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Colonic Necrosis Following Laparoscopic High Anterior Resection for Sigmoid Colon Cancer: Case Report and Review of the Literature

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We report a patient who experienced colonic necrosis after laparoscopic high anterior resection for sigmoid colon cancer, and review the literature to evaluate the clinical features of colonic necrosis following surgery for sigmoid colon and rectal cancer. A 76-year-old man with sigmoid colon cancer underwent laparoscopic high anterior resection. The operation included high ligation of the inferior mesenteric artery and end-to-end anastomosis using circular staples. Pathology findings revealed a pT4N2M0 lesion. Beginning on postoperative day (POD) 1, the patient experienced a high, spiking fever, and gradually developed leukocytosis and high inflammatory condition. The patient complained of abdominal distention, but had no signs of peritonitis. Abdominal computed tomography on POD4 showed wall thickness of the proximal colon from the anastomosis site and ascites with free air. An anastomotic leakage was suspected. Emergency laparotomy revealed a disrupted anastomosis without feces in the abdomen and a gangrenous 15 cm segment of the colon proximal to the anastomosis. The affected area of the colon was excised and Hartmann's procedure was performed. His postoperative period was uneventful. Our review of the literature demonstrates that elderly male patients with cardiovascular and pulmonary complications undergoing laparoscopic sigmoid and rectal cancer surgery with high ligation have high risk of postoperative colonic necrosis. We experienced colonic necrosis following laparoscopic high anterior resection for sigmoid colon cancer and required immediate resection. Elderly male patients with cardiovascular and pulmonary complications undergoing

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laparoscopic sigmoid and rectal cancer surgery with high ligation should be carefully monitored for postoperative colonic necrosis.

Key words: Colonic necrosis – Colonic ischemia – Laparoscopic surgery – Sigmoid colon cancer

Colonic ischemia following colorectal surgery is an extremely rare, but serious, complication. Laparoscopic and robotic colorectal surgery can also result in postoperative colonic ischemia,[1,2] because these methods may contribute to portomesenteric thrombosis, resulting in colonic ischemia.[3] The most serious type of colonic ischemia, called transmural necrosis, requires immediate resection. This report describes a patient who experienced colonic necrosis after laparoscopic high anterior resection for sigmoid colon cancer. We also review the literature to evaluate the clinical features of colonic necrosis following surgery for sigmoid colon and rectal cancer.

Case Presentation

In July 2015, a 76-year-old man was transferred to our facility for surgical treatment of sigmoid colon cancer. He had a 3-month history of gradual body weight loss and bowel habit change with decreased stool caliber. His body mass index was 19.6 kg/m2 (weight: 54.5 kg, height: 1.67 m). His medical history included hypertension and appendectomy for acute appendicitis. Laboratory tests, including complete blood count, blood chemistry, coagulation profile, and urinalysis, were within normal limits except for anemia (hemoglobin: 10.0 g/dL). The serum concentrations of carcinoembryonic antigen and carbohydrate antigen 19-9 were within normal ranges. Computed tomography (CT) revealed an obstructive sigmoid colon lesion with segmental wall thickening and a stenotic lumen (Fig. 1a). Enlarged peritumoral lymph nodes were observed, but no other metastatic lesions were found in the abdomen and chest. Total colonoscopy showed an adenocarcinoma involving the entire circumference of the sigmoid colon 20 cm from the anal verge (Fig. 1b). Barium enema showed an apple core sign at the sigmoid colon (Fig. 1c).

The patient underwent laparoscopic high anterior resection for sigmoid colon cancer in August 2015. Surgery included high ligation of the inferior mesenteric artery (IMA). The splenic flexure was mobilized; end-to-end, tension-free colorectal anastomosis was performed using a circular stapler; and both ends of the bowel appeared well perfused. The anastomosis was airtight, and both doughnuts were complete because all tissue layers were present within the intact doughnuts. There was no obvious trauma to the colon or mesocolon, the colon appeared pink and viable at closure, blood loss totaled 150 mL, and the operation time was 180 minutes. There was no evidence of intraoperative hypotension or cardiac dysrhythmia. No drain was inserted into the pelvic space.

Examination of the resected specimen revealed a sigmoid colon tumor measuring 35 × 35 mm (Fig. 1d). Histopathologic examination of the tumor showed tubular adenocarcinoma [pT4a, pN2, (#241(6/13), #242(0/1), #253(0/2)), M0, H0, P0, PUL0, pStage IIIb, D3, pPM0, pDM0, RM0, R0, CurA, tubular adenocarcinoma, well-differentiated type, intermediate, INFb, ly2, v0, PN1a].

On postoperative day (POD) 1, the patient developed a high fever (39.2°C), but there was no evidence of spontaneous abdominal pain, muscle guarding, or rebound tenderness (Fig. 2a). His body temperature remained high through POD3, and his inflammatory signs worsened (Fig. 2a). Emergency abdominal CT on POD4 showed markedly reduced perfusion and edematous bowel wall thickening of the proximal colon from the anastomosis site, as well as small amounts of intraperitoneal air and free fluid (Fig. 2b). These findings suggested an anastomotic leakage.

Emergency laparotomy revealed a disrupted anastomosis without fecal peritonitis (Fig. 3a). A gangrenous 15-cm segment of the colon proximal to the anastomosis site was excised (Fig. 3b), and Hartmann's procedure was performed. Pathologic examination of the surgically excised specimen revealed that a 10-cm segment of the colon proximal to the anastomosis failed to undergo transmural necrosis (Fig. 3c), with the remaining segment having ischemia of the submucosal/muscular layer of the colon (Fig. 3d).

The patient's postoperative course was uneventful. Hartmann's procedure was reversed 4 months after the second operation.

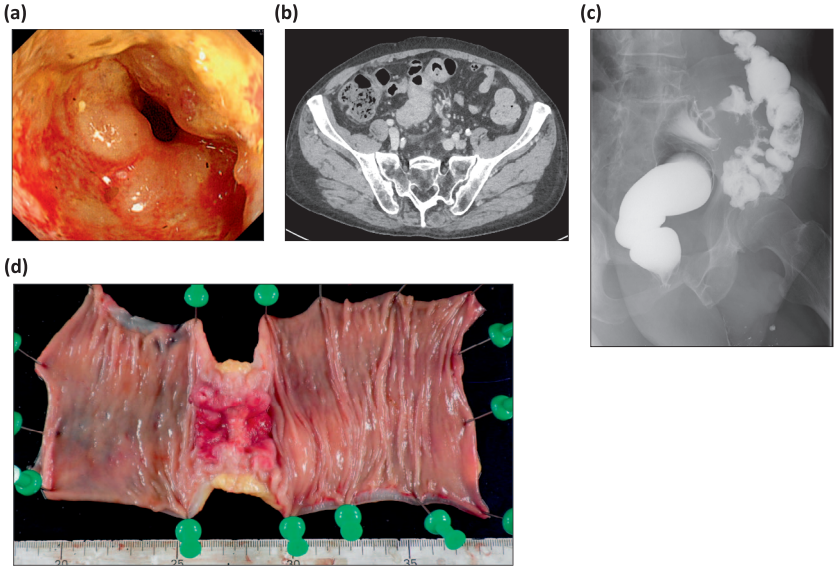

Fig. 1 (a–c) Preoperative imaging, including (a) abdominal computed tomography, (b) total colonoscopy, and (c) barium enema. (d) Photograph showing the resected surgical specimens containing the sigmoid colon cancer.

Discussion

Acute colonic ischemia comprises 3 stages.[4] Stage I is characterized by mucosal ischemia and is reversible, with patients recovering without sequelae. Stage II is characterized by ischemia of the submucosal/muscular layer, resulting in strictures, which are thought to be caused by edema and fibrosis.[5] Stage III is characterized by serious transmural necrosis, which requires immediate resection of the affected tissues. We have reviewed reports of patients with perioperative stage III ischemia following sigmoid and rectal cancer surgery and investigated their clinical characteristics (Table 1). Although the typical symptoms of general ischemic colitis include sudden, mild abdominal pain, and passage of red or bloody diarrhea,[6] these symptoms were rare in patients with perioperative stage III ischemia following sigmoid and rectal cancer surgery. Rather, continuous fever and leukocytosis were the typical clinical features of these patients.

Colonic ischemia following colorectal surgery is a rare, but serious, complication. Risk factors for this condition include radiation therapy,[7] high ligation of the IMA,[8] older age, and cardiovascular disease.[9] All patients we identified with perioperative colonic necrosis had undergone complete high ligation of the IMA.

Reports comparing the effects of high and low ligation of the IMA on patient survival and postoperative complications[10–12] have shown that anastomotic leak rates, tumor recurrence, and survival were not related to the method of vascular ligation. However, reduced colonic blood flow at the proximal site of the anastomosis, as measured by laser Doppler, correlated significantly with older age (>63 years), male sex, and cardiovascular disease.[13] These findings were observed to be consistent in the 13 patients we identified with colonic necrosis after surgery; their average age was 64.6 years, and 12 were male.

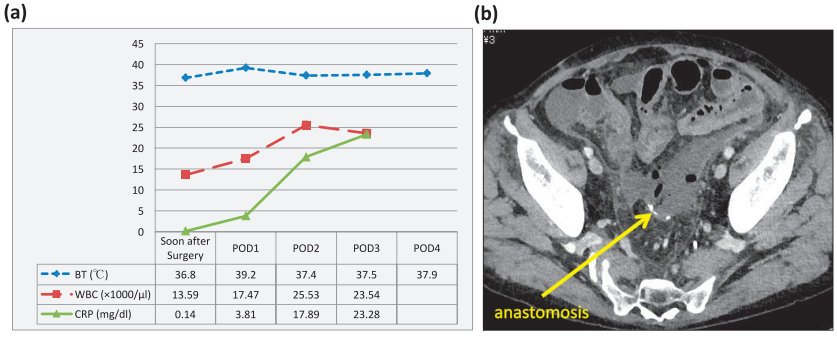

Fig. 2 (a) Body temperature, white blood cell (WBC) count, and serum C-reactive protein (CRP) levels over time of the patient after laparoscopic high anterior resection. (b) Abdominal computed tomography on postoperative day 4.CRP, C-reactive protein; BT, body temperature; POD, postoperative day; WBC, white blood cell.

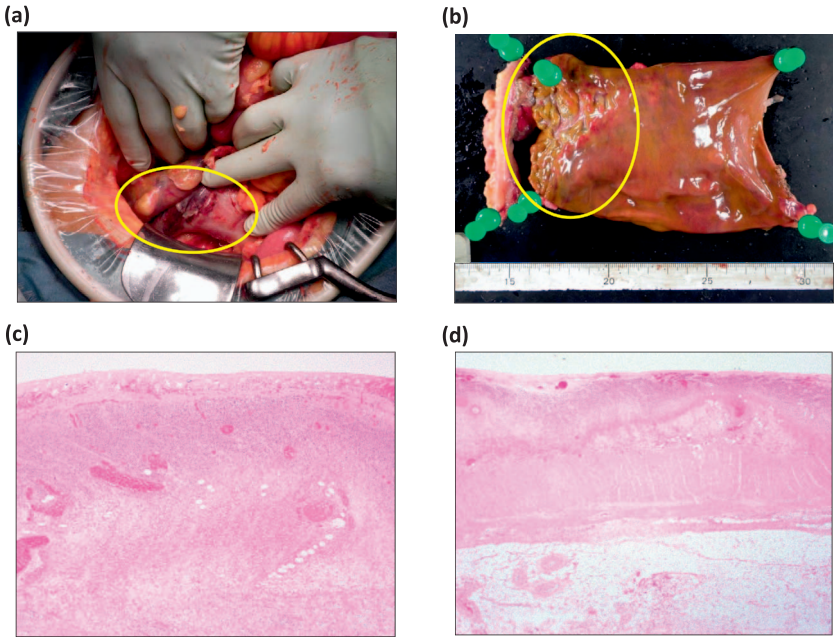

Fig. 3 (a) View during emergency laparotomy. (b) Photograph showing the surgically resected specimen of necrotic colon. (c–d) Histologic examination of the surgical specimen on the (c) anal side and (d) oral side (hematoxylin and eosin staining).

Table 1 Literature review of patients with colonic necrosis following sigmoid and rectal cancer surgery

		First operation					Reoperation				
Patient no.	Age/sex	Medical history	Operation	High ligation	Operation time (min)	Blood loss (ml)	Leukocytosis	Continuous fever	POD of fever spiking	POD of reoperation	Reoperation
1[20]	66/M	HTN, CVA, MI	L-LAR	+	390	350	+	+	1	4	Hartmann operation
2[20]	65/M	HTN, CVA	L-AR	+	285	1600	+	+	1	7	Segmental resection and anastomosis and ileostomy
3[20]	69/M	none	L-LAR	+	268	0	+	+	1	8	Segmental resection and anastomosis and ileostomy
4[20]	81/M	HTN	L-AR	+	225	0	-	+	4	10	Hartmann operation
5[20]	78/M	AAA, TB	L-AR	+	167	0	-	+	1	3	Hartmann operation
6[20]	71/M	HTN	L-LAR	+	178	0	+	+	1	2	Primary repair and ileostomy
7[20]	44/F	HTN, IMV thrombosis	O-LAR	+	420	1000	+	+	1	6	Hartmann operation
8[20]	64/M	none	L-LAR	+	348	0	+	+	3	5	Hartmann operation and ileostomy repair
9[20]	73/M	TB, BPH	O-LAR	+	197	800	+	+	1	2	Hartmann operation and ileostomy repair
10[20]	58/M	DM, HTN, TB	L-LAR	+	426	600	+	+	1	3	Ileostomy
11[21]	50/M	none	L-AR	+	150	0	+	+	3	4	Hartmann operation
12[22]	50/M	ND	Robotic-LAR	+	ND	ND	ND	ND	Bleeding	2	Hartmann operation
Our case	71/M	HTN	L-AR	+	186	150	+	+	1	4	Hartmann operation

AAA, abdominal aortic aneurysm; BPH, benign prostatic hyperplasia; CVA, cerebrovascular accident; DM, diabetes mellitus; F, female; HTN, hypertension; IMV, inferior mesenteric vein; L-AR, laparoscopic anterior resection; L-LAR, laparoscopic low anterior resection; M, male; MI, myocardial infarction; O-LAR, open low anterior resection; POD, postoperative day; TB, tuberculosis.

Many studies have assessed the influence of gender and age on atherosclerosis, with most showing that atherosclerotic lesions in the coronary arteries, abdominal aorta, and carotid arteries were more frequent in men than in women. Furthermore, aging has a significant influence on the progression of atherosclerosis.[14–16] Findings in patients who experienced colonic necrosis following colorectal surgery may be attributable to several factors, including the effects of age and gender on arterial atherosclerosis. Therefore, it might be acceptable to perform low ligation for the high risk patients of colonic necrosis, if tumors are not advanced.

Laparoscopic surgery may contribute to the development of stage III colonic ischemia, as 11 of the 13 reviewed patients underwent laparoscopic operations. Pneumoperitoneum and increased intra-abdominal pressure have been found to reduce mesenteric venous flow.[17,18] In particular, pneumoperitoneum >15 mmHg significantly impairs intestinal tissue oxygen pressure, which may predispose to ischemia. Intestinal tissue oxygen pressure has been found to decrease significantly during mesentery traction in both laparoscopic and open colectomy.[19] The incidence of ischemia during laparoscopic procedures may be minimized by using the lowest acceptable intraabdominal pressure and by intermittent decompression and deflation during prolonged laparoscopic procedures, and by avoiding prolonged traction on the bowel during extracorporeal resection and anastomosis. Although more time is required for intracorporeal than for extracorporeal resection and anastomosis, the former may better maintain intestinal tissue oxygen pressure.

In conclusion, early postoperative colonic necrosis should be considered one of the most serious complications of laparoscopic colorectal resection. In particular, elderly male patients with cardiovascular and pulmonary complications undergoing laparoscopic sigmoid and rectal cancer surgery with high ligation should be carefully monitored regarding the duration of traction on the bowel and the optimal intraabdominal pressure intraoperatively. In addition, it may also be necessary for them to carefully manage postoperatively.

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