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ORIGINAL ARTICLE

Defunctioning loop ileostomy for rectal anastomoses: predictors of stoma outlet obstruction

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Abstract

Purpose Creation of defunctioning loop ileostomy is a standard procedure in laparoscopic lower rectal surgery. Stoma-related obstruction sometimes occurs, but its cause has not been fully analyzed. This study aims to assess stoma obstructive complications and clarify the risk factors of stoma-related obstructions.

Methods Two hundred and thirty consecutive patients who underwent laparoscopic rectal cancer surgery with defunctioning loop ileostomy between April 2007 and December 2017 were recruited, numbering 230. We statistically examined the frequency and risk factor of stoma outlet obstruction.

Results Postoperative stoma-related complications developed in 41 patients (17.8%) overall, and there was no 30-day mortality. Stoma outlet obstructions occurred in 16 patients (7.0%) during postoperative course. Thick subcutaneous fat at the stoma-marking site (vertical distance ≥ 20 mm) and body mass index (≥ 22.2) were significantly associated with the risk of stoma outlet obstruction in univariate analysis. Thick subcutaneous fat was a significant predictive factor of stoma outlet obstruction according to multivariate analysis (odds ratio 3.80).

Conclusions This report investigates significant predictors of stoma outlet obstruction in laparoscopic rectal cancer surgery for the first time. In laparoscopic procedure, stoma outlet obstruction should be particularly considered in obese patients who have especially thick subcutaneous fat of the abdominal wall.

Keywords Stoma outlet obstruction · Loop ileostomy · Rectal cancer

Introduction

In rectal cancer surgery, leakage of lower colorectal or coloanal anastomosis remains a serious problem. Incidence of the overall anastomotic leakage after low anterior resection was reported to be around 10–20% [1]. To mitigate incidence of severe anastomotic leakage, a defunctioning loop ileostomy is recently often prepared for laparoscopic lower rectal cancer surgery [2]. Loop ileostomy is considered to be a reasonable method in terms of easy construction and restoration compared with defunctioning loop colostomy [3, 4]. Various loop ileostomy-related complications, however, occurred in up to 40% of colorectal cancer patients [5–7]. Peristomal infection, stomal necrosis, obstruction, and dehydration caused by high output, parastomal hernia, and skin irritation are seen from the creation to the closure. Little is known about the complications, stoma outlet obstruction is often found by a mechanical ileus and absence of fecal discharge after the initial surgery. Patients develop abdominal distension, nausea, and vomiting following radiology of ileal bowel dilatation. In most cases, decompression tubing is effective against the obstruction of the oral side of entry hole [8, 9]. Moreover, there seem to be some pitfalls in both laparoscopic-specified approach and patient-oriented characteristics [8–10]. This study aims to determine the predictive factors of stoma outlet obstruction after construction of defunctioning loop ileostomy following laparoscopic rectal cancer resection.

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Patients and methods

Retrospective assessment of 230 consecutive patients who underwent laparoscopic rectal cancer resection and creation of planned loop ileostomy at Wakayama Medical University Hospital was conducted between April 2007 and December 2017. Collected data included demographics, medical comorbidity, prior chemoradiation therapy, and complications. All included patients had skin marked preoperatively at the appropriate stoma site by wound ostomy care nurses. Firstly, in order to calculate the fat thickness, we measured the distance between the stoma site marking and the umbilicus. We retrospectively calculated the vertical thickness of the subcutaneous fat (TSF) from the skin to the midpoint of the rectus abdominis muscle at this assumed point using the axial view of preoperative computed tomography (CT) scanning. All measurements of 230 patients were examined by at least two surgeons.

Loop ileostomy was created at the marked site of the lower-right quadrant of the rectus abdominis muscle. A round skin incision was made at the site; the rectus abdominis muscle was split and the peritoneum was broadened to two fingerbreadths size at least. The most distal segment of the ileum was lifted in a loop shape, opened with a transverse incision and sutured to the skin.

Stoma outlet obstruction was defined as ileum obstruction that extended to the entry site of the rectus abdominis muscle and showed a caliber change excluding the paralytic ileus or the adhesive ileus by radiological investigation, mainly CT scanning or enema examination from ileostomy. Patients also required insertion of decompression tube to the proximal limb of the ileostomy and the symptoms smoothly improved (abdominal distention, nausea, and vomiting). This definition was similar to a previous study of ulcerative colitis [9]. High stoma output was defined as a high output (> 2 L/day) from ileostomy.

To test for association between the predictive parameters and complication, Mann-Whitney test, Fisher's exact test, or chi-square tests were used. Odds ratios (OR) with 95% confidence intervals (CI) were calculated in multivariate logistic regression models. All p values less than 0.05 was regarded as statistically significant. Statistical difference was analyzed by JMP Version 13 (SAS Institute Inc., Cary, NC).

Results

Enrolled in this study were 230 patients with rectal cancer (164 male, 66 female) who underwent laparoscopic low anterior resection and synchronous defunctioning loop ileostomy. Excluded were three patients due to their hospital transfer after the initial surgery. There was no 30-day mortality in this study.

Clinical characteristics are shown in Table 1. Median age was 65 years (r 35–83). According to division by physical status by American Society of Anesthesiologists (ASA) classification, 168 patients were in ASA I/II, and 62 in ASA III/IV. Median body mass index (BMI) was 22.2 kg/m^2 (r 15.9–32.4 kg/m^2). Median TSF was 20 mm (r 12.2–46.1 mm). Distance between the anastomosis and the anus was < 5 cm in 134 patients and ≥ 5 cm in 96 patients. Seventy patients (30.4%) received neoadjuvant chemoradiation therapy using capecitabine.

Table 1 Clinical data of 230 patients undergoing defunctioning loop ileostomy

Age	65 (range 35–83)
Gender (male/female)	164/66
ASA class	
I/II	168
III/IV	62
Body mass index (kg/m^2)	22.2
TSF (mm)	20
Anastomotic level	
≥ 5 cm	96
< 5 cm	134
Preoperative CRT	
Yes	70
No	160
Hypertension	
Yes	69
No	161
Diabetes mellitus	
Yes	32
No	198

ASA American Society of Anesthesiologist, *TSF* thickness of subcutaneous fat at stomal site, *CRT* chemoradiation therapy

Data are median or numbers

Before closure of ileostomy, overall ileostomy-related complications occurred in 41 patients (17.8%), with 30 (13.0%) regarded as Clavien-Dindo classification (C-D) ≥ II (Table 2). In this study, we excluded skin disorders and other outpatient complications. Stoma outlet obstruction developed in 16 patients (7.0%) during the postoperative hospital stay. Median timing of primary stomal outlet obstruction was postoperative day 2 (r days 1–6). All these patients had decompression tubing inserted and conservatively recovered from

Table 2 Ileostomy-related complications

Complications	Overall (n = 41)	C-D ≥ II (n = 30)
Stoma outlet obstruction	16	16
Peristomal infection	6	3
Stomal bleeding	2	1
High stoma output	13	7
Acute renal failure	4	3

C-D Clavien-Dindo classification

their obstructive symptoms within 3 days while two of them repeatedly developed in outpatient status and required earlier closure of ileostomy than scheduled. The median period of ileostomy closure in the patients who suffered from outlet obstruction was not significantly longer than that of no obstructive patients. Influence of the various factors on overall complications and C-D ≥ II complications are shown in Table 3. TSF ≥ 20 mm was more likely to be associated with overall complications, although no variable affected C-D ≥ II complications. In multivariate analysis after adjusting for relevant factors, no independent risk factors of both overall and C-D ≥ II complications existed.

BMI ≥ 22.2 and TSF ≥ 20 mm were significantly associated with higher incidence of stoma outlet obstruction in univariate analysis (Table 4). In logistic regression analysis for relevant variables, TSF ≥ 20 mm was the only independent risk factor of developing stoma outlet obstruction (OR 3.80, 95% CI 1.18–12.82) (Table 5).

Discussion

In recent rectal cancer surgery, Sphincter-preserving procedure and preoperative therapy have enabled us to

Table 4 Univariate analysis of stoma outlet obstruction

Variables		Obstruction (+)	Obstruction (−)	*p*
Age	≥ 65	7	106	0.655
	< 65	9	108	
Gender	Male	14	150	0.110
	Female	2	64	
ASA	I/II	14	154	0.490
	III/IV	2	60	
Body mass index	≥ 22.2	11	81	0.016
	< 22.2	5	133	
TSF	≥ 20 mm	9	50	0.007
	< 20 mm	7	164	
Anastomotic level	≥ 5 cm	10	86	0.081
	< 5 cm	6	128	
Preoperative CRT	Yes	4	66	0.618
	No	12	148	
Hypertension	Yes	5	64	0.910
	No	11	150	
Diabetes mellitus	Yes	2	30	0.864
	No	14	184	

ASA American Society of Anesthesiologists, *TSF* thickness of subcutaneous fat at stomal site, *CRT* chemoradiation therapy

Table 3 Univariate analysis of ileostomy-related complications

Variables		Overall (+) (n=41)	Overall (-) (n=189)	p	C-D≥ II (+) (n=30)	C-D≥ II (-) (n=200)	p
Age	≥65	18	95	0.460	13	100	0.495
	<65	23	94		17	100	
Gender	male	34	130	0.059	24	140	0.244
	female	7	59		6	60	
ASA	I/II	30	117	0.239	27	181	0.931
	III/IV	11	51		3	19	
Body mass index	≥22.2	20	72	0.209	14	78	0.427
	<22.2	21	117		16	122	
TSF	≥20mm	16	43	0.037	12	47	0.064
	<20mm	25	146		18	153	
Anastomotic level	≥5cm	21	75	0.177	17	79	0.078
	<5cm	20	114		13	121	
Preoperative CRT	Yes	9	61	0.182	6	64	0.168
	No	32	128		24	136	
Hypertension	Yes	11	58	0.622	7	62	0.383
	No	30	131		23	128	
Diabetes mellitus	Yes	4	28	0.378	3	29	0.490
	No	37	161		27	171	

C-D: Clavien-Dindo classification

ASA: American Society of Anesthesiologists

TSF: Thickness of subcutaneous fat at stomal site

CRT: Chemoradiation therapy

Table 5 Logistic regression analysis for stoma outlet obstruction

Variables		Odds ratio	95% confidence interval	*p*
Body mass index	≥ 22.2	1.13	0.34–3.76	0.834
TSF	≥ 20 mm	3.80	1.18–12.82	0.026
Anastomotic level	≥ 5 cm	2.31	0.81–7.13	0.117

TSF thickness of subcutaneous fat at stomal site

laparoscopically perform very low levels of anastomoses. Defunctioning loop ileostomy has also been performed to prevent severe anastomotic leakage and reoperation [2, 5, 11]. Validity of defunctioning stoma for the prevention of anastomotic leakage remains controversial in nonrandomized studies [11–15]. Recent randomized controlled trials (RCT) showed that defunctioning stoma led to significantly lower incidence of symptomatic anastomotic leakage or lower risk of urgent reoperation [2, 16].

Overall defunctioning ileostomy-related complications have been reported to occur at a rate of 10–50% [5–7]. In this study, the morbidity rate of our patients was 17.8% before closure of ileostomy with no 30-day mortality. There was stoma outlet obstruction (7.0%), high stoma output (5.7%), peristomal infection (2.6%), and bleeding (0.9%) in this series. In various ileostomy-related complications, we particularly analyzed early postoperative obstructive complication at the stoma in laparoscopic procedure; there was little concern in open surgery. Stoma outlet obstruction is reported to develop for various reasons [8–10]. First, the edematous change of the bowel limbs and the tightness of the split fascia are caused in prolonged pneumoperitoneum condition. Second, mechanical twisting of both limbs may occur easily in laparoscopic procedures, especially in obese patients. In this study, we identified greater TSF as an independent risk factor for stoma outlet obstruction. In previous report, however, low BMI was significantly related to stoma outlet obstruction after ileal pouch-anal anastomosis for ulcerative colitis [9]. It is difficult to elucidate the etiology of stoma outlet obstruction in the same way in rectal cancer patients and inflammatory bowel disease patients. For temporary fecal diversion, most surgeons tend to create minimum apertures of the stoma-site skin, resulting in distressed process to split thick subcutaneous fat and the rectus abdominis muscle in obese patients. Through the tight and narrow subcutaneous cavity, it is difficult to pull out the bowel limbs of loop ileum without any tension or any twisting, despite the splitting of the entry hole to two fingerbreadths size or more. Previous studies have shown the overall rates of stoma outlet obstruction ranging from 3.5 to 25.8% including ulcerative colitis, while the incidence of reoperation due to prolonged obstructive symptoms ranged from 0 to 75% in cases of entire stoma outlet obstruction [8–10, 17, 18]. The reported onset time of stoma outlet obstruction ranged from the early postoperative days to 2 weeks or more after the surgery meaning most patients had already started oral intake. In this study, the rate of stoma outlet obstruction was 7.0% and no surgical intervention was required before closure of ileostomy. Their intraoperative difficulties of ileostomy closure were not severe compared to no obstructive patients. Two patients (0.9%), meanwhile, were compelled to have early closing of ileostomy because of repeated stoma outlet obstruction after discharge from hospital. Different reasons for stoma outlet obstruction should be considered during the postoperative status. Edematous change of bowel limbs mainly induced obstructive symptoms especially through the narrow subcutaneous canal early after surgery, besides the change of intestinal fluids could be influenced on the stoma fecal streams after meal started. As stoma outlet obstruction is not a common complication in creating ileostomy, the various pitfalls of laparoscopic procedures should be considered. We should keep in mind to lift up the ileal loop perpendicularly to the abdominal wall assuming the angle under pneumoperitoneum condition.

This study has some limitations. Our findings were retrospective, and stomal complications were analyzed in a single center in a short postoperative term, not considering other outpatient complications after ileostomy closure. We observed only Asian race who are relatively thinner than Western race. We used BMI ≥ 22.2 as a cutoff value, which was median data of our study. However, BMI ≥ 22.2 is relatively low in Western countries. In the future study, risk factor concerning stoma outlet obstruction should be assessed in relatively fatty patients. In this series, whether the proximal limb is located vertically or horizontally depended on the surgeon's preference. An RCT of the direction of the proximal limb of loop ileostomy may be required to ascertain the recommendations for stoma outlet obstruction and twisting prevention.

Conclusion

Greater TSF is a significant risk factor of developing stoma outlet obstruction in creation of defunctioning loop ileostomy following laparoscopic rectal cancer surgery. The diverting stoma is constructed at almost the last period of operation, resulting in varied troublesome points occurring particularly in patients with thick subcutaneous fat.

Surgeons should seriously consider the maneuver with least potentials for complications, yet accommodating fecal diversion.

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Acquisition of data: T, I, M, M, N.
Analysis and interpretation of data: M, Y.
Drafting of manuscript: M, Y.
Critical revision: M, Y.
Supervision: Y.

Compliance with ethical standards

Ethical statement For this retrospective study, the authors receive ethics committee approval of Wakayama Medical University following Ethical Guidelines for Medical and Health Research Involving Human Subjects.

Conflict of interest The authors declare that they have no conflicts of interest.

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