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The effect of intraoperative bleeding and staple number on anastomotic leakage in laparoscopic rectal surgery

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ABSTRACT

Introduction: Anastomotic leakage (AL) after colorectal resection remains one of the most important complications with associated morbidity and mortality. The aim of this study is to investigate the number of staples used during laparoscopic rectal transection and the effect of intraoperative bleeding on AL.

Materials and Methods: The data of 70 patients who underwent low anterior resection (LAR) for colorectal cancer between 2020 and 2022 were retrospectively analyzed. Demographic characteristics of the patients, the number of staples used, intraoperative bleeding status, and the presence of AL were examined.

Results: In the group without AL, the median value was found to be two staples, with at least one stapler and at most two staples used. In the operation of patients with AL, the median value was three staples, at least three staples were used, and at most four staples were needed. A statistically significant difference was observed between the two groups ($p<0.001$). While the rate of AL was 5.56% in the group without hemorrhage, this rate was observed as 31.25% in patients with intraoperative hemorrhage. There was a statistically significant difference between the two groups ($p=0.013$).

Conclusion: Intraoperative hemorrhage and the use of more than two staples in rectal transection in LAR have been shown to be high-risk for AL. Coloproctologists should try to reduce the number of linear staples and transect the rectum with no more than two staples.

Keywords: Anastomosis leakage, Laparoscopic colorectal cancer, Multiple stapler firings

Introduction

The most frequent post-surgery complication is anastomotic leakage (AL), which can poor prognosis and increase local recurrence while also increasing morbidity and mortality.[1-3] Anastomotic leaking can occur from between 1% and 30% of the time.[4] The multiplicity in AL definitions is the cause of this difference in incidence rate.[5]

An adequate blood supply, healthy bowel ends, and tension-free anastomosis are the fundamental prerequisites for anastomotic healing,[6] The causes of AL are thought to be multiple. According to recent studies, body mass index (BMI) is a separate risk factor for the rise in the rate of anastomotic leaks.[7] The American Society of Anesthesiologists (ASA) classification appears to be a significant factor because patients with higher ASA scores also have more AL.[8] Anastomotic safety appears to be influenced by the length of the process, which frequently reflects the intricacy of a particular surgical treatment.[8,9] Even

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though several researchers have suggested that prolonged operating times and the need for perioperative transfusions are related to the emergence of AL, to the best our knowledge, no other study has specifically linked intraoperative blood loss to an increased risk of the disease.[10,11]

Depending on whether an open or laparoscopic method is used, the level of the anastomosis appears to have a significant impact on the leakage rate, making it the most important factor in anastomotic leaks.[12-15] No matter the approach used, leak rates are higher after low anterior resection.[14,15] The restricted space of the pelvis, especially when performing laparoscopic colectomy, frequently causes an undesirable cutting angle and necessitates the use of multiple stapler cartridges for rectal division.[9,13]

This study investigated whether intraoperative bleeding and the number of staplers used during rectal resection affect AL in rectal cancer patients who underwent laparoscopic low anterior resection (LAR).

Materials and Methods

Our research was carried out retrospectively and cross-sectionally after being approved by the Local Ethics Committee with the decision numbered 2022–77. Data were collected by examining patient files and computer records.

A total of 70 patients who underwent laparoscopic LAR for primary rectal cancer in the General Surgery Clinic of Hitit University between 2020 and 2012 were included in the study. The eligibility criterion was rectal cancer which was histologically diagnosed as adenocarcinoma. The exclusion criteria included laparoscopic Hartmann's surgery, emergency surgery, intersphincteric resection, transanal hand-sewn anastomosis, total pelvic resection, ileorectal anastomosis, and pre-operative chemotherapy or radiation therapy.

Patients' age, gender, pathological differentiation, operation time, length of hospital stay, pre-operative serum neutrophil, lymphocyte, platelet, albumin, and C-reactive protein (CRP) levels, number of staples used, presence of an anastomotic leak, and intramural hemorrhage were obtained retrospectively from the archive system. CRP albumin ratio (CAR) was calculated from the values taken before the procedure and added to the study.

All patients underwent rectal division using a linear stapler and end-to-end anastomosis using a circular stapler. After anastomosis, an air leak test was performed for all patients. In patients with some risk factors, such as a positive air leak test or an incomplete doughnut of circular staples, a temporary diverting stoma was considered.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows software (version 26; IBM Corp., Armonk, N.Y., USA). Descriptive statistics; numbers and percentages were used for categorical variables, and mean ± standard deviation was used for numerical variables. Data normal distribution was evaluated with the Shapiro–Wilks test. Relationships between variables were investigated with Pearson or Spearman correlation coefficient by the data distribution.

In the anastomotic leak study groups, the Student's t-test for age alone was used to compare the numerical measures of two independent groups according to data distribution. Operation time, hospital stay, neutrophil, lymphocyte, thrombocyte, albumin, CRP, and CAR levels were evaluated with the Mann–Whitney U-test. In the study groups created for intraluminal hemorrhage, the comparison of numerical measurements for two independent groups was evaluated with the Student t-test for age and albumin following the data distribution, while Mann–Whitney U-test was used to evaluate for operation time, hospitalization time, neutrophil, lymphocyte, platelet, CRP, and CAR levels. The rate comparisons of categorical variables such as gender, tumor differentiation, AL, and presence of intramural hemorrhage according to research groups were evaluated using the Chi-square test. For the statistical significance level, $p<0.05$ was accepted.

Results

Of the patients participating in the study, 42 (60%) were male and 28 (40%) were female. The mean age of the patients was calculated as 66.87±12.51 (68) years. When the pathology results were examined, 22 (31.43%) patients had well-differentiated tumors, 46 (65.71%) patients had moderately differentiated tumors, and 2 (2.86%) patients had poorly differentiated tumors. The mean duration of all surgeries was 210.7±55.23 (202.5) minutes, and the mean hospital stay was 13.23±9.48 (12.5) days.

In the examination of laboratory values, the mean of neutrophils was 4.92±2.39 (4.34), the mean of lymphocytes was 1.6±0.58 (1.5), and the mean of platelets was 245.8±78.41 (230.5). The mean of albumin was 3.86±0.47 (3.9), the mean of CRP was 27.78±41.05 (6.61), and the mean of CAR was 7.55±11.28 (1.67).

An average of two staples was used in the surgeries, and at least one and at most four staples were needed. AL was observed in 8 (11.43%) patients. Intramural hemorrhage was detected in 16 (22.86%) patients.

Examination of Variables for AL

The patients participating in the study were divided into two groups according to the presence of AL, patients without leakage (Group A1) and patients with observed leakage (Group A2).

The mean operation time of patients without AL was 206.32±55.14 (197.5) minutes, and the operations of patients with leakage were 244.38±45.86 (232.5) min. A statistically significant difference of about 40 min was observed between the two groups (p=0.038). The mean hospital stay in the group without an anastomotic leak was 11.74±4.1 (12) days, and the hospital stay in the group with an anastomotic leak was 24.75±23.83 (17.5) days (p=0.027).

The mean CAR was calculated as 6.99±10.27 (1.67) in the group without leakage and as 11.89±17.67 (3.16) in the group with AL, no statistically significant difference was observed in terms of the mean CAR (p=0.810).

In the group without AL, the median value was found to be two staples, at least one stapler, and at most two staples, in the surgery of patients with AL, the median value was found to be three staples, at least three staples were used, and at most four staples were needed. A statistically significant difference was observed between the two groups (p<0.001). In the group without leakage, the incidence of intramural hemorrhage was 17.74%, and in the group with AL, a significant and statistically significant increase was observed, as 62.50% (p=0.013).

Examination of Variables in Terms of Intraluminal Hemorrhage

The patients participating in the study were divided into two groups according to the presence of intramural hemorrhage patients without hemorrhage (Group B1) and patients with hemorrhage (Group B2). The mean age of the group without hemorrhage was 66.63±12.51 (68) years, and the group with intramural hemorrhage was 67.69±12.87 (69) years, no statistically significant difference was observed (p=0.769). While 33 (61.11%) patients were male in Group B1, and 9 (56.25%) patients were male in Group B2, no statistically significant difference was observed (p=0.727).

The mean operation time of the patients without hemorrhage was 208.19±55.88 (200) min, and the average of 219.06±53.86 (210) min in the intramural hemorrhage group, no statistically significant difference was observed (p=0.413). When the laboratory values were compared between the two groups, no statistically significant difference was observed between the mean CAR of the two groups, similar to AL (p=0.769) (Table 1).

In the group without hemorrhage, the median value of the number of staples used was two staples, and at least one, at most four staples were needed. Similarly, the median value of two staples was found in the group with intramural hemorrhage, at least one and at most four staples were used. No statistically significant difference was detected (p=0.628). While the rate of AL was 5.56% in the group without hemorrhage, this rate was 31.25% in patients with intramural hemorrhage. There was a statistically significant difference between the two groups (p=0.013).

Discussion

In this study, it has been shown that the number of staples used in laparoscopic rectal surgery and intraoperative bleeding is associated with AL, and the use of two or more staples and intraoperative bleeding together or alone increases the risk of AL.

The rate of AL defined in the literature after laparoscopic rectal surgery ranges from 5% to 23%,[16] indicating that AL is multifactorial. Numerous studies have already attempted to identify possible risk factors that might facilitate the development of an anastomotic leak.[9,12,13,17] Age, gender, BMI, and ASA preconditions of patients have been thought to increase the risk for anastomosis integrity.[7,8,18] However, we could not show a relationship between patient characteristics and leakage rate in our study.

In the literature, it has been demonstrated that technical procedures have a bigger effect on anastomotic safety than patient preconditions.[12,13] Surgery-related bleeding increases the risk of leaking because it alters the hemodynamics of the anastomosis site. A considerable increase in the incidence of leaks was discovered by Kawada et al.[19] to be related with intraoperative bleeding of more than 100 mL. According to reports, patients receiving LAR for cancer are at risk for leaking if they develop perioperative bleeding that requires two or more units.[17] In our study, while the rate of AL was 5.56% in the group without hemorrhage, this rate was observed as 31.25% in patients with hemorrhage, and it was observed that intraoperative

Table 1. Exploration of all group data and comparisons of anastomosis leak groups and intraluminal hemorrhage groups

Variables	All patients (n=70)	No leakage (n=62)	Anastomosis leak (n=8)	Statistical Significance	No ıntraluminal hemorrhage (n=54)	Intramural hemorrhage (n=16)	Statistical significance
Age	66.87±12.51 (68)	66.84±11.88 (68)	67.13±17.66 (69.5)	0.966	66.63±12.51 (68)	67.69±12.87 (69)	0.769
Gender							
Male	42 (60.00%)	38 (61.29%)	4 (50.00%)	0.705	33 (61.11%)	9 (56.25%)	0.727
Female	28 (40.00%)	24 (38.71%)	4 (50.00%)		21 (38.89%)	7 (43.75%)	
Differentiation							
Well-differentiation	22 (31.43%)	21 (33.87%)	1 (12.50%)	0.379	14 (25.93%)	8 (50.00%)	0.161
Moderate-differentiation	46 (65.71%)	39 (62.90%)	7 (87.50%)		38 (70.37%)	8 (50.00%)	
Poorly-differentiation	2 (2.86%)	2 (3.23%)	0 (0%)		2 (3.70%)	0 (0%)	
Operation duration	210.7±55.23 (202.5)	206.32±55.14 (197.5)	244.38±45.86 (232.5)	0.038	208.19±55.88 (200)	219.06±53.86 (210)	0.413
Hospitalization Duration	13.23±9.48 (12.5)	11.74±4.1 (12)	24.75±23.83 (17.5)	0.027	11.72±4.78 (11.5)	18.31±17.23 (14.5)	0.021
Neutrophils	4.92±2.39 (4.34)	4.65±1.74 (4.23)	7.01±4.91 (4.46)	0.213	4.76±1.74 (4.34)	5.48±3.89 (4.13)	0.629
Lymphocytes	1.6±0.58 (1.5)	1.6±0.59 (1.5)	1.56±0.52 (1.58)	0.919	1.61±0.63 (1.48)	1.55±0.38 (1.54)	0.785
Platelets	245.8±78.41 (230.5)	246.6±78.14 (228.5)	239.63±85.63 (242)	0.912	252.91±80.8 (234)	221.81±66.45 (212)	0.206
Albumin	3.86±0.47 (3.9)	3.88±0.47 (3.9)	3.69±0.45 (3.65)	0.236	3.86±0.49 (3.9)	3.86±0.4 (3.9)	0.981
CRP	27.78±41.05 (6.61)	26.08±38.36 (6.61)	41.01±59.67 (12.71)	0.934	25.65±31.78 (7.21)	34.97±64.13 (5.64)	0.619
CAR	7.55±11.28 (1.67)	6.99±10.27 (1.67)	11.89±17.67 (3.16)	0.810	6.99±9.02 (2)	9.43±17.13 (1.44)	0.769
Stapler count	2 (1-4)	2 (1-2)	3 (3-4)	<0.001	2 (1-4)	2 (1-4)	0.628
Anastomosis leak	8 (11.43%)		3 (5.56%)	5 (31.25%)	0.013		
Intramural hemorrhage	16 (22.86%)	11 (17.74%)	5 (62.50%)	0.013			

hemorrhage increased the risk of anastomotic leak, in line with the literature.

Numerous investigations have investigated to the connection between the quantity of staple firing and the pace of anastomotic leaking. According to research by Ito et al., there is a direct correlation between the number of staple cartridges utilized in the rectal chamber and the incidence of anastomotic leaking.[13] Kim et al. have able to validate these findings through their prospective study including 270 patients.[9] More recently, Braunschmid et al. retrospectively reaffirmed it's conclusion in their study of rectal resections, stating that the number of staples has the strongest effect on the rate of AL leakage.[20]

There are several reasons why multiple staple cartridges are needed to divide the rectum. First, the large diameter of the middle and lower rectal wall may result in the use of more than one clip.[12,13] A narrow male pelvis with limited space and angle in the laparoscopic surgical approach is a risk factor that often leads to the use of two or more staples.[13] Using a 45 mm staple instead of a 60 mm staple initially may require multiple staples to guide the large intestine.[12]

In our study, the median value was two staples in the group without AL, and the median value was three staples in those with AL. It was shown that the use of three or more staples in laparoscopic rectal resection is a serious risk factor for AL.

Our study also has some limitations. The study has a retrospective design and there may be some selection bias. The sample size was not large enough and more samples may be needed to further validate our model. The use of three or more staples during the transaction may have resulted from the laparoscopic learning process.

Conclusion

Intraoperative hemorrhage and the use of more than two staples in rectal transection in LAR have been shown to be high-risk for AL. Coloproctologists should try to reduce the number of linear staples and transect the rectum with no more than two staples.

Disclosures

Ethichs Committee Approval: Our research was carried out retrospectively and cross-sectionally after being approved by the Local Ethics Committee with the decision numbered 2022–77.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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