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# Self-Expandable Metal Stent Placement as a Bridge to Laparoscopic or Open Surgery for Obstructive Colorectal Cancer: Short-Term Outcomes of Nineteen Consecutive Cases

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## Abstract

**Purpose:** Laparoscopic colorectal resection is a feasible and less invasive procedure with short-term advantages compared with open surgery; however, the evidence for its efficacy for treating obstructive colorectal cancer (CRC) is lacking. In this study, we aimed to determine short-term outcomes of SEMS placement for obstructive CRC followed by laparoscopic colorectal resection.

**Methods:** As of August 2013, 51 patients with obstructive CRC underwent stent insertion. Thirty-two patients received palliation therapy not intended for tumor resection. After decompression of the proximal intestine, nine and 10 patients underwent laparoscopic and open surgery, respectively. Clinicopathological, intraoperative, and postoperative data were retrospectively collected.

**Results:** There were no differences in resection rates and curabilities between the two groups. All surgeries were performed with a single-stage anastomosis, and no anastomotic leakage was observed. There was one patient with abdominal morbidity in the open group (Open) and none in the Lap group. There was no mortality in either group. Time to flatus (3.4 ± 1.8 days, Lap; 2.6 ± 1.1 days, Open) and time to oral intake (7.9 ± 2.5 days, Lap; 7.7±1.9 days, Open) were similar between the groups. Postoperative hospitalization times for the Lap group were shorter, but the difference was not statistically significant (15.2 ± 3.9 days, Lap; 21 ± 11.7 days, Open, p = 0.21).

**Conclusion:** Our findings indicate that laparoscopic surgery combined with preoperative stent placement is feasible as well as safe compared with open surgery for obstructive CRC.

**Key words:** Colorectal; Stent; Laparoscopy; Obstruction

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## INTRODUCTION

Colorectal obstruction is a life-threatening oncological emergency that occurs in approximately 7%–30% patients with colorectal cancer (CRC)[1,2]. Immediate decompression of the proximal intestine is mandatory to relieve symptoms and avoid perforation. Traditional surgical options include creation of a stoma followed by resection of the primary tumor (Hartmann's procedure), intraoperative lavage, resection of the tumor with primary anastomosis, or subtotal colectomy with primary anastomosis[3]. Although these surgical procedures are effective for decompressing the colon, multistage operations, creation of stoma, and a high rate of morbidity[4] affect the quality of life of patients.

Using a preoperative transanal drainage tube is another alternative, which has high technical and clinical success rates (93.9% and 86.4%, respectively), and most patients require a single-stage follow-up surgery (90.9%) with a mortality rate of 1.5%[5]. Although the safety and feasibility of using transanal drainage tube is established, the requirement for frequent lavage is bothersome for patients and caregivers. Furthermore, patients require a drainage tube until surgery, and the limitation of oral intake may affect the preoperative condition of patients.

The self-expandable metallic stent (SEMS) provides an alternative to using a transanal drainage tube and is

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less invasive[6-9]. Moreover, SEMS represents a bridge to surgery by increasing the frequency of single-stage surgeries and reduces the rate for introducing permanent stomas without increasing the risk of anastomotic leakage or intra-abdominal abscess compared with emergency operations[10-11]. Furthermore, after SEMS placement, we are able to examine the proximal colon before surgery[12-13]. Preoperative colonic mechanical cleansing can be also performed. Moreover, this procedure is applicable for initially unresectable CRC. In such cases, SEMS placement permits earlier introduction of chemotherapy[14-15], which may benefit patients intended for conversion therapy. Therefore, SEMS placement is a less invasive drainage procedure that provides short-term advantages without increasing morbidity.

Laparoscopic surgery was recently introduced as a less invasive surgical approach for CRC. For example, the laparoscopic approach results in improved short-term outcomes with confirmed oncological safety[4, 16]. Despite the increasing number of experienced surgeons who prefer performing laparoscopic surgery, only few studies report the advantage, safety, and feasibility of laparoscopic colorectal resection combined with SEMS placement[1-2,17]. In this study, we review our experience with SEMS placement followed by laparoscopic surgery and describe the intraoperative and short-term outcome and long-term survival of combining these two less invasive approaches.

## MATERIALS AND METHODS

An endoscopy database and clinical records from the University of Tokyo Hospital, Tokyo, Japan, were retrospectively reviewed. SEMS were consecutively placed for obstructing colorectal cancer in 51 patients as of August 2013. Until January 2012, SEMS placement procedure was not covered by government medical insurance, we conducted a clinical trial (UMIN00000456) with Niti-S enteral colonic uncovered stent, D-type (Taewoong, Inc., Gimpo, South Korea). After covered by the insurance on January 2012, we perform SEMS placement with WallFlex Enteral Colonic Stent (Boston Scientific Corporation, Natick, Mass) in clinical practice.

Nineteen patients underwent colorectal resection, and 32 patients were under palliative care without intent of resection. Nine and 10 patients underwent laparoscopic colorectal resection and open resection, respectively. We collected data on the pre-, intra-, and postoperative variables as follows: a) Preoperative: age, sex, location of the tumor, invasion of surrounding organs, distant metastasis, and peritoneal dissemination; b) intraoperative: approach used for resection, completeness of resection, curability, conversion from laparoscopic to open surgery, and rate of primary anastomosis; and c) Postoperative: Complications at 30 days, time to first flatus, oral intake, and date of discharge. In addition we followed up the patients to analyze postoperative survival. All data entered into our database approved by the institutional review board, and we obtained written informed consent from patients before their enrollment.

## SEMS PLACEMENT

Most patients admitted to the hospital presented with symptoms caused by colonic obstruction as follows: abdominal distension, pain, nausea, or vomiting. Computed tomography was used to establish the diagnosis of obstructive CRC, to determine the location of the obstruction, and to establish the presence of a perforation or penetration. The inclusion criterion for SEMS placement was the urgent necessity to decompress the obstruction caused by a colorectal malignancy. The exclusion criteria were as follows: Presence of a perforation or penetration, complicated or multiple stenosis such as those caused by peritoneal dissemination, obstruction close to the anal verge, and benign stenosis such as that caused by Crohn's disease, diverticulitis, or radiation enteritis.

All procedures were performed by experienced physicians who were members of the Department of Gastroenterology, the University of Tokyo hospital. The physicians informed the patients about the benefits and risks of the procedures and obtained their written informed consent before intervention.

SEMS placement was performed using endoscopy and fluoroscopy (Figure 1) [1-2, 18]. In brief, the endoscope was inserted into the stenosis, and a water-soluble contrast agent was injected through the channel to determine the length and location of the stenosis. A guide-wire was inserted over the obstruction, and the stent was placed through the guide-wire. Immediately after the stent was properly placed, we confirmed that the obstruction was relieved by the evacuation of stool from the proximal intestine. Abdominal X-rays were taken to verify the location and expansion of the stent and to confirm the absence of free peritoneal air. After decompressing the proximal intestine, we examined the proximal colon using a water-soluble contrast enema.


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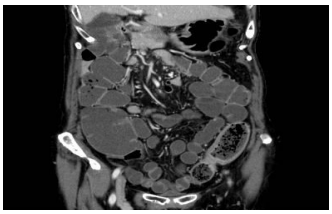
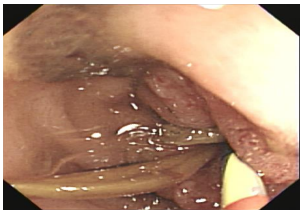
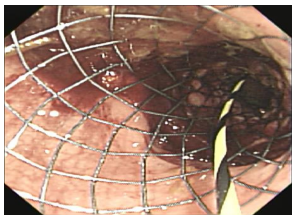


a:Obstruction caused by stenosis in Sigmoid colon



b: Insersion of guide-wire



c: SEMS placement through the guide-wire

**Figure 1**
**Emplacement of Self-Expandable Metal Stent**

## SURGERY

Open or laparoscopic colorectal resection was successfully performed on 19 of 51 patients at the department of Surgical Oncology, the University of Tokyo Hospital. One patient with sigmoid colon cancer with synchronous liver metastasis underwent open surgery. This patient was scheduled to undergo simultaneous hepatic resection. An open approach was, therefore, necessary to determine using palpation and intraoperative ultrasonography and whether other hepatic metastases were present in addition to those recognized before surgery. Another patient suspected with peritoneal dissemination underwent open surgery to identify the grade of peritoneal metastasis. Another patient underwent open surgery because the carcinoma of the sigmoid colon invaded the urinary bladder and left-spermatic duct, which required simultaneous excision. The approach of choice for the other 16 patients was at the surgeon's discretion. Consequently, nine and 10 patients underwent laparoscopic and open surgery, respectively. All surgeries were performed by gastrointestinal surgeons with more than 10 years' experience.

## RESULTS

All stents were properly placed through the stenosis, and clinical success rate was 100%. Patient characteristics for those in the laparoscopic (Lap) and open (Open) groups are shown in Table 1. There were no significant differences between the groups concerning location of tumor, invasion of surrounding organs, and distant metastasis, except for gender. In the Lap and Open groups, 56% (5/9) and 30% (3/9) patients, respectively, had distant metastasis. This rate is higher compared with those listed in the registry of all-stage colorectal cancer (18.2%), which includes data from the Japanese Society for Cancer of Colon and Rectum (JSCCR) registry (1995-1998).

**Table1**
**Characteristics of patients and tumor**

| | | Laparoscopic surgery (*n*=9) | Open surgery (*n*=10) | |
|---|---|---|---|---|
| Sex | male | 8 | 4 | |
| | female | 1 | 6 | *p*=0.03 |
| Age | | 73.2±10 | 77.6±6.8 | n.s. |
| Location of tumor* | | | | |
| | Right color | 1 | 1 | |
| | Left color | 8 | 8 | |
| | Rectum | 0 | 1 | n.s. |
| Invasion | Absei | 7 | 9 | |
| | Present | 2 | 1 | n.s. |
| Distant Metastasis | | | | |
| | Liver | 4 | 7 | |
| Para - | aorta | 2 | 2 | |
| | Peritoneal | 0 | 1 | |
| | Disseminatio | 3 | 0 | n.s. |

Note. *The border of Right/Left colon was set at splenic flexure. There is no difference concerning patient characteristics except for sex.

**Table 2**
**Intra- and Post-Operative Outcomes Between Two Surgical Approach**

| | | Laparoscopic surgery (*n*=9) | Open surgery (*n*=10) | |
|---|---|---|---|---|
| Resection | R0 | 6 | 8 | |
| | R1 | 0 | 0 | |
| | R2 | 3 | 2 | n.s. |
| Curability | A | 4 | 6 | |
| | B | 2 | 2 | |
| | C | 3 | 2 | n.s. |
| Conversion | | 2 | ---------- | |
| Primary anastomosis | | 9 | 10 | n.s. |
| 30-days complication | | | | |
| | Present | 6 | 8 | |
| | Absent | 3 | 2 | n.s. |
| Time to flatus (days) | | 3.4±1.8 | 2.6±1.1 | n.s. |
| Time to oral intake (days) | | 7.9±2.5 | 7.7±1.9 | n.s. |
| Postoperative hospital stay (days) | | 15.2±3.9 | 21±11.7 | n.s. |

*Note.* The short-term outcomes in both groups were similar in this study

Intraoperative and postoperative outcomes are shown in Table 2. Macroscopically complete resection of the tumor with margins free of carcinoma was classified as R0, presence of the tumor at the resected margin was

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classified as R1, and the macroscopic remnant of the tumor as R2. Three cases in the Lap group were classified as R2, which included two patients with unresectable liver metastasis and one with peritoneal dissemination. Two cases in the Open group included one patient with hepatic and paraaortic metastases and one with peritoneal dissemination. There were no differences in resection rate between the two groups.

Curability was judged as follows: Curability A, R0 resection for colorectal cancer without distant metastasis; Curability B, R0 resection for primary and distant metastasis or R1 resection in all stages; and Curability C, R2. There was no difference in curability between the two groups. All surgeries were performed with one-stage anastomosis. Two laparoscopic surgeries were converted to open surgeries to explore the range of peritoneal dissemination in one case and invasion close to the peritoneum in another, which were not recognized before surgery.

Approximately 20%–30% patients experienced postoperative complications. Three cases in the Lap group experienced herpes zoster infection, pneumonia, and influenza, respectively, and two in Open group were due to postoperative ileus or infection of the central vein catheter. Patients in the Lap group did not experience complications associated with abdominal surgery. The rates of postoperative complications, time to first flatus, and time before oral intake were similar in two groups; however, postoperative hospital stays were shorter for patients in the Lap group, although the difference was not statistically significant.

We also investigated postoperative survivals of the patients. Mean follow- up period was 441days. All the patients who underwent colorectal resection were alive during follow-up period. Concerning disease-free-survival, the patients who underwent R0 resection showed no significant difference between two groups (Mean disease-free-survivals were 279 days in Lap group and 263 days in Open group, respectively).

## DISCUSSION

Laparoscopic colorectal resection is a minimally invasive surgical strategy, and its short-term advantages were revealed by several randomized trials. The confirmed benefits of laparoscopic surgery include reduced blood loss, early detection of peristalsis, early oral intake, fewer days of treatment with parental or oral analgesics, shorter hospital stays, and lower postoperative morbidity rates[4, 16, 19]. Nonetheless, application of laparoscopic surgery is justified only if it does not affect long-term survival and disease control. A large-scale randomized trial revealed similar 5-year survival (76.1% in laparoscopic surgery vs. 72.9% in open surgery) and 5-year disease-free rates (75.3% vs. 78.3%, respectively) between laparoscopic and open surgery[20]. Although the number of the patients was small, our study showed similar results. Therefore, we conclude that laparoscopic surgery is the most suitable approach for colorectal cancer with confirmed short-term outcomes and oncological safety. Moreover, an increasing number of gastrointestinal surgeons prefer this minimally invasive approach.

Although several trials of laparoscopic surgery report favorable outcomes, most studies excluded patients with bulky tumors or tumor-infiltration of adjacent organs. We consider that the locally advanced cancer that requires stent placement presents particular difficulties that may hamper laparoscopic surgery. For example, a bulky tumor is difficult to manipulate with forceps and difficult to visualize. Infiltration or inflammation of adjacent organs makes it difficult to separate the tumor from the surrounding layers of tissue. Moreover, when intestinal decompression is incomplete, working space is inadequate and the visual field is limited. Therefore, laparoscopic surgery after stent placement presents significant and unique challenges compared with those of other surgical techniques for treating colorectal cancer.

To the best of our knowledge, few studies compare outcomes of laparoscopic and open surgery after stent placement. For example, in our search of the United States Library of Medicine's PubMed database (http://www.ncbi.nlm.nih.gov/pubmed) using the queries "colorectal," "stent," and "laparoscopic," only four reports were returned that describe the outcomes of laparoscopic and open surgery after stent placement Table 3[1, 21-23]. All of these studies presented similar outcomes, indicating that postoperative morbidity rate are lower in the laparoscopic group. Our findings in this study are the same in that the only postoperative morbidity associated with abdomen was ileus after open surgery. Moreover, the postoperative hospital stays in the laparoscopic group reported by others tended to be shorter. Although the studies cited are case series that include limited numbers of patients, their similar findings taken together with those of the present study, provide a compelling argument in favor of the feasibility and safety of laparoscopic surgery after SEMS placement.

**Table 3**
**Outcome of laparoscopic and Open Surgery After Sems Placement.**

| Author | Year | Patient number | Conversion (%) | Morbidity (%) | Postoperative hospital stay (days) |
|---|---|---|---|---|---|
| Chung | 2008 | 18/18 | N.D. | 11.1/33.3 | 5.5/8.5 |
| Stipa | 2008 | 16/58 | 12.5 | 0/12 | 6.7/9.5 |
| Law | 2013 | 18/18 | N.D. | 11.1/33.3 | 5.5/8.5 |
| Zhou | 2013 | 17/8 | 0 | 11.8/25 | 9/11 |

*Note.* There were only limited number of patients included in the studies comparing Lap and Open surgery. The conversion rate morbidity and mortality were similar to our study.
The former data refer to laparoscopic and the latter open (Lap/Open). N.D. :Not described.


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Preoperative stent placement provides two essential benefits of laparoscopic surgery. The first is intestinal decompression because the expanded intestine limits vision, working space, and interrupts laparoscopic surgery. Another benefit is the opportunity to examine the proximal colon. It is important to identify the presence of synchronous colorectal cancer because it may influence the extent of resection. During laparoscopic surgery, however, we cannot palpate the proximal colon to detect another lesion. Our experience is that synchronous multiple colorectal cancers exist at a rate of 3%–4.4% that cannot be ignored [24-26]. In order to detect synchronous colorectal cancers, we performed barium enema before the surgery and total colonoscopy within six months after.

CT colonography (CTC), a new technique for detecting colorectal neoplasia, is receiving attention as screening method. Randomized trials show that the sensitivity of CTC is higher compared with barium enema [27-28]. Further, extracolonic lesions can also be detected. Therefore, we consider CTC as a new alternative to barium enema, particularly for patients with stent placement.

Another benefit of stent placement is allowing oral intake before surgery. In our preliminary study, resumption of nutrition after transanal drainage, which is measured by levels of serum albumin and total lymphocyte counts, was superior in SEMS patients compared with transanal tube drainage, although the differences were not statistically significant.

The long-term outcomes of laparoscopic colorectal surgery combined with stent placement are unknown. Some physicians are concerned that the tumor may be disseminated by shear forces to the colonic wall generated by the colonic stent. Maruthachalam et al. reported that the level of mRNA (*KRT20*) encoding keratin 20 (CK20) in peripheral blood increased after endoscopic insertion of colonic stents, but not after staging colonoscopy [29]. We believe that the use of colonic stents should not be deterred by this finding because its clinical significance is not established. However, long-term studies of the outcomes of using SEMS are clearly indicated.

Although our study showed no significant difference between Lap and Open groups concerning outcomes, an inevitable limitation existed. Since Japanese governmental medical insurance did not cover SEMS placement for colorectal obstruction until January 2012, we collected only small number of patients in this study. In addition we consider that obstructive colorectal cancer does not account for major proportion of all the colorectal cancers, especially in medically advanced countries where elder citizens are scheduled to undergo colorectal screening program. For these reasons we and other studies (shown in Table 3) did not collect huge number of patients. Multi-institutional study should be needed to conduct prospective case control trial and obtain further findings.

## CONCLUSION

For treating obstructive CRC, laparoscopic surgery combined with preoperative stent placement is a feasible approach that is as safe as open surgery.

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