Safety of subtotal or total colectomy with primary anastomosis compared to Hartmann procedure for left-sided colon cancer obstruction or perforation

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Purpose: Whether subtotal or total colectomy with primary anastomosis (PA) is safer than Hartmann procedure (HP) for left-sided colon cancer obstruction or perforation remains controversial. The purpose of this study was to compare postoperative morbidity, mortality, and defecation frequency between PA and HP for left-sided colon cancer obstruction or perforation.

Methods: This retrospective study enrolled 54 patients from January 2014 to February 2018 who underwent emergency surgery due to left-sided colon cancer obstruction or perforation.

Results: PA was carried out in 20 patients while HP was performed for 34 patients. Thirty-day mortality did not show significant difference between the two groups (15.0% vs. 14.7%, $P = 1.000$). No anastomotic leakage occurred in PA group while three (8.8%) cases of stump leakage occurred in HP group. Stoma repair was performed for 13 cases (44.8%) and stoma reformation was performed for one case in HP group (7.7%). Stoma related complications occurred in five cases (17.24%). For patients after stoma repair, defecation frequency at 3 months after operation was 2.91 ± 2.88 times per day in PA group and 2.86 ± 2.63 times per day in HP group. At 1 year after operation, defecation frequency was changed to 1.40 ± 1.12 times per day in PA group and 1.17 ± 0.39 times per day in HP group.

Conclusion: Primary ileosigmoid or ileorectal anastomosis for left-sided colon cancer obstruction or perforation is safe, and shows similar outcome of defecation frequency compared to HP.

Keywords: Subtotal colectomy, Anastomosis, Colonic neoplasms, Hartmann procedure

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INTRODUCTION

Approximately one-third of patients with colon cancer present to an emergency room because of obstruction or perforation. They have high postoperative mortality and poor survival [1]. Acute obstruction of the colon is an early symptom in 7%–29% of colorectal cancer patients. It often leads to emergency surgery. Acute symptoms are more common in advanced disease and elderly patients. Tumor-related left-sided colon obstruction is particularly difficult for surgery due to the risk of perforation in the enlarged colon near the tumor. Emergency surgery due to malignant obstruction of the left-sided colon is associated with frequent complications and poor survival [2]. Colon perforation is a life-threatening condition. If severe peritonitis occurs after colon perforation, emergency surgery is needed [3].

In the past, Hartmann procedure (HP) was recommended because it could prevent intra-abdominal sepsis associated with anastomotic dehiscence. However, subtotal or total colectomy with

primary anastomosis (PA) is a recent, attractive alternative as it can provide acceptable results in terms of morbidity, mortality, anastomotic leakage, and sepsis complications [4,5]. HP requires a second laparotomy to repair the stoma. Approximately 30% of patients end up with a permanent stoma. Many patients may not be able to receive stoma repair due to their age or condition, cancer aggravation, or postoperative expire. Colostomy repair after HP is associated with long-term hospitalization and morbidity of 33% [6,7].

Self-expandable metallic stent (SEMS) is used to bridge surgery to avoid HP [8-10]. This prevents malnutrition and colon dilatation and improves surgical outcome. However, colonic stent has several disadvantages such as perforation, re-obstruction, and stent migration [11,12]. Technical and clinical failure rates of colonic SEMS are 20%–30% [13]. A randomized controlled trial has reported a technical failure rate of 53.3% [14]. Some reports have suggested that SEMS insertion is associated with adverse oncological outcomes [13]. PA has been proposed as an effective surgical procedure to treat patients with left-sided colon cancer. PA can remove synchronous proximal neoplasms and reduce the risk of subsequent metachronous tumor development [15,16]. Subtotal colectomy with ileosigmoid anastomosis for colon cancer can result in good bowel function. Its potential benefits include shorter hospital stay, reduced mortality and morbidity rates, and avoidance of stoma compared to HP [17].

The present study is based on a recent study showing that PA is not inferior to HP for left-sided colon cancer obstruction or perforation [3,16]. The aim of this study was to evaluate short-term outcomes and defecation frequency after PA compared to those after HP for left-sided colon cancer obstruction or perforation.

METHODS

In this study, we included patients with left-sided colon cancer obstruction or perforation who received emergency surgery, which was subtotal or total colectomy with PA or HP. Between January 2014 and February 2018, 106 patients who underwent emergency surgery for left-sided colon cancer obstruction or perforation were reviewed. First, nine patients were excluded due to pathology stage IV. Second, 43 patients were excluded, including nine patients who underwent left hemicolectomy, 15 patients who underwent anterior resection, 10 patients who underwent low anterior resection, and nine patients who underwent subtotal or total colectomy with end ileostomy. Finally, 54 patients were selected. Twenty patients underwent subtotal or total colectomy with PA and 34 patients underwent HP. Surgery type was based on surgeon preference and intraoperative finding. The surgeon performed subtotal or total

colectomy with PA when synchronous colon cancer or proximal colonic ischemia was observed. Operations were performed by three expert colorectal surgeons (JKL, YTJ, and SJK).

Underlying diseases included hypertension, diabetes mellitus, pulmonary disease (asthma, chronic obstructive pulmonary disease, tuberculosis, pulmonary thromboembolism, and interstitial lung disease), heart disease (myocardial infarction, heart failure, and arrhythmia), renal disease (chronic renal failure), liver cirrhosis, and cerebral vascular accident history. Intraoperative parameters included operation time, approach method, and presence of using inotropics. Postoperative parameters were Clavien-Dindo classification, intensive care unit (ICU) care, duration of ICU, ventilator care, continuous renal replacement therapy (CRRT), postoperative 30-day mortality, postoperative morbidity, and defecation frequency. Defecation frequency was measured at 3 months and 1 year after operation. It was compared according to anastomosis site (ileorectal anastomosis vs. ileosigmoid anastomosis). All data were retrieved from our electronic medical record system and a retrospective analysis was performed. This study was approved by the Institutional Review Board of Gyeongsang National University Hospital (IRB No. 2018-09-011). Informed consent was waived according to IRB regulations. Statistical analysis was performed using SPSS 21.0 software (IBM Corp., Armonk, NY, USA). Significance was calculated using Mann-Whitney U-test for quantitative variables and Fisher exact test for categorical data. $P < 0.05$ was considered significant.

RESULTS

Subtotal or total colectomy with PA was performed in 20 patients while HP was performed in 34 patients. Their clinical characteristics are shown in Table 1. Preoperative systemic inflammatory response syndrome was not significantly different between PA and HP groups (55.0% vs. 55.9%, $P = 1.000$). Preoperative septic shock was not significantly different either between PA and HP groups (20.0% vs. 20.6%, $P = 1.000$). American Society of Anesthesiologists (ASA) scores of patients were not significantly different between the two groups (ASA 2: 55.0% vs. 44.1%; ASA 3: 40.0% vs. 55.9%; ASA 4: 5.0% vs. 0.0%, $P = 0.699$ for PA vs. HP). Underlying diseases of patients were not significantly different between PA and HP groups either (55.0% vs. 47.1%, $P = 0.779$). Intraoperative outcomes are shown in Table 2. PA and HP were similarly carried out for patients with obstruction or perforation. Operative time was significantly different between PA and HP groups (211.0 ± 62.8 minutes vs. 159.9 ± 67.6 minutes, $P = 0.008$). The proportion of patients with continuous inotropics infusion was similar between the two groups (55.0% vs. 41.2%, $P = 0.402$).

Table 1. Clinical characteristics of patients

Characteristic	PA (n = 20)	HP (n = 34)	P-value
Age (yr)	71.9 ± 9.1	71.9 ± 12.1	0.999
Sex			1.000
Male	13 (65.0)	21 (61.8)	
Female	7 (35.0)	13 (38.2)	
Body mass index (kg/m ²)	21.7 ± 2.7	22.0 ± 3.5	0.726
ASA score			0.699
1	0	0	
2	11 (55.0)	15 (44.1)	
3	8 (40.0)	19 (55.9)	
4	1 (5.0)	0	
Underlying disease	11 (55.0)	16 (47.1)	0.779
Location of tumor			0.169
DS junction colon	14 (70.0)	17 (50.0)	
Sigmoid colon	6 (30.0)	17 (50.0)	
Pathology			0.072
I	0	0	
II	9 (45.0)	7 (20.6)	
III	11 (55.0)	27 (79.4)	
SIRS	11 (55.0)	19 (55.9)	1.000
Septic shock	4 (20.0)	7 (20.6)	1.000

Values are presented as mean ± standard deviation or number (%).

PA, primary anastomosis; HP, Hartmann procedure; ASA, American Society of Anesthesiologists; DS, descending and sigmoid; SIRS, systemic inflammatory response syndrome.

Table 2. Intraoperative outcomes

Outcome	PA (n = 20)	HP (n = 34)	P-value
Obstruction	10 (50.0)	30 (88.2)	0.003
Perforation	15 (75.0)	21 (61.8)	0.381
Operation time (min)	211.0 ± 62.8	159.9 ± 67.6	0.008
Approach method			0.236
Open	13 (65.0)	29 (85.3)	
Laparoscopy assisted	4 (20.0)	1 (2.9)	
Open conversion	3 (15.0)	4 (11.8)	
Continuous inotropics infusion	11 (55.0)	14 (41.2)	0.402
Intraoperative complication (bleeding)	4 (20.0)	9 (26.5)	0.746

Values are presented as number (%) or mean ± standard deviation.

PA, primary anastomosis; HP, Hartmann procedure.

Primary endpoints were postoperative morbidity and mortality. There was no significant difference in Clavien-Dindo classification between PA and HP ($P = 0.520$). ICU care was performed for nine (45.0%) cases in PA and 15 (44.1%) cases in HP ($P = 1.000$). Duration of ICU was 4.4 ± 11.5 days for PA and 4.5 ± 10.6 days for HP ($P = 0.961$). Ventilator care was treated for nine (45.0%) cases in PA and 16 (47.1%) cases in HP ($P = 1.000$). CRRT was treated for one (5.0%) case in PA and one (2.9%) case in HP ($P = 1.000$). There was no significant difference in postoperative 30-day mortality be-

Table 3. Postoperative outcomes

Outcome	PA (n = 20)	HP (n = 34)	P-value
Clavien-Dindo classification			0.520
Grade I	5 (25.0)	3 (8.8)	
Grade II	0	0	
Grade III	0	5 (14.7)	
Grade IV	6 (30.0)	11 (32.4)	
Grade V	3 (15.0)	5 (14.7)	
Hospital stay (day)	19.5 ± 13.8	22.0 ± 17.2	0.586
Gas out (day)	7.3 ± 3.2	5.5 ± 4.4	0.139
Oral intake (day)	8.4 ± 2.9	9.2 ± 5.0	0.565
ICU care	9 (45.0)	15 (44.1)	1.000
Duration of ICU (day)	4.4 ± 11.5	4.5 ± 10.6	0.961
Ventilator care	9 (45.0)	16 (47.1)	1.000
Duration of weaning (day)	10.9 ± 18.3	11.0 ± 14.9	0.985
CRRT	1 (5.0)	1 (2.9)	1.000
Postoperative complication			
Ileus	4 (20.0)	8 (23.5)	1.000
Pneumonia	3 (15.0)	4 (11.8)	1.000
Heart problem (AF)	0	3 (8.8)	0.287
Septic shock	5 (25.0)	12 (35.3)	0.549
Wound infection	1 (5.0)	9 (26.5)	0.072
Leakage (anastomosis or stump)	0	3 (8.8)	0.287
Other	0	1 (2.9)	1.000
Reoperation (within 1 mo)	1 (5.0)	12 (35.3)	0.019
Mortality (within 1 mo)	3 (15.0)	5 (14.7)	1.000

Values are presented as number (%) or mean ± standard deviation.

PA, primary anastomosis; HP, Hartmann procedure; ICU, intensive care unit; CRRT, continuous renal replacement therapy; AF, atrial fibrillation.

tween PA and HP (3 cases [15.0%] vs. 5 cases [14.7%], $P = 1.000$). Regarding postoperative complication, there was no case of anastomotic leakage in PA. However, there were three (8.8%) cases of stump leakage in HP (Table 3). Adjuvant chemotherapy was performed for five (25%) patients in PA group and 14 (41.2%) patients in HP group ($P = 0.257$). The reasons for not performing chemotherapy were patient refusal due to old age (over 70 years) and patient morbidity (13 patients, 37.1%), poor performance status (Karnofsky performance index under 60 score or Eastern Cooperative Oncology Group performance status 3–4: 10 patients, 28.6%), death (8 patients, 22.9%), and interhospital transfer (4 patients, 11.4%).

Secondary endpoints were quality of life related to stoma repair, stoma reformation, stoma related complication, and defecation frequency. There were 13 (44.8%) cases of stoma repair in HP group, including one (7.7%) case of stoma reformation due to rectovaginal fistula. In HP group, except within 30-day mortality patients, 16 patients (55.2%) could not receive stoma repair because of their age, condition, and cancer aggravation. Eight patients could not receive stoma repair due to their old age and severe mor-

Table 4. Stoma repair operation

Variable	HP (n = 29) ^{a)}
Stoma repair	
Yes	13 (44.8)
No	16 (55.2)
Time to repair of stoma (day)	243.6 ± 61.4
Stoma repair operation	
Operation time (min)	217.3 ± 63.1
Hospital stay (day)	20.3 ± 7.7
Complication after stoma repair	1 (7.7)

Values are presented as number (%) or mean ± standard deviation.

HP, Hartmann procedure.

^{a)}Except within 30-day mortality patients.

Table 5. Postoperative defecation frequency

	PA (n = 17)	HP (n = 12)	P-value
Defecation frequency (3 mo after operation)	2.91 ± 2.88	2.86 ± 2.63	0.960
Defecation frequency change (1 yr after operation)	1.40 ± 1.12	1.17 ± 0.39	0.496

Values are presented as mean ± standard deviation.

PA, primary anastomosis; HP, Hartmann procedure.

idity. Eight patients could not receive it due to cancer aggravation. Stoma related complications occurred in five (17.24%) cases in HP, including two cases of dermatitis around the stoma, one case of mucocutaneous stomal dehiscence, and two cases of parastomal hernia. For patients admitted to hospital for stoma repair, hospital stay was 20.3 ± 7.7 days. Patients waited 243.6 ± 61.4 days to repair the stoma (Table 4). For patients after stoma repair, defecation frequency at 3 months after operation was 2.91 ± 2.88 times per day in PA group and 2.86 ± 2.63 times per day in HP group (P = 0.960). At 1 year after operation, defecation frequency was changed to 1.40 ± 1.12 times per day in PA group and 1.17 ± 0.39 times per day in HP group (P = 0.496) (Table 5). We compared defecation frequency between those with ileorectal anastomosis and those with ileosigmoid anastomosis. At 3 months after operation, defecation frequency was 3.55 ± 3.21 times per day in those with ileorectal anastomosis and 1.75 ± 1.88 times per day in those with ileosigmoid anastomosis (P = 0.231). At 1 year after operation, defecation frequency was changed to 1.55 ± 1.21 times per day in those with ileorectal anastomosis and 1.13 ± 0.96 times per day in those with ileosigmoid anastomosis (P = 0.486) (Table 6).

DISCUSSION

Surgical management of left-sided malignant colon cancer obstruction has evolved considerably over the last several decades. Its

Table 6. Postoperative defecation frequency of ileorectal anastomosis and ileosigmoid anastomosis groups

	Ileorectal anastomosis (n = 11)	Ileosigmoid anastomosis (n = 6)	P-value
Defecation frequency (3 mo after operation)	3.55 ± 3.21	1.75 ± 1.88	0.231
Defecation frequency change (1 yr after operation)	1.55 ± 1.21	1.13 ± 0.96	0.486

Values are presented as mean ± standard deviation.

treatment consists of the following three stages: formation of a colostomy, resection, and closure of the colostomy. This approach has been gradually replaced by a two-stage procedure in which the tumor is first resected with HP and then restored to continuity. Each stage has morbidity and mortality [16]. Severe peritonitis following colon cancer perforation requires emergency surgery, including resection of the rectosigmoid colon with closure of the anorectal stump and formation of an end colostomy (HP) as well as subtotal or total colectomy with PA [18-20].

One-stage resection and anastomosis have several advantages, such as saving admission time, decreasing hospital costs, and avoiding problems and embarrassment caused by colostomy. Thus, it can provide patients a better quality of life [15]. In addition, this method can decrease risk for patients with proximal synchronous malignant lesions. About 3%–4% of colorectal cancer patients have synchronous colorectal cancer [21,22]. In our study, three (15.0%) patients in the PA group had synchronous cancer. Other studies have reported synchronous cancer in 3%–11% of patients who undergo PA for left-sided colon cancer [15,16]. PA might be an oncologically safe strategy for patients with synchronous tumor [13].

There was no significant difference in postoperative 30-day mortality between PA and HP groups (15.0% vs. 14.7%, P = 1.000). Postoperative septic shock proportion was comparatively high (25.0% vs. 35.3%, P = 0.549). There was no anastomotic leakage in PA. For emergency operation, bowel preparation was not done. Bowel contents might increase the risk of anastomotic leakage. Therefore, we attempted to remove as much bowel content as possible. Nevertheless, when anastomotic leakage was suspicious, we inserted a rectal tube (size: 17.5 × 7 × 200 mm) that passed 10 cm above the anastomosis site and connected to Levin tube bag for natural drainage [23]. Rectal tubes were inserted in three of 20 cases. The duration of rectal tube insert was 8.7 days.

After HP, patients must wait at least 8 weeks before stoma repair can be safely done. They need to wait longer to have proper intestinal recovery [24,25]. However, many patients may not be able to

receive stoma repair because of their age or condition, cancer aggravation, or postoperative death. In this report, eight patients could not receive stoma repair due to their old age and severe morbidity, eight patients could not receive it due to cancer aggravation, and five patients could not receive it due to postoperative death. Thus, these patients might have to make physical and mental adjustments to live with a stoma [25]. In this report, hospital stay was not significantly different between PA and HP groups (19.5 ± 13.8 days vs. 22.0 ± 17.2 days, $P = 0.586$). However, HP group of patients needed a 2nd hospital stay for stoma repair. As a result, the patients' hospital stay was longer. In addition, colonofiberscope and computed tomography of the abdomen were performed before stoma repair. Thus, patients had to pay more in hospital costs. In another study, duration of stoma repair was 26 weeks and stoma repair rate was 48% [26]. Similarly, duration of stoma repair was 34 weeks and stoma repair rate was approximately 44.8% in our center. Regarding reformation after stoma repair, the rate was 5% in one study [26] and 7.7% in our center. A 72-year-old female patient who underwent reformation after stoma repair had sigmoid colon cancer perforation (pT3N2) for which HP was performed. Stoma repair was then performed after 26 weeks. After 4 weeks of stoma repair, loop ileostomy was performed due to a rectovaginal fistula.

Defecation frequency was 2.91 ± 2.88 times per day in PA group and 2.86 ± 2.63 times per day in HP group at 3 months after operation. Five patients (29.41%) used antidiarrheal medication. Patients took antidiarrheal medication when defecation frequency was more than 10 times or they simply wanted to take antidiarrheal medication. The duration of antidiarrheal medication was 4 months. Defecation became stable at 1 year after operation (1.40 ± 1.12 times per day in PA vs. 1.17 ± 0.39 times per day in HP). Defecation frequency was higher in those with ileorectal anastomosis than in those with ileosigmoid anastomosis (3.55 ± 3.21 times per day vs. 1.75 ± 1.88 times per day) at 3 months after operation. At 1 year after operation, it became similar in the two groups (1.55 ± 1.21 times per day vs. 1.13 ± 0.96 times per day).

This study has limitations including its small sample size and retrospective review of medical records. In addition, the patients included were not randomly selected. However, we expect that this initial comparison study will lead to a larger randomized prospective study that will conclusively demonstrate PA (primary ileosigmoid or ileorectal anastomosis) to be a good surgical option in emergency operation for left-sided colon cancer obstruction or perforation.

In conclusion, the present study demonstrates that PA is safer than HP in the aspect of postoperative outcome, and there is similar outcome in defecation frequency between PA and HP. Subtotal or total colectomy with primary ileosigmoid or ileorectal anasto-

mosis is a one-step operation and enables patients to avoid temporary or permanent colostomy. PA is an acceptable treatment strategy for patients undergoing emergency surgery for left-sided colon cancer obstruction or perforation. A large randomized study is crucial to assess the feasibility and advantages of PA, as well as its efficacy with respect to long-term oncological outcomes.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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REFERENCES

- McArdle CS, Hole DJ. Emergency presentation of colorectal cancer is associated with poor 5-year survival. *Br J Surg* 2004;91:605-9.
- Oistamo E, Hjern F, Blomqvist L, Falken Y, Pekkari K, Abraham-Nordling M. 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.
- Tsuchiya A, Yasunaga H, Tsutsumi Y, Matsui H, Fushimi K. Mortality and morbidity after Hartmann's procedure versus primary anastomosis without a diverting stoma for colorectal perforation: a nationwide observational study. *World J Surg* 2018;42:866-75.
- Hoemke M, Treckmann J, Schmitz R, Shah S. Complicated diverticulitis of the sigmoid: a prospective study concerning primary resection with secure primary anastomosis. *Dig Surg* 1999;16:420-4.
- Regenet N, Pessaux P, Hennekinne S, Lermite E, Tuech JJ, Brehant O, et al. Primary anastomosis after intraoperative colonic lavage vs. Hartmann's procedure in generalized peritonitis complicating diverticular disease of the colon. *Int J Colorectal Dis* 2003;18:503-7.
- Khosraviani K, Campbell WJ, Parks TG, Irwin ST. Hartmann procedure revisited. *Eur J Surg* 2000;166:878-81.
- Belmonte C, Klas JV, Perez JJ, Wong WD, Rothenberger DA, Goldberg SM, et al. The Hartmann procedure. First choice or last resort in diverticular disease? *Arch Surg* 1996;131:612-5.
- Park IJ, Choi GS, Kang BM, Lim KH, Lee IT, Jeon SW, et al. Comparison of one-stage managements of obstructing left-sided colon and rectal cancer: stent-laparoscopic approach vs. intraoperative colonic lavage. *J Gastrointest Surg* 2009;13:960-5.
- Alcantara M, Serra-Aracil X, Falco J, Mora L, Bombardo J, Navarro

- S. Prospective, controlled, randomized study of intraoperative colonic lavage versus stent placement in obstructive left-sided colonic cancer. *World J Surg* 2011;35:1904-10.
10. Ho KS, Quah HM, Lim JF, Tang CL, Eu KW. Endoscopic stenting and elective surgery versus emergency surgery for left-sided malignant colonic obstruction: a prospective randomized trial. *Int J Colorectal Dis* 2012;27:355-62.
11. Almadi MA, Azzam N, Alharbi O, Mohammed AH, Sadaf N, Aljebreen AM. Complications and survival in patients undergoing colonic stenting for malignant obstruction. *World J Gastroenterol* 2013;19:7138-45.
12. Sebastian S, Johnston S, Geoghegan T, Torreggiani W, Buckley M. Pooled analysis of the efficacy and safety of self-expanding metal stenting in malignant colorectal obstruction. *Am J Gastroenterol* 2004;99:2051-7.
13. Min CK, Kim HO, Lee D, Jung KU, Lee SR, Kim H, et al. Obstructive left colon cancer should be managed by using a subtotal colectomy instead of colonic stenting. *Ann Coloproctol* 2016;32:215-20.
14. Pirlet IA, Slim K, Kwiatkowski F, Michot F, Millat BL. Emergency preoperative stenting versus surgery for acute left-sided malignant colonic obstruction: a multicenter randomized controlled trial. *Surg Endosc* 2011;25:1814-21.
15. Ghazal AH, El-Shazly WG, Bessa SS, El-Riwini MT, Hussein AM. Colonic endolumenal stenting devices and elective surgery versus emergency subtotal/total colectomy in the management of malignant obstructed left colon carcinoma. *J Gastrointest Surg* 2013;17:1123-9.
16. Hennekinne-Mucci S, Tuech JJ, Brehant O, Lermite E, Bergamaschi R, Pessaix P, et al. Emergency subtotal/total colectomy in the management of obstructed left colon carcinoma. *Int J Colorectal Dis* 2006;21:538-41.
17. Manceau G, d'Annunzio E, Karoui M, Breton S, Rousseau G, Blanchet AS, et al. Elective subtotal colectomy with ileosigmoid anastomosis for colon cancer preserves bowel function and quality of life. *Colorectal Dis* 2013;15:1078-85.
18. Feingold D, Steele SR, Lee S, Kaiser A, Boushey R, Buie WD, et al. Practice parameters for the treatment of sigmoid diverticulitis. *Dis Colon Rectum* 2014;57:284-94.
19. Constantinides VA, Heriot A, Remzi F, Darzi A, Senapati A, Fazio VW, et al. Operative strategies for diverticular peritonitis: a decision analysis between primary resection and anastomosis versus Hartmann's procedures. *Ann Surg* 2007;245:94-103.
20. Salem L, Flum DR. Primary anastomosis or Hartmann's procedure for patients with diverticular peritonitis? A systematic review. *Dis Colon Rectum* 2004;47:1953-64.
21. Mulder SA, Kranse R, Damhuis RA, de Wilt JH, Ouwendijk RJ, Kuipers EJ, et al. Prevalence and prognosis of synchronous colorectal cancer: a Dutch population-based study. *Cancer Epidemiol* 2011;35:442-7.
22. Passman MA, Pommier RF, Vetto JT. Synchronous colon primaries have the same prognosis as solitary colon cancers. *Dis Colon Rectum* 1996;39:329-34.
23. Kim MK, Won DY, Lee JK, Kang WK, Kim JG, Oh ST. Comparative study between transanal tube and loop ileostomy in low anterior resection for mid rectal cancer: a retrospective single center trial. *Ann Surg Treat Res* 2015;88:260-8.
24. Mitry E, Barthod F, Penna C, Nordlinger B. Surgery for colon and rectal cancer. *Best Pract Res Clin Gastroenterol* 2002;16:253-65.
25. Pearce NW, Scott SD, Karran SJ. Timing and method of reversal of Hartmann's procedure. *Br J Surg* 1992;79:839-41.
26. Zorcolo L, Covotta L, Carlomagno N, Bartolo DC. Safety of primary anastomosis in emergency colorectal surgery. *Colorectal Dis* 2003;5:262-9.