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Clinical Significance of Intraoperative Colonoscopy for Anastomotic Assessment in Rectal Cancer Surgery

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Abstract. *Background/Aim: To clarify the usefulness of intraoperative colonoscopy (CS) for preventing postoperative anastomotic leakage and bleeding in rectal cancer surgery. Patients and Methods: The data of rectal cancer patients who underwent circular-stapled anastomosis from January 2008 to December 2016 were compared between 162 patients who received intraoperative CS (the CS group) and 23 patients who did not receive intraoperative CS (the non-CS group). Results: Anastomotic leakage rate in the CS group (8.6%) was similar to that in the non-CS group (4.3%) (p=0.70). Postoperative anastomotic bleeding rate was also similar between the CS and non-CS groups (2.4% vs. 0%, p=0.50). Although a positive air leak test was observed in two patients in the CS group, no postoperative leakage developed by adding intraoperative treatment. Conclusion: Although intraoperative CS did not significantly reduce the incidence of postoperative anastomotic leakage or bleeding, it can be useful for certain cases.*

Anastomotic complications after rectal cancer surgery have important implications on postoperative mortality or poor oncological outcome. Several studies have shown that anastomotic leakage or blood transfusion is associated with poor prognosis in cancer patients (1-5). Therefore, prevention of anastomotic complications is an important issue. A large cohort study from Japan has reported the anastomotic leakage rate of locally advanced low rectal cancer to be 10.8-11.9% (6). In addition, the incidence of anastomotic bleeding has been reported to be 0.6-9.6% (7). Several studies have reported on the techniques to prevent anastomotic complications, for example, transanal tube placement, air leak test (ALT), and defunctioning ileostomy (7-9). The intraoperative ALT is widely used to detect mechanically insufficient colorectal anastomosis. ALT by using colonoscopy (CS) can also help evaluate anastomotic bleeding through direct visualization in addition to anastomotic integrity. Since 2008, we have employed intraoperative CS for the anastomotic assessment of rectal cancer patients who underwent anterior resection.

In this study, we aimed to clarify the usefulness of intraoperative CS for preventing postoperative anastomotic leakage and bleeding after anterior resection for rectal cancer.

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Key Words: Colonoscopy, leak test, anastomotic leakage, anastomotic bleeding.

Patients and Methods

Study population. We retrospectively reviewed and analyzed the prospectively collected database of the Department of Gastrointestinal surgery, Kobe University. Patients with rectal cancer who underwent circular-stapled anastomosis following anterior resection were included in this study; patients with hand-sewn anastomosis after intersphincteric resection were excluded. A total of 185 patients who underwent open or laparoscopic anterior resection for rectal cancer from January 2008 to December 2016 were included. The outcomes of the patients who received intraoperative CS (n=162; CS group) were compared with those of patients who did not undergo intraoperative CS (n=23; non-CS group). Patients were treated for rectal cancer according to the guidelines of the Japanese Society for Cancer of the Colon and Rectum (10, 11). Moreover, tumor characteristics were classified according to the Japanese Classification of Colorectal Carcinoma (12). When the tumor was located between the inferior margin of the second sacral vertebra and the peritoneal reflection, its location was recorded as the upper rectum, whereas when it was located below the peritoneal reflection, its location was recorded as the lower rectum.

Assessment of the anastomotic integrity. All operations were performed by the surgical team specialized in colorectal surgery. After anastomosis formation, an atraumatic bowel clamp was placed proximal to the anastomosis and a colonoscope was gently inserted from the anus until the anastomosis line by an experienced endoscopic surgeon. The anastomosis line was visualized and evaluated for any defect, bleeding, and ischemia. The pelvic cavity was filled with saline water, following which ALT was performed by inflating CO_2 into the rectum through the colonoscope. The presence of air bubbles from the anastomosis was considered as a positive ALT result. Then, additional intraoperative treatment was performed to repair any anastomotic defect or bleeding detected through CS.

Definition of postoperative anastomotic leakage. Clinical signs of anastomotic leakage were defined as abdominal pain, fever, and the discharge of feces, gas, or pus from the pelvic drain. All cases of anastomotic leakage were confirmed using computed tomography, endoscopy, water-soluble contrast enema, digital rectal examination, or relaparotomy. The severity of anastomotic leakage was classified according to the extended Clavien–Dindo classification of surgical complications (13).

Definition of postoperative anastomotic bleeding. Clinical signs of anastomotic bleeding were defined as active and continuous discharge of fresh blood through the anus. These clinically suspicious signs were confirmed through rectal examination or endoscopy. Anastomotic bleeding severity was classified according to the extended Clavien–Dindo classification of surgical complications (13).

Statement of ethics. The study protocol was approved by the Research Ethics Board of the Kobe University Hospital. Informed consent was obtained from all individual participants included in the study.

Statistical analysis. Continuous parameters were compared using Student's *t*-test or Mann–Whitney *U*-test according to data distribution. Categorical variables were analyzed using chi-square and Fisher's exact test. Significance level was set at $p<0.05$.

Results

Patient and tumor characteristics are summarized in Table I. Body mass index (BMI) was significantly higher in the non-CS group than in the CS group (24.1 kg/m^2 *vs.* 22.4 kg/m^2, $p=0.02$). There was no significant difference in tumor characteristics between the two groups.

Surgical outcomes are shown in Table II. The overall incidence of postoperative complications was not significantly different between the groups. The postoperative anastomotic leakage rate in the CS group (8.6%, 14 of 162 patients) was similar to that in the non-CS group (4.3%, 1 of 23 patients) ($p=0.70$). All patients with postoperative leakage received radiologic or operative intervention. While postoperative anastomotic bleeding was not observed in any of the non-CS group (0%), it developed in three patients in the CS group (2.4%) ($p=0.50$). Of these three patients, one received gauze packing and the other two received endoscopic clipping.

Among the 162 patients in the CS group, positive ALT result was observed in two patients (Figure 1A), thus, these patients received additional intraoperative treatment: one underwent only suture closure of the defect and the other underwent ileostomy. Postoperative leakage did not develop in any of them. Postoperative leakage developed in 14 patients, but intraoperative ALT was negative in all of them. Intraoperative CS revealed anastomotic bleeding only in one patient (0.6%, Figure 1B). There were three patients in whom postoperative anastomotic bleeding occurred (Table III). Although anastomotic bleeding was not observed through intraoperative CS in any of them, postoperative bleeding developed within 24 h of surgery in all three cases.

Discussion

ALT is widely used to evaluate mechanically insufficient stapled anastomoses. However, the effectiveness of ALT in reducing anastomotic complications remains controversial. Wu *et al.* reported that performing ALT did not effectively reduce the incidence of clinical colorectal anastomotic leakage after surgery (8). In their study, ALT was performed using various methods such as catheter, endoscope, or syringe. Yang *et al.* evaluated the benefit of ALT with intraoperative CS by comparing it with a 250-ml bulb irrigation syringe in low anterior resection for rectal cancer (14). They reported a lower overall incidence of anastomotic leakage in the intraoperative CS group than in the syringe group. However, the frequency of preventive ileostomy due to a positive ALT result was higher in the intraoperative CS group than in the syringe group. Intraoperative CS might be more appropriate to detect potential air leakage because it can provide air insufflation with more adequate and steady pressure for ALT compared with other methods. Therefore, we propose performing ALT with intraoperative CS.

Previous studies have reported the efficacy of indocyanine green fluorescence imaging in reducing the incidence of anastomotic leakage (15-17). In our patients, anastomotic ischemia may have been the cause of postoperative anastomotic leakage, because a positive ALT result was not observed in any of the patients who developed postoperative anastomotic leakage in the CS group. Intraoperative assessment of mechanical integrity along with anastomotic perfusion using intraoperative CS may greatly contribute to a decrease in the incidence of anastomotic leakage.

The reported incidence of anastomotic bleeding after colorectal resection varies widely from 0.6% to 6.5% (18, 19). Ishihara *et al.* have reported that intraoperative CS is useful to prevent anastomotic bleeding (18). In their study, the incidence of postoperative anastomotic bleeding before introducing intraoperative CS was 1.3%. Since the introduction of intraoperative CS, no postoperative

Table I. *Patient and tumor characteristics*.

	CS (+) n=162	CS (–) n=23	*p*-Value
Age, median (range)	69 (28-96)	68 (38-87)	0.81
Gender, n (%)			
Male	105 (64.8)	18 (78.3)	0.24
Female	57 (35.2)	5 (21.7)	
BMI (kg/m^2), median (range)	22.4 (14.9-38.7)	24.1 (20-34.9)	0.02
Smoker, n (%)			0.45
Yes	45 (27.8%)	4 (17.4%)	
No	117 (72.2%)	19 (82.6%)	
Diabetes, n (%)			0.23
Yes	25 (15.4%)	6 (26.1%)	
No	137 (84.6%)	17 (73.9%)	
ASA physical status classification, n (%)			0.69
I	7 (4.3)	0	
II	153 (94.4)	23 (100)	
III	2 (1.2)	0	
Preoperative chemo-radiotherapy, n (%)			0.61
Yes	6 (3.7)	0	
No	156 (96.3)	23 (100)	
Tumor location, n (%)			0.56
Rectosigmoid colon	80 (49.4)	11 (47.8)	
Upper rectum	60 (37.0)	7 (30.4)	
Lower rectum	22 (13.6)	5 (21.7)	
cStage*, n (%)			0.75
0	1 (0.6)	0	
I	57 (35.2)	8 (34.8)	
II	39 (24.1)	6 (26.1)	
III	53 (32.7)	6 (26.1)	
IV	12 (7.4)	3 (13.0)	
pStage*, n (%)			0.63
0	4 (2.5)	0	
I	51 (31.5)	9 (39.1)	
II	36 (22.2)	3 (13.0)	
III	60 (37.0)	8 (34.8)	
IV	11 (6.8)	3 (13.0)	

ASA: American Society of Anesthesiologists; *Japanese Classification of Colorectal Carcinoma/TNM system.

Table II. *Surgical outcomes*.

	CS (+) n=162	CS (–) n=23	*p*-Value
Type of operation, n (%)			0.36
High anterior resection	61 (37.7)	6 (26.1)	
Low anterior resection	101 (62.3)	17 (73.9)	
Operation approach, n (%)			0.35
Open	23 (14.2)	5 (21.7)	
Laparoscopy	139 (85.8)	18 (78.3)	
Operation time*, min (range)	301 (145-720)	340 (224-803)	0.10
Estimated blood loss*, g (range)	10.5 (0-5345)	30 (0-1405)	0.60
Blood transfusion, n (%)			0.73
Yes	18 (11.1)	3 (13.0)	
No	144 (88.9)	20 (87.0)	
Diverting stoma, n (%)			0.10
Yes	30 (18.5)	8 (34.8)	
No	132 (81.5)	15 (65.2)	
Postoperative complications, n (%)	46 (28.4)	6 (26.1)	0.8
Anastomotic leakage**	14 (8.6)	1 (4.3)	0.70
Grade I or II	0	0	
Grade III or higher	14	1	
Anastomotic bleeding**	3 (2.4)	0 (0)	0.50
Grade I or II	1	0	
Grade III or higher	2	0	
Bowel obstruction	8 (6.5)	3 (13)	0.14
Wound infection	8 (6.5)	1 (4.3)	0.9

*The data are expressed as the median; **According to the Clavien-Dindo classification.

anastomotic bleeding was noted in 73 consecutive cases, and intraoperative CS revealed active and continuous anastomotic bleeding in 9.6% cases. On the other hand, Shamiyeh *et al*. have reported that the incidence of postoperative bleeding is not significantly reduced by intraoperative CS (20); they reported that anastomotic bleeding was not detected using routine intraoperative CS in all patients in whom postoperative anastomotic bleeding occurred. Furthermore, postoperative bleeding was noticed within 30 min to 4 h after surgery in all cases. Consistent with their results, the incidence of postoperative bleeding was not significantly different between the CS and non-CS groups in our study. Postoperative anastomotic bleeding occurred in three patients; however, anastomotic bleeding was not observed through intraoperative CS in any of them. Postoperative anastomotic bleeding was noticed within 24 h of surgery. Considering these results, the usefulness of intraoperative CS for preventing postoperative anastomotic bleeding remains controversial and needs to be further evaluated.

There are some limitations in this study. First, it was a retrospective study without randomization of patient selection. Second, the number of the patients in the non-CS group was very small. Third, the decision to perform ALT using CS depended on surgeons. Randomized controlled studies in a larger scale are necessary to provide evidence confirming the usefulness of intraoperative CS.

In conclusion, anastomotic assessment using intraoperative CS did not significantly reduce the incidence of postoperative anastomotic leakage or bleeding in patients undergoing rectal cancer surgery. However, intraoperative CS provided useful information about the anastomotic integrity and may help perform intraoperative treatment for preventing postoperative anastomotic leakage.

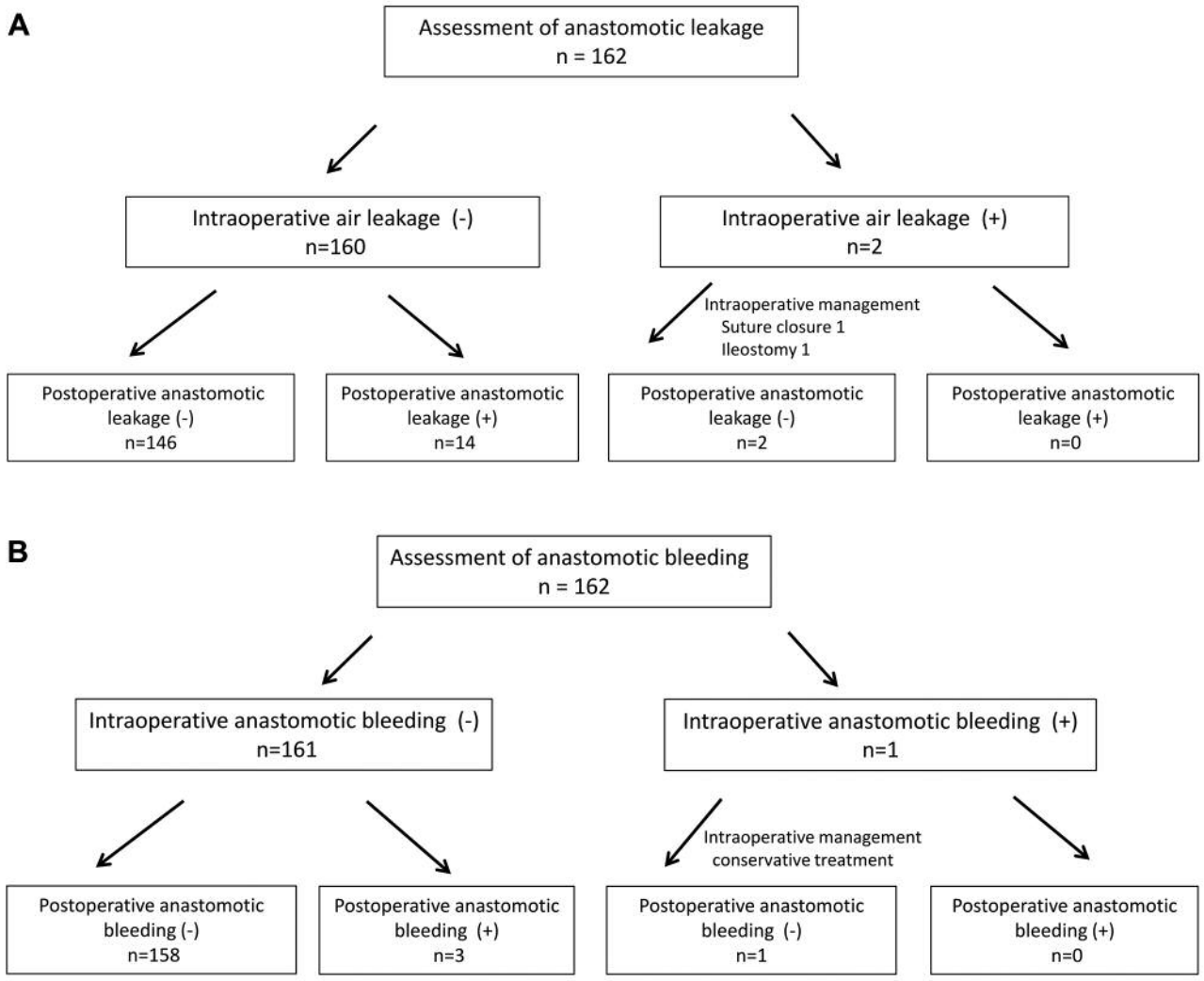

Figure 1. *Flow-chart showing the outcomes of intraoperative colonoscopic assessment. Intraoperative CS was performed in 162 patients. (A) Assessment of anastomotic leakage. (B) Assessment of anastomotic bleeding.*

Table III. *Cases of postoperative anastomotic bleeding.*

Case	Age/Gender	Procedure	Intraoperative bleeding	Diagnosis of bleeding	Management
1	80/Female	Lap-LAR	–	0 POD	Gauze packing
2	60/Male	Lap-LAR	–	0 POD	Endoscopic clipping
3	55/Male	Lap-LAR	–	0 POD	Endoscopic clipping

Lap-LAR: Laparoscopic low anterior resection; POD: postoperative day.

Conflicts of Interest

The Authors declare that they have no conflicts of interest regarding this study.

Authors' Contributions

NS and TM designed the study. NS, TM, KY, HH, MY and SK performed operation and collected data. NS wrote the initial draft of

the manuscript. TO, TN and SS contributed to analysis and interpretation of data. TM and YK critically reviewed the manuscript. All Authors approved the final version of the manuscript.

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