Comparison of short-term outcome between diverting colostomy and colonic stent as a bridge to surgery for left colonic malignant obstruction

Won Beom Jung, MD*, Jin Yong Shin, MD, PhD, Jong Kwon Park, MD, PhD

Abstract

The self-expanding metallic stent (SEMS) has been comprehensively investigated as a bridge to surgery. SEMS enables the control of acute colonic obstruction. However, comparison between SEMS and diverting colostomy as another bridge procedure was still challenging issue. Thus, the aim of this study was to compare these 2 procedures.

In this retrospective cohort study, patients who received diverting colostomy and SEMS for acute left colonic obstruction between February 2016 and August 2018 were included. They were classified into the colostomy group (n = 27), including 5 patients who had SEMS failure previously, and the SEMS group (n = 23). The clinicopathologic parameters, pathologic results, and short-term outcomes were compared.

No significant differences were found in clinicopathologic characteristics and complication rates between the 2 groups. After the bridge procedures, the SEMS group showed a higher rate of laparoscopic colonic resection than the colostomy group (100% vs 76%, P = .023). The colostomy group showed a higher rate of rectal cancer (24.0% vs 9.1%, P = .019) and later recovery of flatus (3 vs 2 days, P = .011) than the SEMS group. Additionally, the length of resected colon was longer in the colostomy group than in the SEMS group (33.9 vs 23.4 cm, P = .007).

Although SEMS might permit higher laparoscopic resection rates and faster recovery of bowel habits than diverting colostomy, SEMS showed meaningful failure rate including migration and perforation. In addition, diverting colostomy showed acceptable complication rates and feasible performance. An individualized approach is necessary considering the advantages and disadvantages of both procedures.

Abbreviations: APCT = abdominopelvic computed tomography, ASA = American Society of Anesthesiologists, BMI = body mass index, EBL = estimated blood loss, LI = lymphatic invasion, PCRT = preoperative concurrent chemoradiation therapy, PNI = perineural invasion, RR = relative risk, SEMS = self-expanding metallic stent, VI = vascular invasion.

Keywords: colonic obstruction, colonic stent, diverting colostomy

1. Introduction

Acute large intestinal obstruction is the initial presentation in 7% to 29% of patients with colorectal cancers and frequently leads to an emergency surgical intervention.[1] Left-sided colonic obstructions are particularly challenging due to the risk of perforation. Hartmann operation was a traditional treatment before the

introduction of decompressive procedures as a bridge to surgery. Emergency surgery, including Hartmann operation due to malignant obstruction of the left colon, is associated with a high frequency of complications and poor survival.[2–4] Both curability and survival rates are lower in emergently operated patients compared with electively operated patients.[2] Thus, the use of decompressive procedures is an important issue for acute malignant colonic obstruction.

The self-expanding metallic stent (SEMS) and transient diverting colostomy are bridge-to-surgery options in left-sided colonic obstruction. They prevent malnutrition and improve outcome by allowing sufficient time for elective surgery.[1] Many recent studies have focused on SEMS as a bridge to surgery. According to several studies, SEMS shows lower short-term overall morbidity and lower rates of temporary and permanent stoma formation than emergency operation.[5–7] SEMS enables control of acute malignant colonic obstruction properly; however, it has several disadvantages including perforation, reobstruction, and stent migration.[8–10]

Comparative studies on the performance and effectiveness of diverting colostomy as a bridge procedure are few. Knowledge of diverting colostomy is of great importance for acute malignant colonic obstruction. Thus, we aimed to compare the short-term outcome of diverting colostomy and SEMS to evaluate the advantages and disadvantages of both procedures, and to propose feasible decompressive procedures applicable to the circumstances.

2. Methods

2.1. Patient enrollment and exclusion criteria

A retrospective review of all patients who received diverting colostomy and colonic stenting as a bridge to surgery for acute left malignant colonic obstruction between January 2016 and December 2018 at a single institution was carried out. Patients were recruited if the lower border of an obstructing tumor was found between the splenic flexure and rectum. We retrospectively collected clinicopathologic characteristics including sex, age, location of obstructive lesion, comorbidity, American Society of Anesthesiologists (ASA) class, body mass index (BMI), history of received operation, and underlying disease prospectively recorded. We also reviewed short-term outcomes and complications from medical records and patient database. The median follow-up period was 12.3 months (1–28). The diagnosis of acute left colonic obstruction was established by clinical examination, abdominal plain radiography, and abdominopelvic computed tomography (APCT). Acute left colonic obstruction was defined as not being able to eat due to abdominal pain and discomfort or having colon obstruction on colonoscopic finding and/or prominent proximal bowel dilatation on APCT caused by tumor obstruction.

The study was approved by the Institutional Review Board of our institution (HPIRB 2019-01-019-001). The Institutional Review Board of Haeundae Paik Hospital approved a waiver of the requirement for informed consent to the research because this study involves no more than minimal risk to the participants. The waiver will not adversely affect the rights and welfare of the participants, and the research could not practically be carried out without the waiver. A total of 50 patients with acute left colonic obstruction were finally included after 5 patients who received only palliative colostomy and 3 patients who received only palliative SEMS without curative resection were excluded. The patients were classified into the colostomy group (n=27) including 5 patients who failed SEMS previously due to migration and/or dysfunction and the SEMS group (n=23) according to whether receiving transient diverting colostomy or SEMS as a bridge to surgery (Fig. 1). The colostomy group

included 4 patients who had synchronous colorectal cancer. Abdominal radiography was performed the next day following decompressive procedure. Successful decompression was defined as clinical and radiologic evidence of resolution of the obstruction within 24 hours from procedure. An oral diet was then introduced.

2.2. Bridge to surgery

All patients visited the emergency room or outpatient clinic due to acute left colon obstruction without perforation. They underwent physical examination, abdominal radiography, APCT with or without enhancement, complete blood cell count, and blood chemistry prior to procedure decision. All patients had abdominal pain or showed abdominal distension. Colorectal surgeons and gastroenterologists selected either diverting colostomy or SEMS as a bridge to surgery considering the location of obstructive lesion, availability of SEMS, and risk evaluation for SEMS perforation. All the SEMS used were uncovered (BONASTENT colonic stent, Seoul, Korea) and had a diameter of 24 mm and length of 60, 80, or 120 mm. In cases of SEMS, the endoscopist dictated the length of stent, and most patients received procedures under conscious sedation, with intravenous midazolam and pethidine.

2.3. Surgery

Curative surgery was defined as complete resection of any measurable disease without involvement of the resection margin. Depending on the location of obstructive lesion and presence of edematous bowels, left colectomy, anterior resection, low anterior resection, subtotal colectomy, and nonsphincter saving operation including abdominoperineal resection and Hartmann operation were performed by 2 experienced colorectal surgeons.

2.4. Histopathology

After surgery, a pathologic examination was performed by gastrointestinal pathologists. Staging was performed according
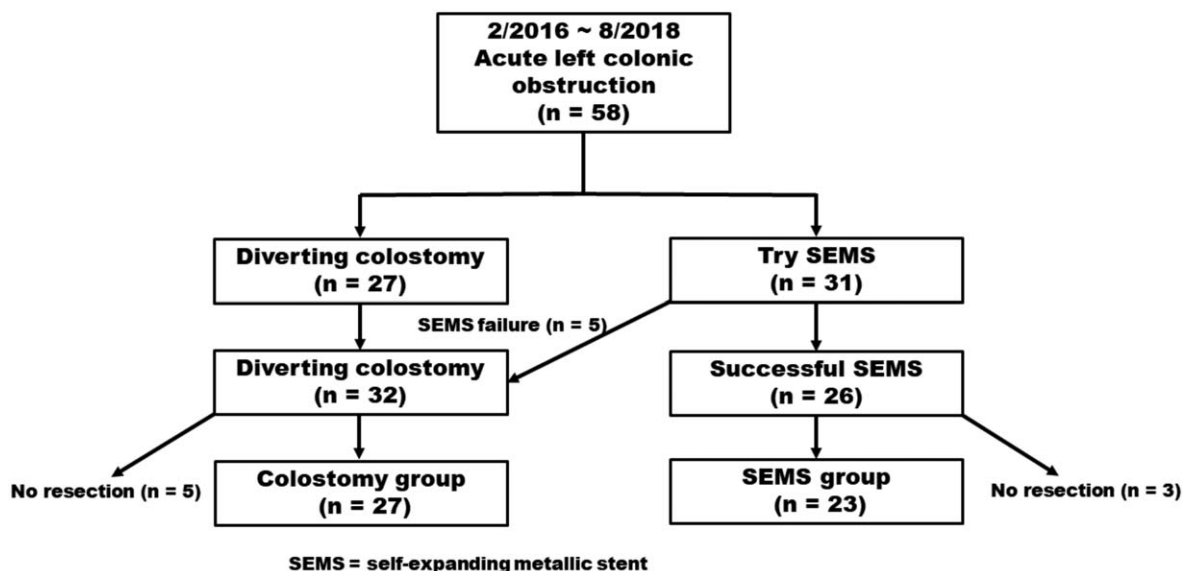

Figure 1. Overall study design and overview of patient population.

to the American Joint Committee on Cancer TNM classification of malignant tumors (8th ed).[11] In addition, the number of harvested lymph nodes, lymphatic invasion (LI), vascular invasion (VI), perineural invasion (PNI), and differentiation were documented. LI, VI, PNI, and differentiation were defined by current practice guidelines.[12–14]

2.5. Operative parameters, short-term outcomes, and complications

We analyzed operative parameters, such as laparoscopic tumor resection rate, rate of conversion to open surgery, permanent stoma rate, type of operation, operation time, estimated blood loss (EBL), length of resected bowel, and combined resection rate of other organs. We also analyzed short-term outcomes, such as postoperative pain score, time to 1st flatus, diet start day, hospital stay, and decompressive procedure-related mortality. We defined postoperative pain score as maximum visual analog scores on days 1 to 7 after surgery to assess postoperative pain severity.[15] Hospital stay was defined as all hospital days after curative operation. Decompressive procedure-related mortality was defined as death within 1 month from diverting colostomy or SEMS. Complications were defined as all complications added together at each hospital stay and 30 days after decompressive procedure or tumor resection. Complications were classified into major or minor complication. Major complication was defined as cases of grade 3 or higher in Clavien–Dindo classification.[16] Complications included infection, urologic complications, neurologic complications, cardiopulmonary complications, parastomal hernia, incisional hernia, postoperative ileus, and anastomotic leakage.

2.6. Statistical analysis

Categorical variables were compared using Chi-squared tests or the Fisher exact test, and continuous variables were compared using independent sample t tests. Overall survival rates were expressed as percentages and analyzed using the Kaplan–Meier method. Survival curves were compared using the log-rank test. All statistical tests were 2-sided, and $P < .05$ was considered statistically significant. Statistical analyses were performed with SPSS 21.0.0.0 (SPSS, Inc, IBM Statistics, Armonk, NY) for Windows.

3. Results

3.1. Clinicopathologic parameters

The colostomy group showed a higher rate of rectal cancer than the SEMS group (24.0% vs 9.1%, $P = .019$). No statistically significant differences were found in clinicopathologic characteristics such as sex, age, comorbidity, ASA grade, and BMI between the 2 groups (Table 1). After the decompressive procedures, the SEMS group showed higher laparoscopic colonic resection than the colostomy group (100% vs 81.5%, $P = .047$). No significant differences were noted in conversion rate to open surgery, multiorgan resection rate, permanent stoma rate, operation time, EBL, and time from bridge procedure to surgery between the 2 groups (Table 2). The colostomy group was not significantly different in tumor stage, differentiation, LI, VI, PNI, number of harvested lymph nodes, tumor size, and chemotherapy rates compared with the SEMS group. Additionally, 18 patients in the colostomy group (66.7%) and 16 patients in the SEMS group

Table 1

Clinicopathologic characteristics of the colostomy and self-expanding metallic stent groups for acute left colonic obstruction.

Clinicopathologic parameters	Colostomy group n = 27	SEMS group n = 23	P
Sex, male/female	12 (44.4)/15 (55.6)	15 (65.2)/8 (34.8)	.17
Age (range), yr	69 (41–88)	70 (48–84)	.78
Comorbidity	9 (33.3)	9 (39.1)	.97
Hypertension	3	5	
Diabetes mellitus	2	2	
Cardiovascular disease	1	1	
Pulmonary disease	2	0	
Liver disease	0	0	
Chronic kidney disease	1	2	
Neurologic disease	3	2	
Psychologic disease	2	1	
ASA grade			.073
1–2	16 (59.3)	19 (82.6)	
3–4	11 (40.7)	4 (17.4)	
BMI ≥ 25	4 (14.8)	7 (30.4)	.18
Location of obstruction			.019
Colon/rectum	17 (63.0)/10 (37.0)	21 (90.9)/2 (9.1)	

Values are presented as median (range) or n (%).
ASA = American Society of Anesthesiologists, BMI = body mass index, SEMS = self-expanding metallic stent.

(69.6%) received adjuvant chemotherapy. Four patients in the colostomy group and 2 patients in the SEMS group received preoperative chemotherapy after decompressive procedures. Only 1 patient in the colostomy group received preoperative concurrent chemoradiation therapy (PCRT) (Table 3).

3.2. Short-term outcomes and complications

The colostomy group showed significantly slower recovery of flatus than the SEMS group (3 vs 2 days, $P = .008$). There was no significant difference in postoperative pain score, diet start day, and hospital stay between the 2 groups. The colostomy group had a higher permanent stoma rate than the SEMS group (14.8% vs 0%, $P = .115$), but this was not statistically significant. In

Table 2

Operative parameters of the colostomy and self-expanding metallic stent groups for acute left colonic obstruction.

Clinicopathologic parameters	Colostomy group n = 27	SEMS group n = 23	P
Laparoscopic resection	22 (81.5)	23 (100.0)	.049
Conversion to open surgery	3 (11.1)	0 (0)	.24
Operation			
Left hemicolectomy	4	4	
Anterior resection	9	10	
Low anterior resection	8	9	
Subtotal colectomy	2	0	
APR/Hartmann operation	4	0	
Combined resection of other organs	5 (18.5)	3 (13.0)	.71
Permanent stoma	4 (14.8)	0 (0)	.11
Operation time (range), min	306.3 (135–575)	273.9 (145–790)	.37
EBL (range), mL	585.9 (65–4500)	288.2 (60–1370)	.11
Length of resected bowel (range), cm	25.0 (13.5–48.0)	20.0 (11.0–55.5)	.23
Time from bridge procedure to surgery	44.8 (5–239)	18.7 (5–146)	.10

Values are presented as median (range) or n (%).
APR = abdominoperineal resection, EBL = estimated blood loss, SEMS = self-expanding metallic stent.

Pathologic results of the colostomy and self-expanding metallic stent groups for acute left colon cancer obstruction.

Pathologic parameters	Colostomy group n = 27	SEMS group n = 23	P
T stage			
1, 2/3, 4	0 (0)/27 (100.0)	0 (0)/23 (100.0)	
N stage			.90
negative/positive	11 (40.7)/16 (59.3)	9 (39.1)/14 (60.9)	
M stage			.073
0/1	13 (59.3)/11 (40.7)	18 (82.6)/4 (17.4)	
Tumor stage			.82
I + II/III + IV	9 (33.3)/18 (66.7)	7 (30.4)/16 (69.6)	
Grade of differentiation			
WD + MD	27 (100)	23 (100)	
PD + MU			
Lymphatic invasion	14 (51.9)	10 (47.6)	.55
Vascular invasion	13 (48.1)	13 (56.5)	.50
Perineural invasion	23 (85.2)	18 (78.3)	.71
Number of harvested LNs (±SE)	21 (±1.9)	24 (±2.1)	.77
Chemotherapy	18 (66.7)	15 (65.2)	.91
Tumor size (range), cm	5.9 (3.0–13.0)	5.3 (2.0–8.0)	.08

LN = lymph node, MD = moderately differentiated, MU = mucinous, PD = poorly differentiated, SE = standard error, SEMS = self-expanding metallic stent, WD = well differentiated.

addition, there was no significant difference in complication rates including major complication (29.6 vs 13.0, $P = .158$) and any complication (48.1 vs. 30.4, $P = .203$) (Table 4). No decompressive procedure-related mortality occurred in this study.

3.3. Survival

The median follow-up period was 12.3 months (1–28). There was no significant difference in the survival rate after decompressive procedure between the colostomy group and SEMS group (1-year

Short-term outcome measures and complications following laparoscopic colorectal cancer resection.

Outcome	Colostomy group n = 27	SEMS group n = 23	P
Postoperative pain score* (range)	5 (3–7)	3 (1–8)	.246
Time to first flatus (range), d	3 (1–9)	2 (1–4)	.008
Diet start (postoperative day, range)	4 (1–27)	3 (1–17)	.469
Hospital stay (range), d	18 (7–87)	11 (7–61)	.083
Decompressive procedure-related mortality	0 (0)	0 (0)	
Complication			
Major complications†	8 (29.6)	3 (13.0)	.15
Any complications	13 (48.1)	7 (30.4)	.20
Infectious complications	7	3	.30
Urologic complications	4	2	.67
Neurologic complications	1	1	1.00
Cardiologic complications	1	2	.58
Postoperative ileus	5	1	.19
Incisional hernia	2	1	1.00
Anastomotic leakage	2	1	1.00

Values are presented as median (range) or n (%).
SEMS = self-expanding metallic stent.
* Maximum visual analog scores on days 1 to 7 after surgery were used to assess postoperative pain severity. Numbers in parenthesis were percentages.
† Major complications were defined as Clavien–Dindo grade III or IV.

overall survival rate 79.3% vs 88.6%, $P = .279$). During the observation period, 6 patients in the colostomy group and 3 patients in the SEMS group died.

4. Discussion

Proper management of left colon cancer obstruction remains a challenging issue. Many studies have revealed that bridge-to-surgery procedures, such as diverting colostomy and SEMS, reduce operative mortality and improve surgical outcomes for left colon cancer obstruction. Our results also revealed no significant differences in hospital stay, morbidity, permanent colostomy rate, overall survival and mortality, and similar to the previously mentioned study. Additionally, our study showed that the SEMS group had a statistically higher laparoscopic resection rate and faster 1st flatus than the colostomy group. We estimated that upfront colostomy might produce peritoneal adhesion which reduces laparoscopic success rate and interferes with bowel movement recovery. In a retrospective study, Ohman[2] reported that operative mortality occurred in 8% of 148 malignant left colon obstruction patients with resection. Another retrospective study showed an operative mortality rate of 10% and a complication rate of 38% after emergency operation with colon resection.[4] A retrospective study revealed that patients operated with acute resection did not only show higher operative mortality rate, but also higher permanent stoma rate, lower number of harvested lymph nodes, and lower rate of adjuvant chemotherapy rate than the staged operation group.[1] A retrospective study reported that elective surgery should be performed, if possible, because emergency surgery for colon cancer obstruction is associated with a high frequency of complications and poor survival.[4]

The benefits of decompressive procedures for right colon cancer obstruction are less than those for left lesions. Although those procedures can prevent the need for emergency surgery and possibly permit preoperative medical optimization of patients, right hemicolectomy with primary anastomosis is possible even in an unprepared colon.[8] Numerous studies showed the efficacy of SEMS as a decompressive procedure. A systematic review and meta-analysis revealed that SEMS patients have higher 5-year overall morbidity within 60 days (51.2% vs 33.9%, relative risk [RR] = 0.59, $P = .023$) after surgery and lower permanent stoma rate (22.2% vs 35.2%, RR = 0.66, $P = .003$) than emergency surgery patients, with left colon cancer obstructions.[5] A retrospective study showed that SEMS patients have lower permanent stoma rate (16.1% vs 52.5%, $P < .001$), lower operative mortality rate (3.2% vs 17.5%, $P = .018$), and lower major complication rate (16.1% vs 40%, $P = .007$) than emergency operation patients.[7] A meta-analysis of 54 studies reported that SEMS as a bridge surgery in 1198 patients showed a clinical success rate of 71.7%, perforation rate of 3.8%, migration rate of 11.8%, and reobstruction rate of 7.3%.[9] In addition, a retrospective study revealed that SEMS patients showed a higher tumor perforation rate than colostomy patients (17% vs 9%, $P = .03$).[10]

Our analysis showed 0% operative mortality, 40% complication rate, 22% major complication rate, and 8% permanent stoma rate. Our study also reported lower permanent stoma rate and mortality rate than the other studies. These results can be attributed to higher laparoscopic operation rate and the recent rapid development of intensive care approach than the past. Our study groups showed a laparoscopic resection rate of 90%.

The SEMS showed numerous advantages; however, we had no choice but to perform transient diverting colostomy in some situations. As described above, the failure rate of SEMS was approximately 30%. However, SEMS was still rather difficult to implant in the descending colon and splenic flexure compared with the rectum and sigmoid colon.[17] Additionally, incontinence manifestation and low rectal cancer within 5 to 10 cm above the anal verge are contraindications for SEMS.[18,19] Severe tenesmus due to placement of the SEMS impinging on the anal sphincter is one of the reasons for contraindication.[20] Because SEMS could distort the mucosal surface of the tumor, SEMS insertion for rectal cancers may interfere in maintaining oncologic safety during surgery except upper rectal cancers. Additionally, patients with rectal cancers are prevented from receiving PCRT after SEMS. According to our study, 10 of 12 rectal cancer cases received diverting colostomy between 2 decompressive bridge procedures. The SEMS group did not receive PCRT, but 1 patient in the colostomy group received PCRT. Thus, our study showed that the colostomy group had a higher rate of rectal cancer than the SEMS group (24.0% vs 9.1%, $P = .019$). Additionally, we were not able to perform SEMS in patients with severe abdominal pain with implicating impending perforation and unstable vital sign including hypotension, tachycardia, and tachypnea.

Diverting colostomy is generally performed under general anesthesia. Thus, tumor resection following diverting colostomy between 2 decompressive procedures is not a real single-stage operation. Moreover, patients tend to dislike stoma even temporarily. We have to perform decompressive procedure individually depending on the circumstance such as variations in tumor location, opinions of endoscopists, subjective symptoms, and objective vital sign. A thorough and individualized approach is necessary.

According to our study, both decompressive procedures enable neoadjuvant chemotherapy before tumor resection and remove the need for emergency surgery by providing sufficient time for elective surgery on left colon cancer obstructions. Our study showed that 6 patients (12%) received neoadjuvant chemotherapy after decompressive procedures.

Amelung et al[21] reported no significant differences and higher incisional hernia rate (29.7% vs 9.8%, $P = .01$) in temporary colostomy patients and SEMS patients undergoing a bridge to surgery procedure for malignant left-sided colonic obstruction in a retrospective case–control study. Similarly, no significant difference was found in incisional hernia rate in our results. Four patients received diverting colostomy following SEMS failure. One patient had sustained pain caused by SEMS malfunction. One patient had recurrent obstructive symptoms, such as abdominal pain and distension, 2 weeks after the SEMS procedure. Guide wire insertion failed in 2 patients during endoscopic examination.

This study has a few limitations that should be considered when interpreting the results. First, a potential for referral and selection bias remains as the study was retrospective, observational in nature, and was performed at a single institution. Second, the follow-up period of the study was short (12 months). Many studies regarding SEMS as a bridge to surgery have been conducted. However, only a few studies have compared 2 decompressive procedures. To the best of our knowledge, this study is the 2nd to compare the short-term outcomes including complications of colostomy and SEMS as a bridge to surgery. Prospective, multicenter, multidisciplinary studies could

potentially overcome several limitations and produce further meaningful results in the future.

In conclusion, diverting colostomy showed acceptable complication rate and feasible performance. Although SEMS might permit higher laparoscopic resection rates and faster recovery of bowel habits than diverting colostomy, SEMS showed meaningful failure rate including migration and perforation. An individualized approach is necessary considering the advantages and disadvantages of both diverting colostomy and SEMS as a bridge to surgery.

Author contributions

Conceptualization: Won Beom Jung, Jin Yong Shin, Jong Kwon Park.
Data curation: Won Beom Jung, Jin Yong Shin, Jong Kwon Park.
Formal analysis: Won Beom Jung.
Methodology: Won Beom Jung, Jin Yong Shin.
Project administration: Won Beom Jung.
Resources: Won Beom Jung.
Supervision: Won Beom Jung.
Validation: Won Beom Jung.
Writing – original draft: Won Beom Jung.
Writing – review & editing: Won Beom Jung.
Won Beom Jung orcid: 0000-0001-5427-5964.

References

[1] Öistämö E, Hjern F, Blomqvist L, et al. Emergency management with resection versus proximal stoma or stent treatment and planned resection in malignant left-sided colon obstruction. World J Surg Oncol 2016;14:232.

[2] Ohman U. Prognosis in patients with obstructing colorectal carcinoma. Am J Surg 1982;143:742–7.

[3] De Salvo GL, Gava C, Pucciarelli S, et al. Curative surgery for obstruction from primary left colorectal carcinoma: primary or staged resection? Cochrane Database Syst Rev 2004;CD002101.

[4] Sjo OH, Larsen S, Lunde OC, et al. Short term outcome after emergency and elective surgery for colon cancer. Colorectal Dis 2009;11:733–9.

[5] Arezzo A, Passera R, Lo Secco G, et al. Stent as bridge to surgery for left-sided malignant colonic obstruction reduces adverse events and stoma rate compared with emergency surgery: results of a systematic review and meta-analysis of randomized controlled trials. Gastrointest Endosc 2017;86:416–26.

[6] Suarez J, Marin G, Vera R, et al. Stent placement prior to initiation of chemotherapy in patients with obstructive, nonoperative left sided tumors is associated with fewer stomas. J Surg Oncol 2017;115:856–63.

[7] Ho KM, Chan KM, Kwok SY, et al. Colonic self-expanding metal stent (SEMS) as a bridge to surgery in left-sided malignant colonic obstruction: an 8-year review. Surg Endosc 2017;31:2255–62.

[8] Almadi MA, Azzam N, Alharbi O, et al. Complications and survival in patients undergoing colonic stenting for malignant obstruction. World J Gastroenterol 2013;19:7138–45.

[9] Sebastian S, Johnston S, Geoghegan T, et al. Pooled analysis of the efficacy and safety of self-expanding metal stenting in malignant colorectal obstruction. Am J Gastroenterol 2004;99:2051–7.

[10] Diane M, Charles S, Gilles M, et al. What is the best option between primary diverting stoma or endoscopic stent as a bridge to surgery with a curative intent for obstructed left colon cancer? Results from a propensity score analysis of the French Surgical Association Multicenter Cohort of 518 patients. Ann of Surg Oncol 2019;26:756–64.

[11] Weiser MR. AJCC 8th edition: colorectal cancer. Ann Surg Oncol 2018;25:1454–5.

[12] Liebig C, Ayala G, Wilks JA, et al. Perineural invasion in cancer: a review of the literature. Cancer 2009;115:3379–91.

[13] Sato T, Ueno H, Mochizuki H, et al. Objective criteria for the grading of venous invasion in colorectal cancer. Am J Surg Pathol 2010;34:454–62.

[14] Washington MK, Berlin J, Branton P, et al. Protocol for the examination of specimens from patients with primary carcinoma of the colon and rectum. Arch Pathol Lab Med 2009;133:1539–51.

[15] Collins SL, Moore RA, McQuay HJ. The visual analogue pain intensity scale: what is moderate pain in millimetres? Pain 1997;72:95–7.

[16] Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg 2009;250:187–96.

[17] Fan YB, Cheng YS, Chen NW, et al. Clinical application of self-expanding metallic stent in the management of acute left-sided colorectal malignant obstruction. World J Gastroenterol 2006;12:755–9.

[18] Ptok H, Meyer F, Marusch F, et al. Palliative stent implantation in the treatment of malignant colorectal obstruction. Surg Endosc 2006;20:909–14.

[19] Tomiki Y, Watanabe T, Ishibiki Y, et al. Comparison of stent placement and colostomy as palliative treatment for inoperable malignant colorectal obstruction. Surg Endosc 2004;18:1572–7.

[20] Fernandez-Esparrach G, Bordas JM, Giraldez MD, et al. Severe complications limit long-term clinical success of self-expanding metal stents in patients with obstructive colorectal cancer. Am J Gastroenterol 2010;105:1087–93.

[21] Amelung FJ, ter Borg F, Consten ECJ, et al. Deviating colostomy construction versus stent placement as bridge to surgery for malignant left-sided colonic obstruction. Surg Endosc 2016;30:5345–55.