


# Risk factors of small bowel obstruction following total proctocolectomy and ileal pouch anal anastomosis with diverting loop-ileostomy for ulcerative colitis

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## Abstract

Small bowel obstruction (SBO) often occurs after total proctocolectomy and ileal pouch anal anastomosis with diverting loop-ileostomy for ulcerative colitis. Little is known about the association between SBO and surgical procedures for diverting loop-ileostomy. We conducted a multicenter, retrospective questionnaire survey. Unlinkable anonymized data on ileostomy procedures and ileostomy-related complications including SBO were collected from institutions specializing in surgery for inflammatory bowel disease. In total, 515 patients undergoing total proctocolectomy and ileal pouch anal anastomosis with loop-ileostomy among 1022 patients with ulcerative colitis undergoing surgery during a 3-year period between 2012 and 2014 were analyzed. Twenty-nine patients without information on complications were excluded. Incidence of ileostomy-related complications and factors associated with the development of small bowel obstruction were determined in 486 patients. The most common complications were parastomal dermatitis (n=169, 34.8%), SBO (n=111, 22.8%), mucocutaneous dehiscence (n=59, 12.1%), stoma prolapse (n=21, 4.3%), parastomal hernia (n=12, 2.5%), and stoma retraction (n=11, 2.3%). Incidence of small bowel obstruction was significantly higher in patients with distance from the ileal pouch to the ileostomy of less than 30 cm and in patients undergoing laparoscopic surgery. Procedures for diverting loop-ileostomy after surgery for ulcerative colitis varied among institutions. Incidence of small bowel obstruction was high after total proctocolectomy and ileal pouch anal anastomosis with diverting loop-ileostomy. Shorter distance between the pouch and the stoma and the laparoscopic surgery were risk factors for SBO in univariate analysis.

## KEYWORDS

diverting loop-ileostomy, ileal pouch anal anastomosis, small bowel obstruction, total proctocolectomy, ulcerative colitis

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## 1 | INTRODUCTION

The most challenging complications associated with low anastomosis after rectal resection are anastomotic leakage and pelvic abscess. In surgery for rectal cancer, anastomotic leakage and pelvic abscess are known to affect survival and are a risk for local recurrence.<sup>1,2</sup> Various preventive measures including ostomies and decompression with transanal tubes are carried out. Diverting colostomy or diverting loop-ileostomy is done after low rectal cancer surgery, one of the representative preventive measures for anastomotic leakage. Whether diverting stomas after resection of rectal cancer reduce the incidence of anastomotic leakage is controversial; however, it is reported that diverting stomas are expected to prevent or reduce the development of clinical symptoms as a result of anastomotic leakage.<sup>3-5</sup> In general, ileostomy is carried out more often than colostomy. However, there is little evidence for surgical procedures in diverting loop-ileostomy, and procedure selection is dependent on the experiences of surgeons at each institution. However, diverting loop-ileostomy potentially increases the risks for stoma-related complications including small bowel obstruction (SBO), stoma prolapse, stoma retraction, parastomal hernia, parastomal dermatitis, and mucocutaneous dehiscence. Risks for stoma-related complications are reportedly 5-46%.<sup>6-9</sup>

In surgery for ulcerative colitis (UC), anastomosis (ileal pouch anal anastomosis [IPAA]) is carried out at a level lower than that for rectal cancer. However, when total proctocolectomy (TPC) is done; a colostomy cannot be carried out. Thus, a diverting loop-ileostomy is created to prevent anastomotic leakage and pelvic abscess. Diverting loop-ileostomy after TPC and IPAA is different from that after rectal cancer surgery because of the absence of the colon and rectum around the small intestine and the traction and fixation of the small bowel mesentery in the pelvic cavity. Diverting loop-ileostomy after TPC and IPAA requires special attention to complications including SBO.

We investigated variations in diverting loop-ileostomy procedures after TPC and IPAA for UC and the incidence of stoma-related complications in Japan, as well as factors associated with SBO, a representative stoma-related complication.

## 2 | METHODS

### 2.1 | Questionnaire survey

We carried out a questionnaire survey at representative institutions specialized in surgery for inflammatory bowel disease (IBD) through the IBD Surgical Forum, a study group to discuss challenges in IBD surgery in Japan. The questionnaire asked about surgical procedures for diverting loop-ileostomy after TPC and IPAA for UC, information on surgical cases of UC during the 3-year period between 2012 and 2014, and complications related to diverting loop-ileostomy after TPC and IPAA. Questions about diverting loop-ileostomy procedures concerned skin and fascia incisions, rotation of the proximal limb, fixation of the ileostomy, use of a stomal bridge, incision of the

intestine, height of the loop-ileostomy, distance from the ileal pouch inlet to the loop-ileostomy, postoperative assessment of loop ileostomies, and duration from creation to closure of ileostomy. Incidence of stoma-related complications including SBO, stoma prolapse, stoma retraction, parastomal hernia, parastomal dermatitis, and mucocutaneous dehiscence were also surveyed. In terms of skin and fascia incision, their shape and size were investigated. Rotation of ileostomy was defined to rotate ileal loop clockwise and create ileostomy as to the efferent limb cranially and the afferent limb caudally as previously described by Marcello et al.<sup>10</sup> Whether and how the ileostomy was fixed to the fascia, whether and how the stomal bridge was formed and how the stoma was opened were also evaluated. Height of the loop-ileostomy defined as the levels of the proximal and distal limbs above the surrounding skin surface immediately after surgery was measured. All data were evaluated by reviewing the medical and operation reports by surgeons or by the "wound, ostomy, and continence nurses" (WOCN). SBO was defined as a disruption of the normal propulsive ability of the gastrointestinal tract that required fasting by the patient. Stoma prolapse was defined as severe prolapse preventing stoma management. Stoma retraction was defined as the disappearance of the stomal mucosa under the surface of the abdominal wall. Parastomal hernia was diagnosed clinically. Parastomal dermatitis was defined as any change in the integrity of the skin such as erythema, erosion, ulcer, or tissue overgrowth. Mucocutaneous separation was recorded if any part of the stoma had detached from the mucocutaneous junction and intervention was required. The questionnaire was sent to 26 institutions from the office of the IBD Surgical Forum in August 2015. Between August and October 2015, 18 (69.2%) institutions replied to the questionnaire.

### 2.2 | Patients

In this retrospective survey, 1022 patients with UC underwent surgery during the 3-year period between 2012 and 2014 at the 18 institutions. Of these, 515 underwent TPC and IPAA with loop-ileostomy, and unlinkable anonymized data on the 515 patients were collected. Procedures undertaken for UC at the 18 institutions during the survey period other than TPC and IPAA with loop-ileostomy were TPC and IPAA without loop-ileostomy in 164 patients, with other procedures including subtotal colectomy and ileostomy, and abdominoperineal resection in 343 patients. Median number of patients undergoing UC surgery at the 18 institutions between 2012 and 2014 was 34 (range, 3-277), and the median number of patients undergoing TPC and IPAA with loop-ileostomy was 14 (range, 2-222) (Table 1). The patients undergoing TPC and IPAA with loop-ileostomy were followed until stoma closure or until October 2015, when the data were collected. Unlinkable anonymized data on ileostomy procedures were analyzed for 515 patients undergoing TPC and IPAA with loop-ileostomy. Of the 515 patients, 29 without information about complications were excluded and the incidence of ileostomy-related complications was calculated in the remaining 486 patients. Factors associated with SBO were identified in the 486

**TABLE 1** No. patients undergoing ulcerative colitis surgery and surgical procedures between 2012 and 2014 in the institutions that replied to the questionnaire

Institution	TPC and IPAA with loop-ileostomy	TPC and IPAA without loop-ileostomy	Other procedures	Total
A	222	16	39	277
B	29	98	91	218
C	62	0	22	84
D	5	36	41	82
E	8	1	41	50
F	26	8	15	49
G	17	4	14	35
H	13	0	22	35
I	14	0	20	34
J	33	0	0	33
K	20	0	8	28
L	12	0	15	27
M	18	0	1	19
N	14	0	4	18
O	8	0	6	14
P	5	1	3	9
Q	7	0	0	7
R	2	0	1	3
	515	164	343	1022

IPAA, ileal pouch anal anastomosis; TPC, total proctocolectomy.

patients. This study followed the ethical guidelines of human subjects based on the Helsinki Declaration. Review and approval by the ethics committee was not carried out because existing unlinkable, anonymized data were used in the present study.

### 2.3 | Statistical analysis

Statistical analyses were carried out using JMP Pro 10 software (SAS Institute, Cary, NC, USA). Statistically significant differences were determined by Fisher's exact test. Odds ratios and 95% confidence intervals were also estimated. Probabilities of less than .05 were considered significant.

## 3 | RESULTS

### 3.1 | Patient characteristics

Of the patients undergoing TPC and IPAA with ileostomy, 330 were men and 185 were women. Peak age was 40-49 years and most patients were 20-50 years, consistent with the age range of patients with UC in Japan. Pancolitis was seen in 444 (86.2%) patients. The clinical course was "relapsing-remitting" in 335 (65.0%) patients, "chronic persistent" in 93 (18.1%), and "acute fulminant" in 42 (8.2%), consistent with the characteristics of UC requiring surgery.

The most frequent indication for surgery was "refractory" disease in 222 (43.1%) patients, followed by "cancer/dysplasia" in 141 (27.4%), reflecting the recent increasing number of patients with long-term UC in Japan. Laparoscopic approaches including hand-assisted laparoscopic surgery were used in 169 (32.8%) patients, reflecting the widespread use of laparoscopic colorectal surgery. The anastomotic technique was "hand-sewn" in 402 (78.1%) patients, which was more common than "stapled" (Table 2).

### 3.2 | Procedures for diverting loop-ileostomy

Procedures for diverting loop-ileostomy after surgery for ulcerative colitis varied among institutions (Table S1). The skin incision was "round" in 387 (75.1%) patients, "vertical" in 64 (12.4%), and "horizontal" in 64 (12.4%). The median length of the skin incision was 2.0 cm (range, 1.5-3.0 cm). The position of the skin incision was "the right lower quadrant of the abdomen" in all patients. The fascia incision was "vertical" in 464 (90.1%) and "cruciate" in 51 (9.9%). Length of the fascia incision was the equivalent to the skin incision

**TABLE 2** Characteristics of patients undergoing TPC and IPAA with ileostomy

		Number (%)
Gender	Male	330 (64.1)
	Female	185 (35.9)
Age (years)	≤19	40 (7.8)
	20-29	88 (17.1)
	30-39	86 (16.7)
	40-49	118 (22.9)
	50-59	93 (18.1)
	60-69	69 (13.4)
	70-79	20 (3.9)
≥80	1 (0.2)	
Disease extent	Pancolitis	444 (86.2)
	Left-sided colitis	67 (13.0)
	Proctitis	1 (0.2)
	Other	3 (0.6)
Clinical course	Relapsing-remitting	335 (65.0)
	Chronic persistent	93 (18.1)
	Acute fulminant	42 (8.2)
	Other	45 (8.7)
Indication for operation	Severe/Fulminant	78 (15.1)
	Refractory	222 (43.1)
	Cancer/Dysplasia	141 (27.4)
	Other	74 (14.4)
Operative approach	Open	346 (67.2)
	Laparoscopic	169 (32.8)
Anastomotic technique	Stapled	113 (21.9)
	Hand-sewn	402 (78.1)

IPAA, ileal pouch anal anastomosis; TPC, total proctocolectomy.

for 328 patients (63.7%), and longer for 187 patients (36.3%). The most common distance from the ileal pouch inlet to loop-ileostomy was  $\geq 40$  cm in 316 (61.4%) patients, followed by 20–30 cm in 141 (27.4%), and 30–40 cm in 58 (11.3%). The loop-ileostomy was “rotated” in 13 (2.5%) patients and “non-rotated” in the remaining 502 (97.5%). A bridge with fascia was used in eight (1.6%) patients only. Fixation of ileostomy was carried out in 46 (8.9%) patients. Median number of fixations among the patients with fixation was four (range, 2–8). The ileum incision procedure was a “transverse incision” in 510 (99.0%) patients and “longitudinal incision” in five patients only (1.0%). Median heights of the proximal and distal limbs of the ileostomy were 2.5 cm (range, 1.0–3.5 cm) and 1.0 cm (range, 0–3.0 cm), respectively (Table 3).

### 3.3 | Incidence of diverting loop-ileostomy-related complications

The most common complications among the 486 patients were parastomal dermatitis ( $n=169$ , 34.8%) followed by SBO ( $n=111$ , 22.8%), mucocutaneous dehiscence ( $n=59$ , 12.1%), stoma prolapse ( $n=21$ , 4.3%), parastomal hernia ( $n=12$ , 2.5%) and stoma retraction ( $n=11$ , 2.3%) (Table 4). Of the 111 patients who experienced SBO, 19 (17.1%) recovered with fasting alone, 19 (17.1%) required nasogastric (NG) tube or ileus tube drainage, 61 (55.0%) required trans-stomal tube drainage, and 10 (9.0%) required trans-stomal tube drainage plus NG tube or ileus tube drainage. Twenty-eight (25.2%) patients underwent reoperation because of unsuccessful tube drainage. We could not find any correlation between each of the diverting loop-ileostomy procedures and the incidence of stoma prolapse and parastomal hernia. The incidence of stoma retraction was higher in patients undergoing straight skin incision and laparoscopic surgery. Many types of procedures were correlated with parastomal dermatitis, and mucocutaneous dehiscence, thus we could not interpret the reasons for the result.

### 3.4 | Risk factors for SBO

Table 5 shows the correlation between each of the diverting loop-ileostomy procedures and SBO. There were no significant differences in the incidence of SBO between round and straight skin incisions, between the lengths of skin incisions ( $< 2$  cm vs  $\geq 2$  cm), between vertical and cruciate shapes of fascia incision procedures, and between the lengths of fascia incisions (equivalent to the length of the skin incision vs longer than the skin incision); the above surgical techniques determine the size of the outlet of the loop-ileostomy. The incidence of SBO was higher when the distance from the ileal pouch inlet to the loop-ileostomy was  $< 30$  cm than with distance  $\geq 30$  cm (33.9% vs 19.5%,  $P=.002$ ). Rotation of ileostomy has previously been reported to affect the incidence of SBO, and most of the patients ( $n=473$ ) underwent a non-rotated procedure; however, there was no significant difference in the incidence of SBO in 13 patients with a rotated procedure. There were no correlations between the incidence of SBO and the presence or absence of

**TABLE 3** Procedures for diverting loop-ileostomy and stoma management

		Number (%)
Skin incision	Round	387 (75.1)
	Vertical	64 (12.4)
	Horizontal	64 (12.4)
Length of skin incision, cm, median (range)	2.0 (1.5–3.0)	
Position of skin incision	Right lower quadrant of abdomen	515 (100)
	Other	0 (0)
Fascia incision	Vertical	464 (90.1)
	Cruciate	51 (9.9)
Length of fascia incision	Equivalent to skin incision	328 (63.7)
	Longer than skin incision	187 (36.3)
Distance from ileal pouch inlet	20 cm $\leq$ , <30 cm	141 (27.4)
	30 cm $\leq$ , <40 cm	58 (11.3)
	40 cm $\leq$	316 (61.4)
Rotation of ileostomy	Non-rotated	502 (97.5)
	Rotated	13 (2.5)
Bridge	No bridge	507 (98.4)
	Bridge using fascia	8 (1.6)
Fixation	No fixation	469 (91.1)
	Fixation to the fascia	46 (8.9)
	No. fixations, median (range)	4 (2–8)
Ileum incision procedure	Transverse incision	510 (99.0)
	Longitudinal incision	5 (1.0)
Height of proximal limb of ileostomy, cm, median (range)	2.5 (1.0–3.5)	
Height of distal limb of ileostomy, cm, median (range)	1.0 (0–3.0)	
Mucocutaneous suture removal	Yes	174 (33.8)
	No	341 (66.2)
Time of stoma closure, months, median (range)	4 (2–6)	

bridges using fascia, presence or absence of fixation to the fascia, and the height of the proximal or distal end. The incidence of SBO was significantly higher in patients undergoing laparoscopic surgery than in those undergoing open surgery (29.0% vs 19.6%,  $P=.023$ ).

## 4 | DISCUSSION

Ulcerative colitis is a chronic inflammatory disease of unknown cause in which the large intestine repeatedly becomes inflamed. The incidence of UC is reportedly lower in East Asia and Japan than in

**TABLE 4** Incidence of loop-ileostomy-related complications

	No. (%)
Small bowel obstruction	111 (22.8)
Stoma prolapse	21 (4.3)
Stoma retraction	11 (2.3)
Parastomal hernia	12 (2.5)
Parastomal dermatitis	169 (34.8)
Mucocutaneous dehiscence	59 (12.1)

the USA and Europe. However, the number of patients with UC in Japan is increasing and the incidence in Japan is nearing that of the USA and Europe.<sup>11</sup> Medication is the mainstay of treatment of UC. Aminosalicylates, such as salazosulfapyridine and 5-aminosalicylate (5-ASA), and steroids are effective and widely used. Immunomodulators such as azathioprine and 6-mercaptopurine (6MP) are more commonly used in refractory cases; calcineurin inhibitors such as cyclosporine and tacrolimus, and antitumor necrosis factor- $\alpha$  (TNF- $\alpha$ ) receptor antibodies have come to be used in severe cases. Consequently, emergency surgery during an acute phase can be avoided in

**TABLE 5** Risk factors for small bowel obstruction

Risk factor	All patients (n=486)	Small bowel obstruction		
		Patients (n=111)	Odds ratio <sup>a</sup>	P*
Skin incision				
Round	358	80 (22.3)	0.90 (0.56-1.44)	.71
Vertical and Horizontal	128	31 (24.2)		
Length of skin incision				
<2 cm	254	53 (20.9)		.28
$\geq$ 2 cm	232	58 (25.0)	1.26 (0.83-1.93)	
Fascia incision procedure				
Vertical	464	108 (23.3)		.44
Cruciate	22	3 (13.6)	0.52 (0.15-1.79)	
Length of fascia incision				
Equivalent to skin incision	328	69 (21.0)	0.74 (0.47-1.14)	.20
Longer than skin incision	158	42 (26.6)		
Distance from ileal pouch inlet				
<30 cm	112	38 (33.9)	2.12 (1.33-3.38)	.002
$\geq$ 30 cm	374	73 (19.5)		
Rotation of ileostomy				
Non-rotated	473	110 (23.3)	3.64 (0.47-28.28)	.32
Rotated	13	1 (7.7)		
Bridge				
No bridge	478	111 (23.2)		.21
Bridge using fascia	8	0 (0.0)		
Fixation				
No fixation	440	97 (22.0)	0.64 (0.33-1.26)	.20
Fixation to the fascia	46	14 (30.4)		
Height of proximal limb				
<2.5 cm	162	42 (25.9)		.25
$\geq$ 2.5 cm	324	69 (21.3)	0.77 (0.50-1.20)	
Height of distal limb				
<1.0 cm	248	51 (20.6)		.24
$\geq$ 1.0 cm	238	60 (25.2)	1.30 (0.85-1.99)	
Operative approach				
Open	317	62 (19.6)		.02
Laparoscopic	169	49 (29.0)	1.68 (1.09-2.59)	

Number (and percentage) of patients are shown.

<sup>a</sup>Odds ratio and 95% confidence interval.

\*Fisher's exact test was used to evaluate significant differences.

more patients.<sup>12,13</sup> However, some patients fail to achieve remission induction with these treatments and require surgery. These patients are at high risk for postoperative infectious complications because they are severely immunosuppressed and have malnutrition as a result of prolonged treatment before surgery.<sup>14,15</sup> The standard surgical procedure for UC is TPC and IPAA. Postoperative complications including anastomotic leakage and pelvic abscess after IPAA can affect survival, and impair defecation and pouch function (including a risk for permanent stoma as a result of pouch failure) in a later phase.<sup>16</sup> Thus, diverting loop-ileostomy is often carried out to prevent complications after TPC and IPAA. In the present survey, among patients undergoing TPC and IPAA, 515 (75.8%) had diverting loop-ileostomy and 164 did not.

As with diverting loop-ileostomy after rectal cancer surgery, there is little evidence for surgical procedures in diverting loop-ileostomy after TPC and IPAA for UC. Procedures are selected on the basis of the experience of surgeons at individual institutions. Moreover, there have been few studies on procedures for diverting loop-ileostomy and stoma-related complications in patients undergoing diverting loop-ileostomy only. In our survey, the most common stoma-related complication was parastomal dermatitis in 169 (34.8%) of 486 patients, followed by SBO in 111 (22.8%). The incidence of SBO was high. These stoma-related complications have a lower mortality than cases with infectious complications including anastomotic leakage and pelvic abscess, but their frequencies are higher than those of infectious complications.<sup>17,18</sup> Parastomal dermatitis, stoma prolapse, stoma retraction, parastomal hernia, and mucocutaneous dehiscence can be treated on an outpatient basis and are likely to be curable with stoma closure. However, SBO impairs quality of life because of a prolonged length of hospital stay and is clinically challenging because it may require surgery unless it responds to fasting and tube decompression. SBO after diverting loop-ileostomy also often occurs after rectal cancer surgery. The incidence of SBO after diverting loop-ileostomy in rectal cancer surgery is at most 10% to 14%,<sup>19–21</sup> whereas the incidence of SBO after UC surgery is higher in some reports (15–24%).<sup>22–24</sup> These reported rates are similar to our survey results. Studies in patients who required surgery as a result of SBO reported that potential causes included constriction and angulation at the site where the loop of the ileum was elevated to the abdominal wall for ileostomy and passed through the fascia and skin, and adhesion around the outlet secondary to the above causes. Marcello et al. reported that 180° rotation of the oral intestine in loop-ileostomy after IPAA is associated with SBO.<sup>10</sup> However, no studies including those on diverting loop-ileostomy in rectal cancer surgery reported similar results. Thus, we evaluated the association between ileostomy procedures likely to affect the development of SBO and the incidence of SBO. There were no associations between the incidence of SBO and the following factors that determine the size and constriction of the outlet of the diverting loop-ileostomy: round or straight skin incision, length of skin incision (<2 cm or ≥2 cm), vertical or cruciate shape of fascia incision, and length of fascia incision (equivalent to or longer than the skin incision). With

regard to rotation of ileostomy, there was a large imbalance in the number of patients and no statistically significant difference was noted; however, the incidence of SBO in the “non-rotated” group was higher than in the “rotated” group (23.3% vs 7.7%, respectively). Factors significantly associated with SBO were distance from ileal pouch <30 cm and laparoscopic surgery in univariate analysis; patients with distance from the ileal pouch <30 cm and those undergoing laparoscopic surgery were at a higher risk for SBO than those with distance from the ileal pouch ≥30 cm and those undergoing open surgery. One reason for this may be that there is an increase in the incidence of internal herniation and angulation in the space created by the taut superior mesenteric vessels that is fixed straight toward the pelvis after IPAA and the loop of ileum brought up to the abdominal wall. Thus, diverting loop-ileostomy near the ileal pouch could decrease mobility and be difficult to return if angulation occurs around the loop of the ileum brought up to the abdominal wall. One study reported that the incidence of SBO was high early after laparoscopic surgery.<sup>23</sup> In laparoscopic surgery, this phenomenon may be increased possibly because of the earlier recovery of bowel peristalsis and hence increased mobility of the bowel to move into the potential space. Furthermore, the resection level of mesenteric blood vessels is often different between open and laparoscopic surgery for UC. The mesocolon itself may be a site for early postoperative small bowel adhesion and potential cause of obstruction. A possible gap between the skin and fascia incisions at the ileostomy site as a result of pneumoperitoneum could also be considered as one cause of SBO by stomal obstruction. However, it is difficult to determine the reasons for this on the basis of the present survey results. In the future, new information may be available if findings at the time of stoma closure are compared between patients with and without SBO.

In conclusion, the present study shows that procedures for diverting loop-ileostomy after UC surgery varied and that the incidence of SBO was high after TPC and IPAA with diverting loop-ileostomy, as in previous reports. Most of the procedures for ileostomy were not significantly associated with SBO. Patients whose loop-ileostomy was located closer to the ileal pouch and those undergoing laparoscopic surgery were at a significantly higher risk for SBO. These patients should be monitored carefully.

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## DISCLOSURE

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## SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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