

Computed Tomography Findings at 6th Month Related to Chronic Anastomotic Complications After Rectal Surgery

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Objective: This study aimed to assess a radiologic test and clinical findings as risk factors of chronic complications after anastomotic leakage (CCAL) in rectal surgery.

Summary of Background Data: Anastomotic leakage (AL) is the most important complication that is related to chronic complications like unhealed chronic sinuses, strictures, and infections.

Methods: This retrospective study included patients who developed anastomotic leakage (AL) after undergoing extraperitoneal anastomosis. Patients with the following characteristics were excluded: (1) patients with no anastomoses, (2) patients undergoing multiple resections due to synchronous colorectal lesions, (3) patients with no curative resections of the primary lesions, and (4) patients experiencing immediate postoperative mortality. Finally, 72 patients were analyzed in this study. The patients were divided into the no chronic complication (NCC) group and the chronic complication (CC) group.

Results: Of the 72 included patients, 17 (23.6%) had CCAL. The patients in the CC group more frequently had radiotherapy and lower tumor compared to the patients in the NCC group. A total of 52 (52/55 [94.5%]) and 4 patients (4/17 [23.5%]) in the NCC group and the CC group achieved bowel continuity 3 years after the primary surgery, respectively ($P < 0.0001$). According to the multivariate analysis, CT findings at the sixth postoperative month and tumor height were associated with CCAL ($P < 0.0001$ and $P = 0.046$, respectively).

Conclusion: This study showed that CT findings at the 6th postoperative month and tumor height were possibly associated with CCAL.

Key words: Anastomotic leak – Rectum – Pelvic infection – Chronic complication

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Anastomotic leakage (AL) is the most important complication after colorectal surgery. Its incidence rates are reportedly 2.9% to 15% after rectal surgery and 3.4% to 6% for all colorectal surgeries.¹ AL is associated with early morbidity and mortality.^{2,3} Patients with AL more frequently develop intestinal obstruction, weight loss, and sepsis compared to those without AL.³ The postoperative 30-day mortality rate of AL is reportedly 29% in patients with AL.² Several patients undergo diversion surgeries using a diverting stoma to reduce the complications of AL and to avoid life-threatening peritonitis.⁴ However, a diverting stoma does not reduce the long-term morbidity, such as a permanent stoma, of patients with AL.⁵

AL is associated with chronic complications, and some patients develop unhealed chronic sinuses, strictures, and infections.^{6,7} The overall incidence of long-term complications in patients with AL has not been thoroughly investigated. Few studies have focused on the natural course or treatment of chronic complications after anastomotic leakage (CCAL).^{7,8} The incidence rate of persistent anastomotic sinus after AL is reportedly 36%.⁸ CCAL affects patients' quality of life. Some patients with CCAL require surgical and radiologic interventions.⁹ However, reoperation for CCAL is associated with low healing and high morbidity rate.^{9,10}

Although AL is associated with CCAL, not all patients with AL develop CCAL. The authors found that some patients with AL experienced CCAL after a successful ileostomy takedown and that some patients with CCAL had long-term radiologic changes. The authors believed that predicting CCAL is important to comprehensively understand CCAL and to improve its treatment. Considering a comprehensive understanding regarding the risk factors for CCAL, patients with high likelihood of complications can be clearly identified, and appropriate intensive care can be provided to these patients. A few studies have investigated the association between clinical findings and chronic complications after AL. This study aimed to analyze the radiologic test and clinical findings as risk factors for CCAL in rectal surgery.

Methods

This retrospective study included patients who underwent colorectal surgery between January 2008 and December 2016. Patients with AL or presacral abscess after rectal surgery along with extraperitoneal anastomosis were included. Patients

with the following characteristics were excluded in this study: (1) patients with no anastomoses, (2) patients undergoing multiple or further resections due to synchronous colorectal lesions, (3) patients with no curative resections of the primary lesions, and (4) patients experiencing immediate postoperative mortality. Patients were divided into the no chronic complication (NCC) and chronic complication (CC) groups. The primary outcome parameter was the association between the results of the radiologic test and CCAL. The secondary outcome parameters were the incidence of CCAL and the incidence of intestinal continuity. This study was approved by the institutional review board of the University Medical Center (2019-02-036). This retrospective study involved minimal patient risk; therefore, the board waived the need for informed consent.

Operation

All surgeries were performed by specialist colorectal surgeons. High or low ligation of the inferior mesenteric artery was performed during surgery. Mobilization of the splenic flexure was also performed if needed. All surgeries included partial or total removal of the mesorectum circumferentially with preservation of the hypogastric nerve and pelvic plexuses. The anastomosis was usually performed using a mechanical staplers or using a coloanal hand-sewn technique. Open, laparoscopic, and robotic resections were performed according to standard procedures. Some patients underwent diverting ileostomy at the time of the primary surgery.

Anastomotic leak

All patients underwent AL, defined as a defect of the intestinal wall's integrity at the colorectal or coloanal anastomosis site leading to communication between the intra- and extraluminal compartments.¹¹ Clinical peritonitis without evidence of defects and perianastomotic fluid collection with gas were considered AL. AL was also diagnosed based on contrast study, abdominopelvic computed tomography (CT), and physical examination findings. The severity of AL was presented based on AL grade.¹¹ Grade A is AL requiring no active therapeutic intervention,¹¹ grade B is AL requiring active therapeutic intervention,¹¹ and grade C is AL requiring re-laparotomy.¹¹ Some patients received antibiotics after AL. Other patients with AL under-



Fig. 1 Abnormal CT finding at sixth month after anastomotic leak. There is air-fluid collection in pelvis (white arrow).

went several interventions including stoma formation, radiologic drainage, or transanal drainage.

Stoma takedown was performed 10 to 12 weeks after stoma formation if there was no evidence of AL based on a contrast study finding. If a persistent sinus was observed at 10 to 12 weeks, stoma takedown was delayed and performed once it had stabilized. The radiologic or transanal drains were removed after presacral inflammation was resolved and abscess volume was reduced.

Postoperative follow-up and chronic complications

Patients were followed up by clinical examination, colonoscopy, or abdominopelvic CT. All patients underwent a follow-up examination every 3 months for the first 2 years and subsequently every 6 months for the next 3 years. All patients underwent follow-up CT at 6, 12, 24, and 36 months. Abnormal CT findings were defined as presence of fluid, free air, or air-fluid collection associated with the anastomotic site with or without leakage (Fig. 1). All patients checked tumor height, as determined using endoscopy and/or digital rectal examination. The height of tumor defined as the height of tumor center from the anal verge.

CCAL included permanent presacral sinus, stricture, delayed fistula, and delayed anastomotic dehiscence. A permanent presacral sinus was defined as perianastomotic sinus > 12 months after

the primary surgery. An anastomotic stricture established both the clinical symptoms of colonic obstruction and endoscopic narrowing of the anastomosis. A delayed fistula was defined as a fistula connected with anastomosis > 12 months after the primary surgery. Delayed anastomotic dehiscence was defined as an anastomotic disruption that occurred after the adaptation of intestinal continuity.

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences software version 25 (IBM Corporation, Armonk, NY, USA). All continuous data were analyzed using Student's *t*-test. The long-term outcomes were analyzed using the chi-squared test or Fisher's exact test. Univariate and multivariate analyses were performed using logistic regression. *P* values less than 0.05 were considered statistically significant.

Results

Clinical characteristics

Between January 2008 and December 2016, 2372 patients underwent colorectal surgery in our tertiary hospital. Of them, 756 underwent low anterior resection. Of the 756 patients, a total of 121 without anastomosis and 90 without curative resection were excluded from this study. Ten patients who died immediately during the postoperative period were also excluded. Finally, 535 patients underwent extraperitoneal anastomosis. Of them, 83 underwent AL. Five patients who were transferred to other hospitals and 6 patients with incomplete medical records were excluded from this study. Finally, 72 patients were analyzed in this study.

In this study, 17 (23.6%, 17/72) patients had CCAL. Eight patients had permanent presacral sinus. Out of the 8 (11.1%, 8/72) patients with permanent presacral sinus, 2 experienced local recurrence of the primary tumor that was associated with permanent presacral sinus, and 3 had fistulae (2 anastomosis-vaginal fistulae, 1 sinus-cutaneous fistula). Six patients (8.3%, 6/72) had anastomotic strictures. Three patients (4.2%, 3/72) underwent delayed anastomotic dehiscence.

There were 58 male patients (80.6%) and 14 female patients (19.4%) in this study. The mean age of the patients was 60.6 years (range: 30–82 years). The clinical characteristics of the patients are shown in Table 1. The patients in the CC group more frequently had radiotherapy, lower tumor height,

Table 1 Clinical characteristics between NCC and CC

Group	NCC (%)	CC (%)	P value
Sex			
Male	45 (81.8)	13 (76.5)	0.728
Female	10 (18.2)	4 (23.5)	
Age (years), Mean (range)	60.4 (30–82)	61.2 (40–77)	0.810
ASA			
1	22 (40.0)	6 (35.3)	0.264
2	22 (40.0)	10 (58.8)	
3	11 (20.0)	1 (5.9)	
Radiotherapy			
No	48 (87.3)	7 (41.2)	<0.0001
Yes	7 (12.7)	10 (58.8)	
Tumor height (cm), Mean $\pm$ SD	8.1 $\pm$ 2.3	6.0 $\pm$ 1.6	<0.0001
Height of anastomosis (cm), Mean $\pm$ SD	3.9 $\pm$ 1.6	2.8 $\pm$ 1.4	0.019
operation			
Open	13 (23.6)	2 (11.8)	0.139
Laparoscopic	37 (67.3)	12 (70.6)	
Robotic	3 (5.5)	0 (0.0)	
Conversion	2 (3.6)	3 (17.6)	
Ligation of Inferior mesenteric artery			
High ligation	38 (69.1)	12 (70.6)	1.000
Low ligation	17 (30.9)	5 (29.4)	
OP time (minutes), Mean $\pm$ SD	207.6 $\pm$ 54.4	230.9 $\pm$ 57.4	0.132
Additional resection			
No	45 (81.8)	14 (82.4)	1.000
Yes	10 (18.2)	3 (17.6)	
Primary stoma			
No	38 (69.1)	4 (23.5)	0.001
Yes	17 (30.9)	13 (76.5)	

lower anastomosis, and primary stoma compared to the patients in the NCC group. Out of the 72 patients, 13 underwent additional resection during primary surgery. The additional resection included 2 salpingo-oophorectomies, 3 liver resections, 2 small intestinal resections, 3 cholecystectomies, 2 partial bladder wall resections, and 1 nephrectomy. Out of the 72 patients, 30 (41.7%) had defunctioning stomas after primary surgeries.

Anastomotic leak

The median duration between the primary surgery and the diagnosis of AL was 6.0 days (range: 2–75 days). Of the 72 patients, 30 (41.7%) had defunctioning stomas after primary surgeries, and 50 patients (69.4%) were diagnosed with AL by CT. The rest of the patients were diagnosed with AL by contrast enema studies and physical examination. The clinical characteristics of AL between the two groups are shown in Table 2. There was no significant difference in the diagnostic date of AL

Table 2 Characteristic of anastomotic leakage

Group	NCC (%)	CC (%)	P value
Date of anastomotic leakage, Median (range)	6.0 (2–60)	6.0 (3–14)	0.414
Symptoms of peritonitis			
Subclinical	24 (43.6)	9 (52.9)	0.501
Clinical	31 (56.4)	8 (47.1)	
Leakage grade ^a			
A	3 (5.5)	1 (5.9)	0.230
B	23 (41.8)	11 (64.7)	
C	29 (52.7)	5 (29.4)	

^aA: requiring no active intervention; B: requiring active intervention; C: requiring re-laparotomy.

between the 2 groups ($P = 0.414$). The symptoms of peritonitis and leakage grade were not associated with CCAL.

During the 3-year follow-up period, 16 (22.2%) patients did not undergo surgery for bowel continuity. In the NCC group, 52 (94.5%) patients achieved bowel continuity. However, 4 (23.5%) patients in the CC group achieved bowel continuity ($P < 0.0001$).

Radiologic results

The radiologic findings are shown in Table 3 and 4. The CT findings at AL diagnosis and the contrast study findings of AL after 3 months were not different between the 2 groups. However, the CC group showed more frequent leakage based on contrast study findings at 3 months compared to the NCC group. The CC group showed more frequent abnormal CT findings at the sixth, 12th, 24th, and 36th postoperative months compared to the NCC group ($P < 0.0001$, Table 4). In the NCC group, abnormal findings were not observed over time, but

Table 3 Radiologic findings between the NC and the CC groups at anastomotic leakage

Group	NCC (%)	CC (%)	P value
CT findings at diagnosis of AL			
Air	16 (29.1)	1 (5.9)	0.137
Fluid	13 (23.6)	6 (35.3)	
Air-fluid	26 (47.3)	10 (58.8)	
Contrast study after 3 months			
No leakage	31 (56.4)	7 (41.2)	0.239
Leakage	17 (30.9)	9 (52.9)	
Not applicable ^a	7 (12.7)	1 (5.9)	

AL, anastomotic leakage; CC, chronic complications; CT, computed tomography; NCC, no chronic complications.

^aThe patients treated with antibiotics without ileostomy.

Table 4 Abnormal CT findings between the NCC and the CC groups during follow-up

Group	NCC (%)	CC (%)	P value
CT at 6 month			
NO	43 (78.2)	1 (5.9)	<0.0001
Yes	12 (21.8)	16 (94.1)	
CT at 12 month			
NO	46 (83.6)	1 (5.9)	<0.0001
Yes	9 (16.4)	16 (94.1)	
CT at 24 month			
NO	48 (87.3)	2 (11.8)	<0.0001
Yes	7 (12.7)	15 (88.2)	
CT at 36 month			
NO	50 (90.9)	2 (11.8)	<0.0001
Yes	5 (9.1)	15 (88.2)	

CC, chronic complications; CT, computed tomography; NCC, no chronic complications.

in the CC group, few positive changes were observed.

Risk factor

The association between the results of the patients' clinical characteristics and CCAL is summarized in Tables 5 and 6. According to the univariate analysis, radiotherapy, tumor height, and CT findings at the sixth postoperative month were associated with the incidence of CCAL. However, tumor height and CT findings at the sixth postoperative month were associated with CCAL according to the multivariate analysis. Tumor height was negatively associated with the incidence of CCAL (hazard ratio [HR] = 0.597, 95% confidence interval [CI] = 0.359–0.991, $P < 0.046$). The CT findings at the sixth postoperative month were positively associated with the incidence of CCAL (HR = 55.670, 95% CI = 5.304–584.275, $P < 0.001$).

Table 5 Univariate analysis for chronic anastomotic complications

	Risk analysis		
	OR	95% CI	P value
Sex			
Male	1.000		
Female	1.385	0.372–5.150	0.627
Radiotherapy			
No	1.000		
Yes	9.796	2.807–34.181	<0.0001
Tumor height	0.612	0.390–0.959	0.032
Anastomosis height	1.060	0.561–2.001	0.857
6 th month CT			
No	1.000		
Yes	57.333	6.887–477.270	<0.0001

CT, computed tomography.

Table 6 Multivariate analysis of chronic anastomotic complications

	Risk analysis		
	OR	95% CI	P value
Radiotherapy	1.847	0.215–15.876	0.576
Tumor height	0.597	0.359–0.991	0.046
6 th month CT	55.670	5.304–584.275	0.001

CT, computed tomography.

Discussion

Previous studies assessing the long-term complications of AL have documented the incidence of complications, clinical course, and treatment of AL.^{7,12} Although these studies are considered beneficial in comprehensively understanding CCAL, they did not focus on the factors that were associated with long-term complications or the factors that were predictive of the complications. This study showed that abnormal CT findings at the sixth postoperative month and tumor height were associated with CCAL.

CCAL was reported in several studies. The incidence of the persistent anastomotic sinus was reportedly 36% to 44% in patients with AL after rectal surgery with total mesorectal excision.^{6,8,12} The benign stricture after colorectal surgery could be considered a CCAL. The AL was significantly associated with the benign stricture after colorectal surgery.¹³ Strictures were observed in 11.4% to 17.6% of patients with AL and 1.8% of patients without AL.^{13,14} A fistula formed from the presacral sinus was also considered a CCAL. Fistula formation was reportedly observed in 55% of patients with chronic presacral sinus.¹⁵ In this study, the incidence rate of CCAL was reportedly 23.6% based on a 3-year follow-up period.

The risk factors associated with CCAL were not comprehensively assessed in the previous studies. Chronic presacral sinus was not associated with operation type and anastomosis type.¹⁶ Patients receiving neoadjuvant therapy more frequently had chronic presacral sinus compared to patients not receiving neoadjuvant therapy. However, there was no statistically significant difference between these patients.^{6,16} AL and low rectal cancer were the risk factors for an anastomotic stricture.¹⁴ CCAL was not associated with defunctioning stoma at the primary surgery.⁸ In this study, patients with lower tumor height more frequently developed chronic complications compared to patients with higher tumor height. The height of anastomosis was not

associated with the incidence of CCAL. According to the multivariate analysis in this study, tumor height revealed significant results.

Radiologic abnormalities associated with AL could persist after recovering from AL. Two months after surgery, patients with AL showed variable amounts of air and fluid in the presacral area.¹⁷ Although the abnormalities associated with AL were less extensive than those in the early period, some patients who underwent AL also showed several abnormalities in CT studies 6 months after the surgery. The authors focused on the fact that some patients with AL consistently experienced radiologic abnormalities even after AL had improved. In this study, patients without CCAL showed improved radiologic results over time. However, patients with CCAL showed few changes in radiologic test. The authors assessed the association between CT abnormality and CCAL. The results of radiologic test through follow-up revealed the association between CT abnormality and CCAL. The authors focused on the first detection of CCAL. This study showed that the abnormal findings observed in radiologic test at the sixth postoperative month were associated with CCAL.

Treatments for CCAL are considered complex and controversial. In this study, among the patients with CCAL, 13 underwent permanent colostomy. Of the 13 patients, 5 had permanent presacral sinus. Moreover, a total of 5 and 3 patients had stenoses and delayed anastomotic dehiscence, respectively. Of the 5 patients with permanent presacral sinus, one underwent transverse colon loop colostomy and re-anastomosis. Patients underwent repeated anastomotic dehiscence after the transverse colon loop colostomy takedown. Finally, one patient underwent permanent transverse colostomy.

This study had some limitations. First, this was a retrospective study, and the study had a small sample size. A selection bias may have been observed in this study as this study enrolled patients diagnosed with AL. Second, CCAL may have been underestimated because of patients lost to follow-up. The percent of patients who underwent chronic complications were lower than that reported by the previous studies.^{6,8,12} Hence, a multicenter prospective observational study assessing the natural course of CCAL is required.

In conclusion, our study suggested that abnormal CT findings at the sixth postoperative month and tumor height are associated with CCAL. It may be possible to consider the risk of CCAL after AL and to select patients who require treatment. The

authors believe that considering a comprehensive understanding regarding the risk factors for CCAL, patients with high likelihood of complications can be clearly identified, and appropriate intensive care can be provided to these patients.

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