

Endoscopy-based early enterostomy closure for superior mesenteric arterial occlusion

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CONCLUSION: Endoscopic examination of blood flow and edema in the remnant bowel is useful to assess the feasibility of early closure of enterostomy in SMAO cases.

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Key words: Superior mesenteric arterial occlusion; Closure of enterostomy; Endoscopic inspection

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Abstract

AIM: To evaluate the efficacy of endoscopic examination of blood flow and edema in the remnant bowel.

METHODS: We retrospectively studied 15 patients who underwent massive bowel resection with enterostomy for superior mesenteric arterial occlusion (SMAO); the patients were divided into a delayed closure group (D group) and an early closure group (E group).

RESULTS: The mean duration from initial operation to enterostomy closure was significantly shorter in the E group (18.3 ± 2.1 d) than in the D group (34.3 ± 5.9 d) ($P < 0.0001$). The duration of hospitalization after surgery was significantly shorter in the E group (33 ± 2.2 d) than in the D group (51 ± 8.9 d) ($P < 0.0002$).

INTRODUCTION

Construction of a temporary stoma is a relatively common surgical procedure. A transient stoma is known to lower the operative risk, but it should be closed at the earliest opportunity; however, in the literature, the morbidity and mortality rates after ileostomy or colostomy closure are rather high^[1-8]. Several studies have compared colostomy closure and ileostomy closure, and found that a multitude of factors influence the development of complications after stoma closure, such as perioperative treatment, time of operation, and surgical technique^[9-12]. Patients with superior mesenteric arterial occlusion (SMAO) often require massive bowel resection because of considerable intestinal necrosis. Massive intestinal resection often causes short-bowel syndrome and necessitates parenteral nutrition. In order to avoid

the development of this syndrome, it is important to retain as much of the remnant bowel as possible. SMAO is known to frequently occur in patients with atrial fibrillation; hence, even if the patients survive after the initial operation, the risk of disease recurrence remains considerably high. Moreover, reperfusion injury may occur in SMAO patients, thereby causing unstable hemodynamics and multiple organ failure^[13,14]. Calvin *et al.*^[15] reported that bowel infarction recurred in 32% of patients early after the resection of the necrotic bowel. In the case of enterostomy, it is difficult to determine the timing of enterostomy closure after the initial operation. In order to assess the feasibility of early closure and its outcome, we endoscopically inspected blood flow and edema in the remnant bowel of stoma patients and defined a minimal delay as optimal for closing small bowel stomas. In this study, we evaluated the efficacy of endoscopic examination of blood flow and edema in the remnant bowel.

MATERIALS AND METHODS

Patients

We retrospectively studied 15 patients (12 men and 3 women; age range: 57-74 years; mean age: 68 years) who had undergone massive bowel resection with enterostomy for SMAO between April 1990 and March 2009 at the Department of Surgery, Social Insurance Yokohama Central Hospital, Yokohama, Japan. The patients were divided into 2 groups according to the timing of enterostomy closure: delayed closure group (D group) and early closure group (E group). All patients gave written informed consent to this study.

Surgical technique

The technique used for stoma closure did not differ between the E and D groups. In brief, after thorough mobilization of the bowel *via* a parastomal incision, a stoma was excised and the adhesions between the bowel and the peritoneum and omentum were cleared. Both the bowel ends were resected, and sutured manually with 2-layered end-to-end anastomosis.

Assessment of the enterostomy closure on the basis of the clinical findings

After initial surgery, when there was an improvement in the small intestinal dilatation and sufficient bowel movement was observed, the patients were allowed to resume a normal diet. Subsequently, parenteral nutritional support was initiated for the patients in whom oral intake was not sufficient, or for those with severe diarrhea. The clinical findings were confirmed as positive when (1) oral intake was sufficient; (2) diarrhea was controlled by medications; and (3) initial disease was sufficiently controlled without recurrence. When these criteria were satisfied, enterostomy closure was performed. These patients were classified as group D.

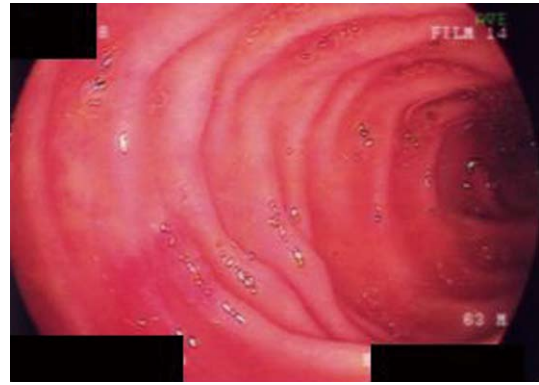


Figure 1 Endoscopic inspection of remnant bowel. Endoscopic examination revealed that sufficient blood flow had been retained and edema had subsided in the remnant bowel.

Endoscopic inspection

After initial surgery, when there was an improvement in the small intestinal dilatation and sufficient bowel movement was observed, endoscopic examination was performed. We used a cholangioendoscope (Olympus CHF Type P20Q; Olympus Medical Systems Co., Tokyo, Japan) for endoscopy, and it was inserted from the opening of the enterostomy.

Assessment of enterostomy closure on the basis of the endoscopic findings

The endoscopic findings were confirmed as positive when (1) sufficient blood flow resumed in the remnant bowel; and (2) the bowel edema subsided. Enterostomy closure was performed when these criteria were satisfied (Figure 1). However, if the criteria were not met, endoscopic examination was performed again after 3 d. These patients were classified as group E.

Statistical analysis

Results are presented as the mean \pm SD unless otherwise stated. Univariate analysis was performed using Student's *t* test for continuous variables and Fisher's exact test and chi-square test for categorical variables. A *P* value of less than 0.05 was considered statistically significant.

RESULTS

Delayed closure of enterostomy (D group) was performed in 8 patients and early closure of enterostomy (E group) was performed in 7 patients. Table 1 shows the patient characteristics and initial operative variables. No differences were observed in the mean age and sex ratio between the patient groups. Risk factors and initial diseases for the SMAO patients in the E group were: hypertension in 85.7%, diabetes mellitus in 57.1%, atrial fibrillation in 57.1%, and apoplexy in 14.3%; while those for the patients in the D group were: hypertension in 65.2%, diabetes mellitus in 62.5%, atrial fibrillation in 37.5%, and apoplexy in 25%. There was no significant difference between the groups with regard to the pro-

Table 1 Characteristics of patients *n* (%)

	Early closure group (<i>n</i> = 7)	Delayed closure group (<i>n</i> = 8)	<i>P</i> value
Age (yr)	67.0 ± 4.6	69.4 ± 5.6	< 0.3885
Sex ratio (male:female)	6:1	6:2	1
Initial disease			
HT	6 (85.7)	5 (62.5)	< 0.5692
DM	4 (57.1)	5 (62.5)	1
Af	4 (57.1)	3 (37.5)	< 0.6193
Apo	1 (14.3)	2 (25)	1
Length of resected bowel (cm)	265 ± 38	239 ± 32	< 0.168
Initial enterostomy complication			
Skin erosion	1 (14.3)	3 (37.5)	< 0.5692

HT: Hypertension; DM: Diabetes mellitus; Af: Atrial fibrillation; Apo: Apoplexy.

portion of patients with risk factors and initial diseases. The mean length of the resected bowel at the initial operation was 265 ± 38 cm in the E group and 239 ± 32 cm in the D group; there was no significant difference between the groups in this regard. All the patients in the E and D groups underwent jejunostomy. No deaths occurred in either of the groups. The most common initial postoperative complication observed was skin erosion, with an incidence rate of 14.3% in the E group, and 37.5% in the D group.

Table 2 shows the postoperative variables. The mean duration from initial operation to enterostomy closure was significantly shorter in the E group (18.3 ± 2.1 d) than in the D group (34.3 ± 5.9 d) (*P* < 0.0001). The postoperative complications observed were wound infection and pneumonia, with an incidence rate of 14.3% each in the E group, and 25% each in the D group. There was no significant difference between the 2 groups with regard to postoperative complications (*P* = 1). The duration of hospitalization after surgery was significantly shorter in the E group (33 ± 2.2 d) than in the D group (51 ± 8.9 d) (*P* < 0.0002).

DISCUSSION

Under favorable local or general conditions, a transient small bowel stoma creation may be required to protect a distal anastomosis or to avoid intraperitoneal intestinal anastomosis. It is generally recommended that the temporary stoma be closed within 9–12 wk after its construction^[16]. However, because some patients poorly tolerate the temporary stoma owing to extracellular dehydration, difficult pouch fitting, parenteral nutrition requirement in the cases when the stoma is very proximal, and psychological or social impact, it might be advisable to opt for early closure^[17].

On the other hand, patients with SMAO often require massive bowel resection because of considerable intestinal necrosis. Massive intestinal resection often causes short-bowel syndrome and necessitates parenter-

Table 2 Outcomes *n* (%)

	Early closure group (<i>n</i> = 7)	Delayed closure group (<i>n</i> = 8)	<i>P</i> value
Time of closure of enterostomy after initial operation (d)	18.3 ± 2.1	34.3 ± 5.9	< 0.0001 ¹
Complications			
Wound infection	1 (14.3)	2 (25)	1
Pneumonia	1 (14.3)	2 (25)	1
Hospital stay (d)	33.0 ± 2.2	51.1 ± 8.9	< 0.0002 ¹

¹Significant difference.

al nutrition. To avoid this syndrome, it is important to retain as much of the remnant bowel as possible. However, SMAO is frequently observed in patients with atrial fibrillation; hence, even if the patients survive after initial operation, the risk of disease recurrence is considered high. Moreover, reperfusion injury may occur in SMAO patients and may cause unstable hemodynamics and multiple organ failure^[10,11]. Calvien *et al*^[12] reported that bowel infarction recurred in 32% of the patients early after the resection of necrotic bowel. If we deem primary anastomosis as risky owing to the presence of ischemic changes along the bowel, we perform the bowel resection without anastomosis, and perform an enterostomy. However, a bowel stoma or enterostomy is also a major psychological handicap (altered body schema, odor, uncontrolled emissions, *etc.*) and causes significant physical stress (risk of severe dehydration and electrolyte imbalance). Local care in an intensive care unit needs to be prolonged sometimes, to avoid secondary skin erosions caused by the highly corrosive digestive enzymes. Parenteral nutritional support may also be required if the enterostomy is very proximal, with associated risk of infection caused by the insertion of a central venous catheter. Moreover, it is important to perform early closure of enterostomy to avoid adverse effects on the quality of life of patients. In order to assess the feasibility of early closure of enterostomy, it is necessary to adequately examine the blood flow and edema in the remnant. Thus, we directly examined the blood flow and edema in the remnant bowel of these patients by endoscopy.

Generally, endoscopic examination of the upper digestive tract is performed using esophagogastroduodenoscope, and that of the lower digestive tract (colon and rectum) is performed using colon fiberscope. However, because the opening of the jejunostomy was small in our cases, it would have been difficult to smoothly insert the esophagogastroduodenoscope or colon fiberscope into the small intestine *via* the jejunostomy. Moreover, these procedures are painful for the patients because the diameters of these endoscopes are relatively large. Hence, we used the cholangioendoscope that has a relatively smaller diameter and can be smoothly inserted into the intestine without causing any pain. A

trans-nasal esophagogastroduodenoscope with a small diameter can also be used.

In the case of enterostomy created due to SMAO, it is difficult to determine the timing of enterostomy closure after initial operation. The time chosen for enterostomy closure should be accurately determined taking the following two factors into account: the risk of anastomotic leak that usually occurs between 5 and 7 d^[18] postoperatively; the development of dense adhesions due to acute inflammation that appear 2 wk after the creation of the enterostomy^[19]. Moreover, the risk of bowel infarction recurrence should be carefully assessed, as high rates have been reported after necrotic bowel resection^[15]. Megengaux *et al*^[19] reported that small bowel stomas can be closed on the 10th d after initial surgery, without major complications. Their concept of choosing postoperative day 10 for the closure of stoma was based on the fact that this time point comes after the days when anastomotic leakages are frequently observed, i.e. postoperative days 5-7^[18], and before postoperative day 14, thereby ensuring that acute inflammation does not develop. However, because immediate anastomosis is associated with a high risk of dehiscence, Hanish *et al*^[20] suggested that it is preferable to avoid this procedure in stoma patients who present with perforation associated with peritonitis or ischemia due to extensive mesenteric infarction. Because our patients required stoma creation due to SMAO, we considered that it was necessary to precisely investigate the blood flow in the remnant bowel before early closure of the stoma. In the patients of the early closure group, enterostomy closure was performed after 18.3 ± 2.1 d, and no complications associated with anastomosis developed thereafter. This time is significantly shorter compared to the recommended time of 9-12 wk after the construction of enterostomy^[16].

Hospitalization in the patients of the early closure group was significantly shorter than that in the patients of the delayed closure group. The incidence rate of complications such as wound infection and pneumonia in the patients of the early closure group was 14.3%, while that of the patients of the delayed closure group was 25%. Although there was no significant difference between groups, the incidence rate of complications was lower in the early closure group than in the delayed closure group.

To the best of our knowledge, early closure of jejunostomy based on endoscopic findings *via* the stoma has never been studied in patients with SMAO. On the basis of these results, we conclude that endoscopic examination of blood flow and edema in the remnant bowel is a useful predictor to determine the time of enterostomy closure in SMAO cases.

COMMENTS

Background

A transient stoma is known to lower the operative risk, but it should be closed

at the earliest opportunity; however, the morbidity and mortality rates after ileostomy or colostomy closure are rather high. It is generally recommended that the temporary stoma be closed within 9-12 wk after its construction. Fifteen patients who underwent massive bowel resection with enterostomy for superior mesenteric arterial occlusion (SMAO) were divided into a delayed closure group (D group) and an early closure group (E group).

Research frontiers

The mean duration from initial operation to enterostomy closure was significantly shorter in the E group (18.3 ± 2.1 d) than in the D group (34.3 ± 5.9 d) ($P < 0.0001$). The duration of hospitalization after surgery was significantly shorter in the E group (33 ± 2.2 d) than in the D group (51 ± 8.9 d) ($P < 0.0002$).

Innovations and breakthroughs

Endoscopic examination of the blood flow and edema in the remnant bowel was found to be useful for assessing the feasibility of early closure of enterostomy in SMAO cases.

Applications

In the authors' study, the number of patients with endoscopic examination of the blood flow and edema in the remnant bowel was very small, but they can propose that endoscopic examination of blood flow and edema in the remnant bowel is a useful predictor to determine the time of enterostomy closure in SMAO cases.

Peer review

This manuscript is well constructed and the comparison of two methods of the preoperative evaluation clearly delivered. The conclusions were supported by the data. The topic is particularly interesting and up-to-date, because of the lack of surgical procedures to determine the timing of enterostomy closure. The work is written in good English. As a result, the work meets the standards of the *World Journal of Gastroenterology*. In conclusion the manuscript can be published.

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