

# Influence of old age on the postoperative outcomes of obstructive colorectal cancer surgery after the insertion of a stent

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**Purpose:** In some patients more than 70 years of age with obstructive colorectal cancer, their concerns about the postoperative complications lead them to refuse surgery after the insertion of a stent. This study aimed to compare the postoperative outcomes between obstructive colorectal cancer patients aged less than 70 years and those aged 70 years and more who underwent surgery after the insertion of a colonoscopic stent.

**Methods:** Patients with obstructive colorectal cancer who underwent surgery after the insertion of a colonoscopic stent between March 2004 and March 2014 were reviewed retrospectively by using medical records. The patients were divided into two groups: 22 patients were aged less than 70 years (group A) and 30 patients were aged more than 70 years (group B).

**Results:** Although no significant difference in comorbidity was noted between the two groups, the American Society of Anesthesiologists (ASA) score was higher in group B. There was no significant difference in cancer location, stage, or the time from the insertion of the stent to operation. The perioperative results including operation time, blood loss, and length of stay were not significantly different between the groups. The postoperative complications were also not significantly different.

**Conclusion:** The surgical outcomes of elderly patients were similar to those of younger patients, despite higher ASA scores. These results indicate that surgery can be performed safely in elderly patients with obstructive colorectal cancer after the insertion of a stent.

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**Key Words:** Colorectal neoplasms, Stents, Intestinal obstruction, Aged

## INTRODUCTION

The risk of developing colorectal cancer increases with age. The incidence is the highest at approximately 80 years of age [1,2]. Colon obstruction occurs in 20% to 30% of colorectal cancer patients, potentially resulting in pathological distension, bacterial infection, electrolyte imbalance, necrosis, and perforation of the colon. Emergency decompression, therefore, is necessary to prevent these complications [3]. Primary resection and anastomosis without preoperative

bowel preparation and colon decompression has a high risk of anastomosis leakage followed by a temporary or permanent stomy, which is associated with decreased quality of life in most patients. Distended bowels caused by colon obstruction could be an obstacle to achieving adequate operative field conditions, thereby increasing the incidence of complications. Recently, curative or palliative colonic stenting for patients with obstructive colorectal cancer has been introduced, and its efficacy has been reported to be good [4]. Colonic stenting helps to avoid emergency surgery and allows preoperative

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bowel preparation for an elective surgery. It, therefore, enables surgeons to perform primary bowel anastomosis and to avoid stoma-related complications and inconvenience [5]. In addition, colonic stenting has not been shown to have an adverse influence on the perioperative mortality, long-term survival, or progression of colorectal cancer [6].

In some patients more than 70 years of age with obstructive colorectal cancer, their concerns about the postoperative complications lead them to refuse surgery after the insertion of a stent. Elderly patients often have a reduced physiological reserve to cope with the stress of surgery. However, the advancement of surgical techniques, introduction of novel equipment, and improvement of anesthesia and postoperative care have allowed elderly patients undergo surgery more safely during the last few decades. There have been few studies comparing the postoperative outcomes between patients aged less than 70 years and those aged 70 years or more after the insertion of a colonoscopic stent. This study aimed to compare the postoperative outcomes between obstructive colorectal cancer patients aged less than 70 years and those aged 70 years and more who underwent surgery after the insertion of a colonoscopic stent.

## METHODS

### Study population and design

Obstructive colorectal cancer patients who underwent surgery after the insertion of a colonoscopic stent between March 2004 and March 2014 were reviewed retrospectively by using medical records. A previous study showed that age more than 70 years was an independent predictive factor of the postoperative mortality and morbidity after colorectal surgery [7]. Based on this result, patients were divided into two groups based on their age at the time of surgery: group A (age < 70 years) and group B (age  $\geq$  70 years). Exclusion criteria were as follows: severe comorbidity as judged by an American Society of Anesthesiologists (ASA) score of 4, refusing surgery, and age less than 20 years.

For the pathologic diagnosis and preoperative clinical staging of colorectal cancer, colonoscopic biopsy, abdominal and pelvic CT scanning, and PET-CT scanning were performed.

Preoperative mechanical bowel preparation (MBP) was performed by using polyethylene glycol (PEG). MBP involved ingestion of 4 L of PEG 2 days before surgery.

### Collection and comparison of clinical data

Patient data were collected retrospectively from electronic medical records, including information about patient demographics, cancer characteristics, treatment, and survival. We also obtained survival data of the patients from Division of Cancer Registration & Surveillance, National Cancer Control

Institute of Korea. The two groups were compared considering patient demographics, surgery type, and postoperative outcomes including morbidity and mortality. Postoperative morbidity and mortality were defined as an adverse event and death within 30 days of colorectal surgery, respectively. Data on the following postoperative complications were analyzed: surgery-related infections (i.e., surgical-site infections [SSI]), nonsurgery related infections including pneumonia and urinary tract infections, anastomotic leakage, and postoperative ileus.

Anastomosis leakage was clinically defined as the symptoms and signs of feculent or purulent peritonitis caused by anastomotic dehiscence during the postoperative period. Abdominal CT scanning was used to verify the leakage. A postoperative ileus was defined as the cessation of bowel motility resulting in bowel distension visible on plain abdominal radiographs and requiring the insertion of a nasogastric tube to resolve the bowel distension.

### Statistical analyses

Statistical analyses were performed with PASW Statistics ver. 18.0 (SPSS Inc., Chicago, IL, USA). The data are presented as frequencies and percentages for categorical variables and were analysed with the Pearson chi-square test or the Fisher exact test. The Kolmogorov-Smirnov test was used to test normal distribution of continuous variables. Normally distributed variables were subjected to examination with Student t-test and results were presented as mean  $\pm$  standard deviation. Continuous variables that displayed no normal distribution were examined with the Mann-Whitney U test and results were expressed as median (interquartile range). The Kaplan-Meier method was used to analyze survival. A two-tailed  $P < 0.05$  was considered statistically significant.

### Ethics statement

This study protocol was reviewed and approved by the Institutional Review Board of the Keimyung University Dongsan Medical Center (IRB No. 2014-03-037-002). Informed consent was waived owing to the retrospective design of the study.

## RESULTS

### Demographics and clinical findings

A total of 52 patients were enrolled in this study. Twenty-two patients were aged less than 70 years (group A) and 30 patients were aged 70 years or more (group B). The mean age of the patients in both groups was significantly different ( $60.0 \pm 6.4$  years vs.  $76.1 \pm 4.6$  years;  $P < 0.01$ ). There was no significant difference in the sex, comorbidity, cancer location, and cancer stage between the groups. Although no significant difference in comorbidity was noted between the two groups, more patients

in group B presented with high ASA scores; 4.5% and 23.3% of patients had a score of 3 in groups A and B, respectively (P = 0.017) (Table 1).

A total of 10 patients with stage IV colorectal cancer underwent surgery for primary colorectal cancer (6 in group A and 4 in group B). Combined resection for metastatic lesions was performed simultaneously in 3 patients (2 in group A and 1 in group B). One patient in group B underwent radiofrequency ablation for liver metastasis (Table 2).

**Table 1.** Patient demographics

Demographic	Age < 70 yr (n = 22)	Age ≥ 70 yr (n = 30)	P-value
Mean age (yr)	60.0 ± 6.4	76.1 ± 4.6	<0.001
Sex			
Male : female	18 : 4	18 : 12	0.131
Comorbidity	8 (36.4)	11 (36.7)	0.982
Hypertension	4 (18.2)	8 (26.7)	
Diabetes mellitus	2 (9.1)	4 (13.3)	
Cardiovascular disease	5 (22.7)	6 (20.0)	
Pulmonary disease	0 (0)	3 (10.0)	
ASA score			0.017
1	10 (45.5)	4 (13.3)	
2	11 (50.0)	19 (63.3)	
3	1 (4.5)	7 (23.3)	
Cancer location			0.597
Transverse colon	1 (4.5)	1 (3.3)	
Descending colon	3 (13.6)	5 (16.7)	
Sigmoid colon	10 (45.5)	18 (60.0)	
Rectum	8 (36.4)	6 (20.0)	
Cancer stage			0.291
II	11 (50.0)	14 (46.7)	
III	5 (22.7)	12 (40.0)	
IV	6 (27.3)	4 (13.3)	

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

ASA, American Society of Anesthesiologists.

The perioperative results are shown in Table 2. The time from the insertion of the stent to the operation was not different significantly (median [interquartile range]: 13.0 [5.0–89.3] days vs. 13.5 [10.8–26.0] days, P = 0.767). There were no stent-related complications prior to surgery in either group. Blood loss and length of stay were not significantly different between the two groups. Operation time, however, was longer in group A (215 ± 99 minutes vs. 163 ± 43 minutes, P = 0.028) (Table 3). In group A, three patients with rectal cancer received neoadjuvant chemoradiotherapy after colonic stenting, followed by abdominoperineal resection 4 to 8 weeks after the completion of neoadjuvant chemoradiotherapy. Of the three patients, first patient had a huge tumor measuring 7 cm × 6 cm, which was located 4 cm from the anal verge (AV) and invaded the urinary bladder; second patient had a tumor, located 3 cm from the AV, with invasion of the levator ani muscle; and third patient with a tumor located 5 cm from the AV had invasion of the urinary bladder and urethra.

**Postoperative results and complications**

The postoperative results are shown in Table 4. The time to the passage of the first flatus after surgery was not different between the two groups (2.6 ± 1.2 days vs. 3.0 ± 1.0 days, P = 0.370). The time to ingestion of the first soft food, however, was longer in group B (5.7 ± 1.8 days vs. 8.1 ± 3.8 days, P = 0.008). The morbidity rate was not significantly different between the groups (22.7% vs. 26.7%; P = 0.746); 13 morbidities occurred in 52 patients (25%). Postoperative ileus occurred in 2 patients (1 patient in each group), which resolved with conservative management including the insertion of a nasogastric tube. The number of patients with SSI was the same between the two groups. Three patients in each group had a diagnosis of SSI, and 2 in each group had superficial incisional SSIs. One patient in each group had space/organ SSIs and underwent percutaneous drainage. Urinary tract infection (1 patient) and

**Table 2.** Surgical resections in patients with stage IV colorectal cancer

Patient	Age (yr)	Location of primary cancer	Location of metastasis	Surgery for primary cancer	Combined resection for metastasis
1	43	Sigmoid colon	Liver	Anterior resection	Right posterior sectionectomy (simultaneous)
2	53	Sigmoid colon	Para-aortic lymph nodes	Hartmann procedure	-
3	53	Descending colon	Distant lymph nodes	Left hemicolectomy	-
4	57	Sigmoid colon	Liver (multiple)	Anterior resection	-
5	63	Sigmoid colon	Liver (multiple)	Anterior resection	-
6	69	Sigmoid colon	Liver	Anterior resection	Left hepatectomy (simultaneous)
7	70	Sigmoid colon	Liver	Anterior resection	Right lobectomy (simultaneous)
8	76	Sigmoid colon	Liver	Anterior resection	Radiofrequency ablation (simultaneous)
9	77	Rectum	Liver (multiple)	Anterior resection	-
10	84	Sigmoid colon	Peritoneum	Anterior resection	-

**Table 3.** Perioperative outcomes

Variable	Age < 70 yr (n = 22)	Age ≥ 70 yr (n = 30)	P-value
Duration <sup>a)</sup> (day), median (IQR)	13.0 (5.0–89.3)	13.5 (10.8–26.0)	0.767
Operation type, n (%)			0.947
Laparoscopic	9 (40.9)	12 (40)	
Open	13 (59.1)	18 (60)	
Operation, n (%)			0.442
Extended right hemicolectomy	1 (4.5)	1 (3.3)	
Left hemicolectomy	3 (13.6)	6 (20)	
Anterior resection	9 (40.9)	14 (46.7)	
Low anterior resection	4 (18.2)	7 (23.3)	
Hartmann procedure	2 (9.1)	2 (6.7)	
Abdominoperineal resection	3 (13.6)	0 (0)	
Operation time (min), mean ± SD	215 ± 99	163 ± 43	0.028
Blood loss (mL), median (IQR)	50.0 (50.0–100.0)	50.0 (50.0–100.0)	0.486

IQR, interquartile range; SD, standard deviation.

<sup>a)</sup>From the insertion of the stent to operation.**Table 4.** Postoperative course and complications

Variable	Age < 70 yr (n = 22)	Age ≥ 70 yr (n = 30)	P-value
First flatus (day)	2.0 (2.0–3.0)	3.0 (2.0–4.0)	0.318
First soft diet (day)	5.0 (4.0–7.0)	7.0 (6.0–8.0)	0.004
Length of stay (day)	11.0 (9.8–13.3)	11.0 (9.5–18.0)	0.708
Morbidity	5 (22.7)	8 (26.7)	0.746
Ileus	1	1	
SSI	3	3	
UTI	0	1	
Anastomosis leakage	0	1	
PMC	0	2	
Bladder injury	1	0	
Mortality	0	0	

Values are presented as median (interquartile range) or number (%). SSI, surgical site infection; UTI, urinary tract infection; PMC, pseudomembranous colitis.

pseudomembranous colitis (2 patients) occurred in group B. One patient in group B experienced anastomosis leakage and underwent reoperation (colostomy). Urinary leakage caused by the bladder injury was diagnosed during the postoperative period in 1 patient in group A and was treated with a urinary catheter for 2 months. There was no mortality in either group.

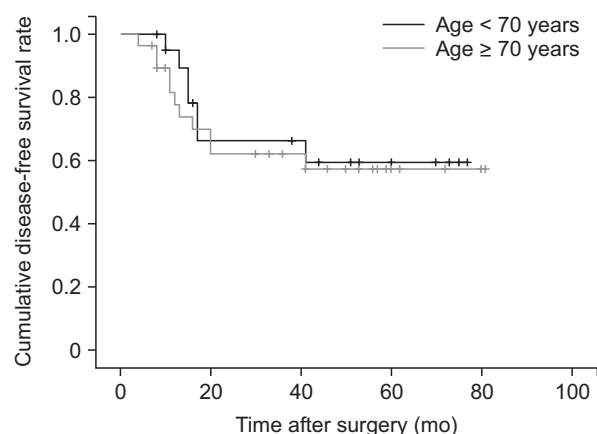
### Cancer recurrence, disease-free survival and overall survival

During a median follow-up period of 43 months (range, 7–81 months), disease recurrence rate was not different significantly between the two groups (8 of 22, 36.4% vs. 11 of 30, 36.7%,  $P = 0.982$ ). Systemic recurrence occurred in 7 and 10 patients in each group, respectively. One patient in each group had local recurrence (Table 5).

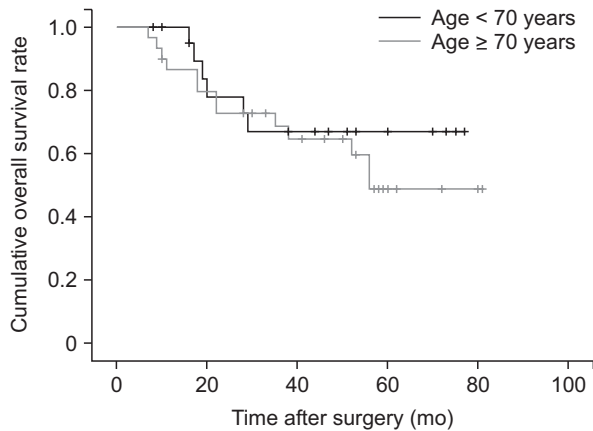
The 5-year disease-free survival rate was similar in group

**Table 5.** Recurrence sites of the two groups

Site	Age < 70 yr (n = 22)	Age ≥ 70 yr (n = 30)	P-value
Recurrence, n (%)	8 (36.4)	11 (36.7)	0.982
Local	1	1	
Systemic	7	10	
Liver	2	5	
Lung	2	1	
Peritoneum	1	3	
Adrenal gland	1	0	
Multiple organs	1	1	

**Fig. 1.** Disease-free survival rates of both groups.

A (59.6%) and group B (57.4%) ( $P = 0.710$ ) (Fig. 1). The 5-year overall survival rate was lower in group B, but no statistical difference was observed between the two groups (66.9% vs. 48.8%,  $P = 0.490$ ) (Fig. 2).



**Fig. 2.** Overall survival rates of both groups.

## DISCUSSION

Aging is characterized by the gradual loss of reserve capacity. The effects of the aging process on various organ systems do not usually affect the function of organs in the normal state; however, during periods of stress, elderly patients may not be able to meet the increased metabolic demands. The loss of reserve capacity is the single most important factor that decreases elderly patients' ability to tolerate operations [8]. Age more than 70 years is an independent predictor of increased postoperative complications, mortality, and a longer length of hospital stay [9]. Based on these data, limited surgery is occasionally advocated for elderly patients [10,11]. Several studies, however, revealed that age alone is not a contraindication for a major surgery and does not influence the postoperative morbidity and mortality [12-14]. The advancement of surgical techniques, introduction of novel equipment, and improvement of anesthesia and postoperative care have allowed elderly patients to undergo surgery more safely. In particular, with increasing experience in laparoscopic surgical techniques, the elderly patient population can benefit the most from a laparoscopic approach [15].

With the prolongation of the average life expectancy, the incidence of colorectal cancer also is increasing. However, few studies have compared the postoperative outcomes of obstructive colorectal cancer surgery after colonic stenting according to patient age. Some elderly patients with obstructive colorectal cancer refuse surgery after the insertion of a stent owing to concerns about the postoperative complications, even in patients without severe comorbidities. In the present study, the postoperative complication rate was not significantly different between the two groups (22.7% vs. 26.7%,  $P = 0.746$ ), despite higher ASA scores in group B. As urinary tract infection, pseudomembranous colitis, and anastomosis leakage developed only in group B, it might be thought that elderly patients are more vulnerable to morbidity. The absolute number of these

morbidities, however, is small. Furthermore, postoperative ileus and SSI occurred in both groups, and the number of cases and severity of complications were similar.

The operation time was longer in group A ( $215 \pm 99$  minutes vs.  $163 \pm 43$  minutes,  $P = 0.028$ ). This difference might be caused by differences in the resection range between the two groups; wider resections tended to be performed in the younger age group than in the older age group.

Although the complication rate was not different, the time to ingestion of the first soft food was longer in the older age group. Reduced appetite and concerns about aspiration pneumonia are thought to be causes of delays in the time to ingestion of the first soft food. The time to the passage of the first flatus after surgery was not different between the two groups; this suggests that the recovery of gastrointestinal tract motility after surgery was not affected by age. Recently, a preoperative scoring system was developed to predict postoperative ileus after laparoscopic colectomy. A patient age of more than 60 years was included in the predictive score. However, it was not statistically significant [16]. In an observational study involving a registry of 2,400 patients who underwent resection for colorectal cancer, age was not a risk factor for the independent prediction of prolonged ileus or the duration of ileus [17].

Laparoscopic surgery has been thought to provide benefits to elderly patients with a significantly lower morbidity and mortality rate than predicted [15]. Furthermore, recent studies showed that laparoscopic surgery was associated with less morbidity than open surgery for colon cancer in elderly patients [18,19]. In the present study, laparoscopic surgery was performed in approximately two-fifth of the patients in both groups. Obstructive colorectal cancers were large and sometimes showed inflammatory or malignant adhesions with adjacent organs. Because of these obstacles, open surgery was performed more often than laparoscopic surgery for obstructive colorectal cancers. In cases of obstructive colorectal cancer that is small and not adhered to adjacent organs, elderly patients could benefit from laparoscopic surgery.

The optimal interval between colonic stenting and surgery is controversial [3,20,21]. The patients were usually allowed to take oral intake in our hospital after confirming of successful function of stent and assessment of the patients' bowel function. At the same time, preoperative clinical staging of colorectal cancer and evaluation of the patients' clinical condition were performed. The time from colonic stenting to completion of preoperative evaluation was around 7 to 10 days, which varied according to the patient's condition. After completion of preoperative evaluation, the patients received a bowel preparation 2 days before surgery. Some patients were discharged after completion of preoperative evaluation and readmitted several weeks later for surgery. Three patients with rectal cancer received neoadjuvant chemoradiotherapy

after colonic stenting. They underwent surgery four to eight weeks after the completion of neoadjuvant chemoradiotherapy. Two patients with stage IV colon cancer received palliative chemotherapy after colonic stenting, followed by surgery three months later. These might eventually result in longer time intervals between colonic stenting and surgery.

Oncologic outcomes were similar between the two groups. The recurrence rate and 5-year disease-free survival rate was not different significantly. Although there was no statistical difference, the 5-year overall survival rate of group A was longer than that of group B (66.9% vs. 48.8%). It might be caused by a longer expected remaining lifetime of group A.

On the basis of the results of this study, surgery might be suggested after colonic stenting for elderly patients with obstructive colorectal cancer who want palliative treatment instead of surgery. However, meticulous preoperative evaluation for general health status should be performed.

To the best of our knowledge, this is the first study to compare the postoperative outcomes between patients with obstructive colorectal cancer aged less than 70 years and those aged 70 years and more who underwent surgery after the insertion of a colonoscopic stent. However, this study has some limitations. First, it was not a prospective, controlled study, which may cause potential selection bias. Second, as

patients were retrospectively enrolled in this study, sample size estimation could not be performed. These limitations are potential weaknesses of this study.

Because of the difference in life expectancy between the two groups, survival rates such as overall and disease-free survival could not be evaluated. For assessment of the influence of old age on the postoperative outcomes, only short-term effects were estimated.

In conclusion, the surgical outcomes of elderly patients were similar to those of younger patients, despite higher ASA scores. These results indicate that surgery can be performed safely in elderly patients with obstructive colorectal cancer after the insertion of a stent.

## CONFLICTS OF INTEREST

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

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