

## Two-stage resection for malignant colonic obstructions: The timing of early resection and possible predictive factors

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### Abstract

**AIM:** To study potential predictive factors for early radical resection in two-stage resection for left malignant colonic obstruction.

**METHODS:** Thirty-eight cases of left-sided obstructive colon cancer undergoing two-stage operations were reviewed between January 1998 and August 2008. Patients were classified into two groups ( $n = 19$  each): early radical resection (interval  $\leq 10$  d) and late radical resection (interval  $> 10$  d). Baseline demographics, post-diversion outcome, perioperative data, tumor characteristics, outcome and complications were analyzed.

**RESULTS:** The baseline demographics revealed no differences except for less pre-diversion sepsis in the early group ( $P < 0.001$ ) and more obstruction days in the late group ( $P = 0.009$ ). The mean intervals of early and late radical resections were  $7.9 \pm 1.3$  d and  $17.8 \pm 5.5$  d, respectively ( $P < 0.001$ ). After diversion,

the presence of bowel sounds, flatus, removal of the nasogastric tube and the resumption of oral feeding occurred earlier in the early group. The operation time and duration of hospital stay were both significant reduced in the early group. Complication rates did not differ between groups.

**CONCLUSION:** The earlier recovery of bowel function seems to be predictive of early radical resection. In contrast, pre-diversion sepsis and more obstruction days were predictive of delayed radical resection.

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**Key words:** Colorectal cancer; Colostomy; Diversion; Obstruction; Two-stage resection

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### INTRODUCTION

Bowel obstruction occurs in 7%-47% of patients with colorectal cancer (CRC)<sup>[1-9]</sup>. This condition usually requires emergency surgical intervention and is associated with high postoperative morbidity, mortality and a poor 5-year survival rate<sup>[4,5,8]</sup>. Surgical management for patients with obstructive CRC varies widely according to the tumor location, severity of the patient's condition and experience level of the surgeon. Resection with anastomosis in one stage is now a generally accepted practice

for primary right-sided obstructive CRC<sup>[1,4,6,9-12]</sup>. For left-sided obstructive CRC, two types of surgical intervention have been used: primary resection and staged resection (diversion prior to resection). A randomized trial of emergency colostomy versus resection in patients with left-sided obstructive CRS demonstrated that the only advantage of primary resection was a shorter hospital stay<sup>[13]</sup>. A Cochrane systematic review found no evidence to suggest a benefit in terms of mortality when comparing staged procedures with primary resection<sup>[11]</sup>. Although the optimal choice of treatment for patients with left-sided obstructive CRS remains controversial<sup>[8,11,14-17]</sup>, several studies have reported better results for staged procedures<sup>[1,2,4,9,18,19]</sup>.

Two-staged resection consists of a colostomy or ileostomy to resolve the obstruction as a first step, followed by radical resection and simultaneous closure of the stoma. Corman suggested the use of a 10- to 14-d interval between diversion and radical resection<sup>[20]</sup>. The mean interval has ranged widely from 11.5 d to 42 d<sup>[1,9,14,19,21,22]</sup>. The appropriate interval for two-stage resection for left-sided obstructive CRC remains controversial and ranges widely. In critically ill patients, the interval should be longer than Corman's suggestion. In contrast, we supposed that in patients with early recovery of bowel function or those lacking any pre-diversion septic condition, the interval may be shorter than 10 d. This study aimed to evaluate the timing of early radical resection and possible predictive factors.

## MATERIALS AND METHODS

### Patients

From January 1998 to August 2008, there were 132 patients diagnosed with complete obstructive CRC who were treated with emergency surgery at the Tri-Service General Hospital in Taipei, Taiwan. These patients were admitted through the emergency department. Patients with the following criteria were excluded: (1) a tumor proximal to the splenic flexure; (2) colonic perforation with peritonitis; (3) primary resection with or without anastomosis; (4) three-stage resection; (5) palliative ileostomy or colostomy for non-resectable tumors, disseminated disease or critical illness; (6) a colonic stent; or (7) rectal cancer. Consequently, 38 cases with left-sided obstructive CRC for which the patients underwent two-staged resection were investigated.

### Methods

Cases with intervals of 10 d or less between diversion and radical resection were classified as group A (early radical resection). Cases with intervals of longer than 10 d were classified as group B (late radical resection). Data collected from extensive chart reviews were recorded and compared. These included (1) baseline demographics including baseline data, comorbidities, days of obstruction (no feces passage) and the mean interval; (2) post-diversion outcomes including stoma type, the tim-

ing of oral feeding, the passage of flatus, the presence of bowel sounds, removal of the nasogastric tube and complications; (3) perioperative data and tumor characteristics including surgery type, operation time, blood loss, blood transfusion, tumor location, pathology diagnosis and tumor stage; and (4) the outcome in terms of hospital stay and complications.

The definition of sepsis was adopted from those published by the International Sepsis Definitions Conference<sup>[23]</sup>. Significant comorbidities included hypertensive cardiovascular disease, diabetes mellitus, coronary arterial disease, cerebral vascular accidents, chronic obstructive pulmonary disease, liver cirrhosis and chronic renal insufficiency. Complete bowel obstruction was diagnosed based on clinical history, physical examination, a failure to pass flatus, decreased or absent bowel sounds and the X-ray signs of a distended, obstructed colon. Patients with partial bowel obstruction that responded to nasogastric decompression and intravenous fluid replacement were not included in this category of colonic obstruction. After fluid resuscitation, the correction of imbalanced electrolyte levels and optimization of the patient's general condition, emergency T-loop colostomy was performed within 24 h. Prophylactic antibiotic treatment was administered during the induction of anesthesia and maintained for 24 h unless the septic condition persisted. The type of radical resection depended on the tumor location and each surgeon's judgment; meanwhile, the colostomy was closed. The patient's nutrition status, such as their hemoglobin and serum albumin levels, were corrected to 10 dL/mg and 3.5 dL/mg, respectively, before definitive treatment. Tumor, node, metastasis classification was used for tumor staging<sup>[24]</sup>.

Group A (early radical resection): Nineteen cases in which the patients underwent two-staged resection with an interval of 10 d or less were classified as group A. A T-loop colostomy was performed as a first step, followed by radical resection and simultaneous closure of the colostomy.

Group B (late radical resection): Nineteen cases in which the patients underwent two-stage resection with an interval of more than 10 d were classified as group B. The surgical approach was the same as for group A.

### Statistical analysis

Data were processed and analyzed using the Statistical Package for Social Sciences for Windows, Version 15.0 (SPSS, Inc., Chicago, IL, United States). Continuous variables were analyzed using independent Student's *t*-tests. Nominal data were compared using chi-squared or Fisher's exact tests. *P* < 0.05 was assumed to be statistically significant.

## RESULTS

### Baseline demographics

The baseline demographics of this patient population are shown in Table 1. There were no significant differences between groups A and B except for a higher inci-

Table 1 Baseline demographics

	Group A (n = 19)	Group B (n = 19)	P value
Gender, male/female	14/5	13/6	0.721
Age (yr)	60.6 ± 13	67.9 ± 14.9	0.117
Pre-diversion sepsis (%)	0	10 (53)	< 0.001
Co-morbidities			0.139
0	10 (53)	4 (21)	
1	7 (37)	9 (47)	
2	2 (11)	4 (21)	
≥ 3	0	2 (10.5)	
Days of obstruction	3.6 ± 1	4.8 ± 1.6	0.009
Interval (d)	7.9 ± 1.3	17.8 ± 5.5	< 0.001

Data are presented as n, n (%), mean ± SD or as noted.

Table 2 Post-diversion outcome

	Group A (n = 19)	Group B (n = 19)	P value
Stoma type			
T-loop colostomy	19	19	
Time to presenting with bowel sounds (d)	1.6 ± 0.5	2.7 ± 1.2	0.001
Time to passage of flatus (d)	1.8 ± 0.4	3 ± 1.4	0.001
Time to removal of the nasogastric tube (d)	1.8 ± 0.8	3.1 ± 1.5	0.002
Time to initiation of oral feeding (d)	2.2 ± 0.6	3.5 ± 1.3	0.001
Complications			
Sepsis	0	1 (5)	0.311
Stomal infection	1 (5)	3 (16)	0.290

Data are presented as n, n (%), mean ± SD or as noted.

dence of pre-diversion sepsis in group B (0% *vs* 53%,  $P < 0.001$ ) and more days of obstruction in group B ( $3.6 \pm 1$  d *vs*  $4.8 \pm 1.6$  d,  $P = 0.009$ ). The mean intervals for early and late radical resection were  $7.9 \pm 1.3$  d and  $17.8 \pm 5.5$  d, respectively ( $P < 0.001$ ). The molecular markers, such as white blood cell count and levels of hemoglobin, C-reactive protein and serum albumin, were measured and statistically analyzed. The initial white blood cell count and C-reactive protein level (before diversion) were higher in group B, but there was no significant difference in comparison to group A. The initial hemoglobin and serum albumin levels were similar in both groups.

### Post-diversion outcome

Post-diversion outcomes are shown in Table 2. All 38 patients underwent T-loop colostomy for emergency diversion. Bowel sounds, the passage of flatus, removal of the nasogastric tube and oral feeding were observed earlier in group A than group B ( $1.6 \pm 0.5$  d *vs*  $2.7 \pm 1.2$  d,  $1.8 \pm 0.4$  d *vs*  $3 \pm 1.4$  d,  $1.8 \pm 0.8$  d *vs*  $3.1 \pm 1.5$  d,  $2.2 \pm 0.6$  d *vs*  $3.5 \pm 1.3$  d;  $P = 0.001$ ,  $0.002$ ,  $0.001$  and  $0.001$ , respectively). There were no differences between groups in terms of the complications of diversion.

Table 3 Perioperative data and tumor characteristics

	Group A (n = 19)	Group B (n = 19)	P value
Type of operation			0.201
Left hemicolectomy	16 (84)	11 (58)	
Extended left hemicolectomy	1 (5)	3 (16)	
Anterior resection	2 (10)	5 (26)	
Operation time (h)	4.9 ± 0.4	5.5 ± 0.7	0.003
Blood loss (mL)	213 ± 149	250 ± 92	0.533
Blood transfusion (mL)	26.3 ± 78.8	39.5 ± 93.7	0.642
Tumor location			0.162
Transverse colon	2 (10)	2 (10)	
Descending colon	11 (58)	5 (26)	
Descending/sigmoid colon	2 (10)	7 (37)	
Sigmoid colon	4 (21)	5 (26)	
Pathological diagnosis			
Adenocarcinoma	19	19	
Tumor differentiation			0.734
Well or moderate	15 (79)	13 (69)	
Poor	3 (16)	4 (21)	
Undifferentiated or not known	1 (5.3)	2 (10)	
Stage			0.260
II	6 (32)	11 (58)	
III	11 (58)	7 (37)	
IV	2 (10)	1 (5)	

Data are presented as n, n (%), mean ± SD or as noted.

### Perioperative data and tumor characteristics

The perioperative data and tumor characteristics are shown in Table 3. There was no significant difference between the two groups in terms of the type of operation, blood loss, blood transfusion, tumor location, tumor stage or stage of tumor differentiation. The pathology was adenocarcinoma in all 38 cases. Operation time was longer in group B than in group A ( $4.9 \pm 0.4$  h *vs*  $5.5 \pm 0.7$  h,  $P = 0.003$ ).

### Outcomes and complications

The outcomes and complications are shown in Table 4. Group A had a shorter mean hospital stay than group B ( $21.2 \pm 3.2$  d *vs*  $36.2 \pm 17.4$  d,  $P = 0.001$ ). There were no differences between groups in terms of complications.

## DISCUSSION

The study conducted on this series of 38 cases showed that early oral feeding, the passage of flatus, the presence of bowel sounds and the time to removal of the nasogastric tube could be predictive factors for early radical resection in patients undergoing a two-stage resection. Pre-diversion sepsis and longer obstruction days, in contrast, were associated with the delay of radical resection. Malignant colonic obstruction usually required emergency surgical intervention. A single-stage strategy has been suggested for patients with primary right-sided obstructive CRC<sup>[1,4,6,9-12]</sup>. Although the topic is debated, a staged procedure for left-sided obstructive

Table 4 Outcome and complications

	Group A (n = 19)	Group B (n = 19)	P value
Hospital stay	21.2 ± 3.2	36.2 ± 17.4	0.001
Ileus > 4 d	1 (5)	2 (10)	0.547
Anastomotic leakage	0	0	
Wound infection	4 (21)	5 (26)	0.703
Post-resection sepsis	1 (5)	1 (5)	
Other complications			0.548
Urinary tract infection	0	1 (5)	
Pneumonia	1 (5)	1 (5)	
Upper gastrointestinal bleeding	0	1 (5)	

Data are presented as n, n (%), mean ± SD or as noted.

CRC is still considered to be the best option due to its safety<sup>[8,15,18,19,21,25]</sup>. Corman suggested that a 10- to 14-d interval be used for two-stage procedures. The mean interval has ranged from 11.5 d to 42 d. The optimal interval has not been thoroughly investigated<sup>[1,9,14,19,21,22]</sup>. The present study grouped patients based on the timing of radical resection. The mean intervals were 7.9 ± 1.3 d and 17.8 ± 5.5 d in the early and late radical resection groups, respectively.

Tumors cause obstruction by two major mechanisms: mechanical or adynamic obstruction<sup>[26]</sup>. In our study, the late radical resection group had significantly more pre-diversion sepsis than the early group (0% *vs* 53%, *P* < 0.001) and a longer period of obstruction (3.6 ± 1 d *vs* 4.8 ± 1.6 d, *P* = 0.009). As is known, sepsis is associated with adynamic obstruction. We consider that pre-diversion sepsis and longer durations of obstruction-especially more than 5 d, which exacerbates mechanical obstruction-may be the predisposing factors necessitating a delay in radical resection. In contrast, the absence of pre-diversion sepsis or a shorter period of obstruction may lead to more rapid recovery of bowel function and early radical resection.

A nasogastric tube is usually placed temporarily to decompress the proximal bowel and to alleviate acute bowel obstruction symptoms<sup>[26]</sup>. The passage of flatus and the presence of bowel sounds are generally considered to be signs of the recovery of bowel movement. In this series, the initiation of oral feeding, flatus, the presence of bowel sounds and removal of the nasogastric tube were observed sooner in the early radical resection group. These signs may imply the early elimination of edematous bowel, the early recovery of bowel movement and the early timing of any further surgical intervention required. However, more evidence is necessary to clarify the relationship between the recovery of bowel function or edematous status and the timing of the initiation of oral feeding, flatus, the presence of bowel sounds and removal of the nasogastric tube.

In our data, the operation time was significantly longer in cases that underwent delayed radical resection. This may have been caused by more severe post-inflammatory bowel adhesion in group B. Post-inflammatory bowel adhesion makes radical surgery difficult, even after a longer interval. However, further studies will be necessary to demonstrate the severity of bowel adhesion in patients with obstructive CRC.

The early radical resection group tended to stay in the hospital for less time than the late group (21.2 ± 3.2 d *vs* 36.2 ± 17.4 d, *P* = 0.001). No anastomotic leakage was noted in either group. The rates of wound infection, post-resection sepsis and complications, such as urinary tract infection, pneumonia and upper gastrointestinal bleeding, were similar between groups. The five-year disease-free survival rates were also similar between groups.

Although a 10- to 14-d interval between diversion and radical resection is generally accepted for the two-stage resection of acute left malignant colonic obstruction, early radical resection (with an interval shorter than 10 d) may be considered when the patients present with the earlier recovery of bowel function or the lack of any pre-diversion septic condition.

The present study found that earlier oral feeding, the presence of bowel sounds, the passage of flatus and removal of the nasogastric tube, all of which indicate the recovery of bowel function, seem to predict early radical resection. In contrast, pre-diversion sepsis and obstructions longer than five days may indicate the need to delay radical resection. The early radical resection group benefited from a shorter hospital stay with no difference in terms of complications compared to the late group. Further prospective or multicenter studies are recommended to clarify the relationship between such factors and the optimal timing of radical resection.

## COMMENTS

### Background

Surgical management for patients with obstructive colorectal cancer (CRC) varies widely according to tumor location, severity of the patient's condition and experience of the surgeon. Resection with anastomosis in one stage is now generally accepted for primary right-sided obstructive CRC. For left-sided obstructive CRC, two types of surgical intervention have been used: primary resection and staged resection (diversion prior to resection). Two-staged resection consists of colostomy or ileostomy to resolve the obstruction as a first step, followed by radical resection and closure of the stoma at the same time. Corman suggested a 10- to 14-d interval between diversion and radical resection. In critical illness patients, the interval would be longer than the Corman's suggestion. In contrast, the authors supposed that the patients with early recovery of bowel function or no pre-diversion septic condition, the interval may be earlier than 10 d.

### Research frontiers

Signs of earlier oral feeding, presence of bowel sound, passage of flatus and removal of the nasogastric tube, which indicating recovery of bowel function, seem to be predictive factors for early radical resection. In contrast, pre-diversion sepsis and obstructions longer than five days might indicate a later timing for radical resection.

### Innovations and breakthroughs

The present study found signs of earlier oral feeding, presence of bowel sound, passage of flatus and removal of the nasogastric tube, which indicating recovery of bowel function, seem to be predictive factors for early radical resection. In contrast, pre-diversion sepsis and obstructions longer than five days might



indicate a later timing for radical resection. The early radical resection group had an advantage of a shorter hospital stay with no difference in terms of complications comparing to the late group.

### Applications

Earlier oral feeding, presence of bowel sound, passage of flatus and removal of the nasogastric tube, which indicating recovery of bowel function, seem to be predictive factors for early radical resection in two-staged resection for obstructive CRC.

### Peer review

This paper describes two-stage resection for acute left-sided malignant colonic obstructions: timing of early radical resection and possible predictive factors. This work provides useful information on the early group had significantly earlier presence of bowel sounds, flatus, and removal of nasogastric tube and resumption of oral feeding.

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