Suitability of Primary Anastomosis for Colorectal Perforation

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Abstract

Colorectal perforation is often treated with colostomy without primary anastomosis due to the risk of anastomotic leakage. However, colostomy affects the patients' quality of life and may cause complications during closure. This study aimed to examine the suitability of primary anastomosis for colorectal perforation and determine the risk factors for postoperative anastomotic leakage. We retrospectively examined patients who underwent emergency surgery for colorectal perforation associated with generalized peritonitis between April 2007 and March 2017. Cases with iatrogenic or traumatic causes were excluded. Patients were divided into primary anastomosis and colostomy groups. Their age, time after onset, preoperative sequential organ failure assessment (SOFA) score, perforation site, cause of perforation, shock, intraperitoneal infection, steroid use, chronic renal failure, and mortality were compared. Subgroup analysis of the primary anastomosis group was performed to identify risk factors for anastomotic leakage. The cohort comprised 232 patients (112 men, 120 women; mean age, 73 years). Primary anastomosis and colostomy were performed in 27 and 205 patients, respectively. The primary anastomosis group consisted mainly of men with right colonic perforation. Of the 27 patients who underwent primary anastomosis, anastomotic leakage occurred in 5 (18.5%). Patients with anastomotic leakage demonstrated high SOFA scores (4.2 vs. 1.9, $p < 0.05$) and Hinchey stage IV disease (80% vs. 27.3%, $p < 0.05$). Of the 5 patients with anastomotic leakage, 2 died. Anastomotic leakage after primary anastomosis for colorectal perforation occurs in patients with septic complications or severe intraperitoneal infection. Therefore, primary anastomosis should be avoided in this patient population.

Keywords Colorectal perforation · Primary anastomosis · SOFA · Anastomotic leakage

Background

Colorectal perforation is a frequent fatal condition [1–4] that has been extensively studied in terms of background factors, such as age and underlying disease [1, 4]; intraoperative findings, such as intraperitoneal infection [2]; and prognostic factors, such as the sequential organ failure assessment (SOFA)

score. Treatment of colorectal perforation consists of intraperitoneal lavage and repair of the perforation site. In addition, given the risk of anastomotic leakage, colostomy is selectively performed in many cases. However, in patients who are beyond the acute phase, colostomy delays their reintegration into society, affects their daily activities, requires reoperation after closure, and poses numerous other problems. In light of these problems, primary anastomosis is sometimes performed without colostomy [5, 6]. However, the suitability of primary anastomosis remains controversial. Although several previous case reports have demonstrated that primary anastomosis can be performed without complications in patients with no risk factors, such as shock or immunosuppression [5, 6], none have examined patients that do develop anastomotic leakage. While we have comprehensively assessed primary anastomosis based on factors such as perforation site, general condition, and degree of infection, consistent standards have not yet been established. Furthermore, surgeons have differing opinions on the suitability of primary anastomosis, even when examining the same patient. Consequently, the standardization of operative procedures is far from a reality. Therefore, the present

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study retrospectively examined cases of primary anastomosis for colorectal perforation to determine risk factors for anastomotic leakage and the suitability of primary anastomosis.

Methods

We retrospectively examined patients who underwent emergency surgery for colorectal perforation with generalized peritonitis at the Department of General Surgery, Saitama Medical University, Moroyama, Japan, between April 2007 and March 2017. This study was approved by the Institutional Review Board of Saitama Medical University Hospital (No. 18031). Cases with iatrogenic or traumatic causes were excluded. Patients who underwent primary anastomosis without colostomy were defined as the primary anastomosis group, while patients who underwent any form of colostomy were defined as the colostomy group. These two groups were compared in terms of age, time after onset, preoperative SOFA score, perforation site, cause of perforation, shock, intraperitoneal infection, steroid use, chronic renal failure, and mortality. We also performed the same comparisons within the primary anastomosis group between patients with and without anastomotic leakage to determine possible risk factors. Intraperitoneal infection was assessed in accordance with the Hinchey classification [7], with Hinchey III defined as generalized peritonitis associated with purulent ascites and Hinchey IV defined as generalized peritonitis associated with fecal matter. Shock was defined as a mean blood pressure ≤ 65 mmHg despite massive transfusion and catecholamine administration upon entering the operating room. In cases of reoperation, anastomotic dehiscence was diagnosed based on intraoperative findings. In cases of primary operation, anastomotic leakage was diagnosed based on computed tomography findings of increased free air and abscess formation surrounding the anastomosis site.

Surgical Technique

In all cases, surgery for colorectal perforation was performed via laparotomy. The intestine was anastomosed with an autosuture device or an automatic anastomotic device. In principle, colostomy consisted of the Hartmann's procedure, in which the perforation site is resected and an end colostomy is formed from the proximal end. However, in some cases, the intestine was anastomosed after resection of the perforation site, and the stoma was formed at the proximal diversion. In other cases, the perforation site was directly taken out of the body to make a colostomy (exteriorization). The peritoneum was washed with $\geq 10,000$ ml of saline solution, and a closed drain was implanted in the pelvic floor. To close the abdomen, the muscle layer was closed with interrupted monofilament absorbable sutures, and the skin was closed with subcutaneous monofilament absorbable sutures after washing the

subcutaneous tissue with 1000 ml of saline solution. Carbapenem antibiotics were administered prior to surgery.

Statistical Analysis

Statistical analysis was performed using Excel (Microsoft, Seattle, WA) and BellCurve for Excel (Social Survey Research Information Co., Ltd., Tokyo, Japan). Continuous variables and categorical variables were examined using the Mann-Whitney *U* test and the χ^2 test, respectively. Statistical significance was defined as $p < 0.05$.

Results

A total of 232 patients underwent emergency surgery for colorectal perforation with generalized peritonitis during the study period. The cohort comprised of 112 men and 120 women with a mean age of 73.0 years. The most common cause of perforation was diverticulum (79 patients), followed by malignancy (72 patients) and idiopathic cause (70 patients). The most common perforation sites were the sigmoid colon (138 patients) and the rectum (45 patients), and 88% of cases occurred in the left colon (Table 1). Primary anastomosis and colostomy were performed in 27 and 205 patients, respectively. Colostomy was performed with Hartmann's procedure, exteriorization, and proximal diversion in 173, 17, and 15 patients, respectively. Compared to the colostomy group, the primary anastomosis group had a significantly higher percentage of men and perforation in the right colon. Shock occurred in a total of 45 patients, almost entirely among patients who underwent colostomy. In the primary anastomosis group, shock occurred in only 1 patient (Table 2). A

Table 1 Characteristics of patients with colorectal perforation

No. of patients	232
Age (years)	73.0
Sex (M/F)	112/120
In-hospital mortality (%)	37 (16%)
Cause of perforation	
Diverticulum	79
Malignancy	72
Idiopathic	70
Ulcer	5
Ischemia	3
Others	3
Site of perforation	
Rectum	45
Sigmoid	138
Descending	20
Transverse	12
Ascending	14
Cecum	3

Table 2 Comparisons between the anastomosis and colostomy groups

	Anastomosis	Colostomy	<i>p</i> value
No. of patients	<i>n</i> = 27	<i>n</i> = 205	
Age (years)	72.8	73.0	0.981
Sex (M:F)	21:6	91:114	0.002
Time to surgery since onset (h)	17.3	23.6	0.460
SOFA score	3.0	2.3	0.321
Left colon	13 (48%)	190 (92%)	0.001
Malignancy	12 (44%)	60 (29%)	0.109
Shock	1 (4%)	44 (21%)	0.028
Hinchey IV	10 (37%)	84 (41%)	0.695
Steroid use	1 (4%)	21 (10%)	0.275
Chronic renal failure	3 (11%)	25 (12%)	0.871
In-hospital mortality	5 (19%)	32 (16%)	0.698

SOFA, sequential organ failure assessment

total of 37 patients (16%) died in the hospital, but in-hospital mortality did not differ between the primary anastomosis (19%) and colostomy groups (16%). Anastomotic leakage occurred in 5 of 27 primary anastomosis patients (18.5%). Compared to patients without anastomotic dehiscence, patients with anastomotic dehiscence more commonly demonstrated high SOFA scores (4.2 vs. 1.9, $p < 0.059$) and Hinchey IV disease (80% vs. 27.3%, $p < 0.05$) (Table 3). Table 4 shows the details of the 5 patients with anastomotic leakage. Of these 5 patients, 4 had SOFA scores of ≥ 3 , and 2 died.

Discussion

Anastomotic leakage is a serious and frequently fatal complication [8] that occurs in 2.4–12% of standard colorectal surgery cases [9–12]. However, in patients with colorectal perforation, it is significantly more frequent [13]. Anastomotic leakage is

Table 3 Potential risk factors for anastomotic leakage

	Leakage	No leakage	<i>p</i> value
No. of patients	5	22	
Age (years)	67.4	74.0	0.274
Time to surgery after onset (h)	10	18	0.130
SOFA score	4.2	1.9	0.039
Left colon	2 (40%)	11 (50%)	0.686
Malignancy	4 (80%)	8 (36%)	0.076
Shock	0 (0%)	1 (5%)	0.627
Hinchey IV	4 (80%)	6 (27%)	0.028
Steroid use	0 (0%)	1 (5%)	0.627
Chronic renal failure	1 (20%)	2 (9%)	0.484
In-hospital mortality	2 (40%)	3 (14%)	0.171

SOFA, sequential organ failure assessment

typically avoided by performing a colostomy followed by a secondary operation to close it. However, for patients who are past the acute phase, colostomy poses many disadvantages, such as negative effects on daily activities and delayed reintegration into society. When performing closure, the operative procedure must account for complications such as anastomotic leakage. In comparisons between primary anastomosis and colostomy with secondary anastomosis for perforated diverticulitis, Salem et al. [14] reported that complications were less frequent after primary anastomosis than secondary anastomosis. However, primary anastomosis has a poor reputation due to a high frequency of anastomotic leakage, up to 28% [13]. In addition, primary anastomosis is not definitely suitable for all patients. Therefore, strict indications must be established to ensure that primary anastomosis is not performed in patients with a high risk of anastomotic leakage. In the present study, anastomotic leakage occurred in 5 of 27 patients (18.5%) who underwent primary anastomosis. These patients demonstrated significantly higher preoperative SOFA scores and more frequently had Hinchey IV disease, suggesting that these may be key factors to consider before selecting patients for primary anastomosis.

A number of previous studies have discussed the suitability of primary anastomosis for colorectal perforation. Biondo et al. [5] believe that primary anastomosis should not be performed for patients with cirrhosis, chronic kidney disease, or immunosuppression. They reported that of 33 Hinchey III–IV patients without these comorbidities who underwent primary anastomosis, leakage occurred in only 1 patient. Vascular lesions, immunosuppression, and recent laparotomy were identified as risk factors for leakage after primary anastomosis in a study by Richter et al. [6], where only 1 of 34 patients (2.9%) without these risk factors experienced anastomotic leakage. In their study, the mortality in patients undergoing primary anastomosis was 11%, and the authors concluded that anastomotic leakage did not affect prognosis. However, no study has specifically examined patients in whom anastomotic leakage occurred. In the present study, the clinical backgrounds of the patients with anastomotic leakage suggested that preoperative SOFA score and Hinchey IV disease may be risk factors. Factors involved in post-colectomy anastomotic leakage include not only intraoperative complications, such as incomplete anastomosis, anastomotic blood supply, and excessive tension and bleeding in the anastomosis site, but also patient factors such as chronic diseases (diabetes, cirrhosis, renal failure, etc.), steroid use, and sex [15, 16]. Among these factors, anastomotic blood supply seems to play a particularly significant role. In a typical colectomy, anastomotic leakage occurs because of intraoperative technical lapses, such as compromise of anastomotic blood supply due to the ligation of mesenteric vessels. However, in colorectal perforation, anastomotic leakage is considered to involve microangiopathy associated with sepsis. Sepsis causes vascular endothelial dysfunction and results in microangiopathy associated with hypercoagulation [17]. These complications become even more serious if sepsis

Table 4 Details of patients with anastomotic leakage

Age/ sex	Cause of perforation	Location	Surgical procedure	Hinchey	SOFA	Outcome
67, M	Malignancy	Ascending	Ileocecal resection	III	7	Death
88, M	Malignancy	Sigmoid	Sigmoidectomy	IV	5	Death
62, M	Malignancy	Ascending	Right hemicolectomy	IV	5	Alive
49, M	Malignancy	Ascending	Right hemicolectomy	IV	3	Alive
71, M	Diverticulum	Sigmoid	Sigmoidectomy	IV	1	Alive

SOFA, sequential organ failure assessment

progresses into disseminated intravascular coagulation or septic shock. Therefore, primary anastomosis should only be performed in patients with a SOFA score less than 2 and without sepsis. Furthermore, even in patients who are in a stable condition prior to surgery, the effects of infection can be compounded by the open surgical field, thereby leading to organ dysfunction, more severe coagulation disorders, and subsequent postoperative shock. Although postoperative septic shock is difficult to predict, Hinchey IV disease and a SOFA score ≥ 3 have been reported as risk factors [18]. Therefore, primary anastomosis should not be performed in patients with Hinchey IV disease, as it may lead to particularly severe cases of sepsis.

In this study, in 3 of the 5 patients with anastomotic leakage, the perforation site was in the right colon. Although guidelines for selecting the operative procedure in emergency colon surgery have not been established, emergency surgery for the right colon often consists of ileocolonic anastomosis [19, 20], while emergency surgery for the left colon typically involves a colostomy without anastomosis [21, 22]. This difference in operative procedure selection seems to be rooted in the belief that anastomotic leakage in the right colon is uncommon. However, one study has found anastomotic leakage to be more common in emergency surgery for the right colon than for the left [23]. Therefore, anastomosis should not be routinely performed in the right colon. In the present study, although colostomy was selected for 50% of patients with perforation in the right colon, anastomotic leakage occurred in 20%. However, the high rate of high SOFA scores among patients with anastomotic leakage suggests that risk assessment [24] can improve therapeutic outcomes without routinely performing primary anastomosis during right colon surgery.

The present study was limited in that it was not a randomized controlled trial, meaning that anastomosis was not performed for empirically high-risk patients. In particular, only 1 patient who underwent anastomosis presented with preoperative shock, which was therefore not necessarily demonstrated to be a true risk factor. In addition, the present study did not include enough patients with renal failure or those using steroids. More such patients must be enrolled and analyzed.

Finally, primary anastomosis should not be performed in patients with sepsis. Even if a patient does not have sepsis prior to surgery, they may develop postoperative sepsis in the event of pronounced infection, such as fecal peritonitis. Chronic disease

(cirrhosis, renal failure, etc.) and steroid use, which have been previously reported as risk factors for anastomotic leakage in primary anastomosis, were not risk factors in the present study. However, anastomosis is also regarded with caution during typical colectomy in patients with cirrhosis or renal failure and those using steroids; therefore, primary anastomosis for colorectal perforation should be avoided in these patients [25]. Furthermore, anastomotic leakage is affected not only by blood supply, but also by other factors such as internal intestinal pressure. Based on this data, and the fact that anastomotic leakage also occurs to a noticeable extent in typical colectomy, comprehensive assessment of patients is warranted.

Conclusion

In this study, anastomotic leakage after primary anastomosis for colorectal perforation occurs in patients with septic complications or severe intraperitoneal infection. Therefore, primary anastomosis should be avoided in this patient population. Furthermore, since the mortality rate of patients with anastomotic leakage is high, cautious assessment of the primary anastomosis is necessary.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

For this type of study formal consent is not required.

Consent for Publication Not applicable.

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