of discussion. Earlier studies demonstrated that the simultaneous resection of colon primary and liver metastases is associated with a shorter hospital stay and did not increase the morbidity or mortality rates in comparison with staged operations.[27,28] Moreover, simultaneous liver resection was shown to decrease the overall rate of complications by avoiding the need for a second laparotomy.[27]

Roxburgh *et al*[29] reported that the long-term outcome following simultaneous liver resection was determined by patient factors including pathologic characteristics. In the emergency operation performed for patients with obstructive colon cancer, a pathologic diagnosis and preoperative systemic evaluation needed for the curative surgery cannot be achieved. In the present study, the pathological diagnosis and systemic evaluation could be performed preoperatively following SEMS placement for all patients with obstructive colon cancer. Moreover, EOB-MRI is known to have higher accuracy for the detection of liver metastasis (especially small nodules) compared to enhanced CT scans,[30] and preoperative ^{99m}Tc-GSA scintigraphy and the ICG test have been reported to be useful for planning hepatectomies and the prediction of postoperative liver failure.[30–32] In the present study, 3 patients with liver metastasis in whom curative hepatectomy might have been applicable underwent EOB-MRI, ^{99m}Tc-GSA scintigraphy, and an ICG test preoperatively. Among them, 2 patients desired the simultaneous liver resection and were discharged without serious complications.

Laparoscopic surgery, even for advanced colorectal cancers, has been established and widely developed.[33,34] In the surgical procedures for obstructive colorectal cancers, the distended bowel is

Table 3 Surgical details and outcomes

Patient	Type of surgery	Procedure	Dissected lymph node, n	Operative time, min	Blood loss, mL	Resection	Complication
1	Open	Left hemicolectomy Colostomy	5	134	10	Curative	Wound infection
2	Open	Left hemicolectomy	8	216	210	Curative	–
3	Open	Left hemicolectomy	40	165	150	Curative	Wound infection
4	Open	Left hemicolectomy Segmental resection Liver resection	24	468	320	Curative	–
5	Open	Anterior resection	22	160	100	Curative	–
6	Open	Anterior resection	24	140	170	Curative	–
7	Open	Anterior resection Liver resection	21	215	50	Curative	Anastomotic leakage
8	Open	Segmental resection	13	117	40	Curative	–
9	Open	Segmental resection	23	194	100	Curative	–
10	Open	Right hemicolectomy	22	119	10	Non-curative	–
11	Open	Right hemicolectomy	19	158	230	Curative	–
12	Laparoscopic	Left hemicolectomy	8	246	260	Curative	–
13	Laparoscopic	Left hemicolectomy	25	229	10	Curative	–
14	Laparoscopic	Anterior resection	21	370	50	Curative	Anastomotic leakage
15	Laparoscopic	Segmental resection	23	227	30	Curative	Ileus
16	Laparoscopic	Segmental resection	18	252	130	Noncurative	–
17	Laparoscopic	Right hemicolectomy	29	239	50	Curative	–
18	Laparoscopic	Right hemicolectomy	43	224	50	Curative	Pneumonia

thought to restrict the appropriate surgical field, and the fragile bowel can be a risk factor for intraoperative injuries. In the present study, laparoscopic surgery was intended for 7 patients according to our tumor criteria, and all of these surgeries could be carried out without conversion to open surgery. SEMS placement allowed the distended bowel to deflate and to undergo preparation sufficiently.

However, the present study was not of a large number of patients or oncologic outcomes, and the long-term oncologic outcome after laparoscopic surgery for obstructive colorectal cancer is still controversial.[35,36] Therefore, a randomized, prospective study is needed to determine the safety and feasibility of laparoscopic surgery following SEMS placement.

In the present study, SEMS placement was performed not only for the patients with left-sided cancer, but also those with right-sided cancer. The feasibility of stent placement for right-sided tumors has not been reported sufficiently, because right-sided obstructions are usually treated with an emergency operation. A recent study demonstrated that SEMS placement for patients with a left-sided colonic obstruction significantly decreased the stoma formation rate compared to the emergency operation; there were no significant differences among the patients with right-sided colonic obstruction.[37] Moreover, in cases of a right hemicolectomy for a right-sided obstruction, a preoperative evaluation of the presence of proximal synchronous neoplasms is not thought to be essential. It is thus not possible to make any conclusions about the value of SEMS placement for right-sided obstructions in light of the present findings, but it is apparent that a sufficient preoperative time may be reserved as well as for left-sided obstructions.

In conclusion, the results of the present study indicate that SEMS placement as a bridge to surgery for patients with obstructing colon cancer has a clinical benefit, especially in regard to the preoperative systemic evaluation. In the future, large-scale randomized prospective studies may provide reliable clinical evidence of the value of SEMS placement for obstructive colonic diseases.

Acknowledgments

All procedures followed were in accordance with the guidelines of the Ethics Committee standards of Nagasaki Rosai Hospital and with the Declaration of Helsinki. Informed consent was obtained from all patients included in this study.

Conflict of interest: None declared.

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