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Transmural necrosis of the ascending colon secondary to traumatic hemorrhagic shock: A case report

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ABSTRACT

Introduction: Acute mesenteric ischemia is caused by a severe reduction in blood flow to the intestine, eventually resulting in non-occlusive mesenteric ischemia, and less frequently, bowel necrosis, which is associated with high mortality.
Case presentation: We report a 10-year-old boy with no past medical history with necrosis of the ascending colon after resuscitation from hemorrhagic shock due to femoral vein injury caused by a bicycle handlebar injury. Contrast-enhanced computed tomography demonstrated hypodense thickening of the ascending colon wall and intrahepatic portal gas. Exploratory laparoscopy demonstrated necrosis of the ascending colon and paralysis of the intestines.
Conclusion: Colonic necrosis secondary to hemorrhagic shock in children without evidence of pre-existing cardiovascular disease is extremely uncommon. Lack of familiarity with this condition may cause serious complications. Clinicians must be aware of this disease to promptly diagnose and aggressively treat the condition early.

1. Introduction

Non-occlusive mesenteric ischemia (NOMI) is a type of acute mesenteric ischemia without any blockage in the mesenteric blood supply. NOMI is typically seen in post-cardiac surgery patients and elderly patients with aortic insufficiency, congestive heart failure, myocardial infarction, or renal or hepatic disease [1,2]. Although NOMI associated with conditions that may compromise circulation such as shock or persistent hypotension has been previously reported, the development of bowel necrosis due to NOMI in previous healthy children is extremely uncommon [3].

Herein, we report a rare case of necrosis of the right colon that developed after hemorrhagic shock in a 10-year-old traumatized boy without colon injury. NOMI found during shock is usually superficial and does not lead to transmural necrosis unless there are additional pathologies for compromise of the mesenteric circulation, including embolism, dissection, or strangulation [4,5]. Exploratory laparoscopy helped us decide to perform an emergency bowel resection. We discuss the clinical importance and pathophysiology of this condition and present radiological images. Emergency physicians must be familiar with this possibility of colon involvement.

This manuscript was prepared following the CARE guidelines.

2. Case presentation

A 10-year-old boy with no past medical history was brought to our emergency department. He had been found lying on the road beside his bicycle with a pool of blood surrounding his legs and dried blood on his clothes. A 2 cm × 3 cm open wound on his left

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thigh was found, presumably caused by a bicycle handlebar injury. Upon hospital arrival, his vital signs were as follows: systolic blood pressure, 67 mmHg; pulse, 142 beats/min; and body temperature, 35.3 ˚C. His airway was patent without dyspnea. His Glasgow Coma Scale score was 10 (E3V3M4). No bruising on his abdomen was noted. Since the patient was diagnosed with hemorrhagic shock, endotracheal intubation and rapid intravenous infusion of lactated Ringer's solution were performed, and a blood transfusion was given.

Blood tests revealed hemoglobin of 7.2 g/dL, hematocrit of 24.1%, platelet count of 171 × 10^3/μL, APTT of >240 sec, PT-INR of 1.66, antithrombin III of 45%, urea nitrogen of 17.4 mg/dL, creatinine of 0.65 mg/dL, and creatine kinase of 201 U/L. Focused assessment of sonography for trauma demonstrated no intraabdominal fluid. Electrocardiogram showed no abnormality. Plain computed tomography (CT) of the whole body showed no intracranial hemorrhage, lung contusion, or pneumothorax. Contrast-enhanced CT demonstrated intrahepatic portal gas (Figure A) and hypodense thickening of the ascending colon wall (Figure B). There was no pneumoperitoneum or extravasation of the contrast medium in the peritoneal cavity.

The decision was made to urgently take the patient to the operating room to repair his damaged left femoral vein under general anesthesia. In addition, a diagnostic single incision laparoscopy was performed due to suspected ischemic/traumatic changes in the ascending colon. The laparoscopy showed diffuse expansion of the intestine and an ischemic ascending colon. The procedure was subsequently converted to an exploratory laparotomy (Figure C). The patient was diagnosed with NOMI and a laparoscopic-assisted right hemicolectomy was performed. Gross examination of the resected specimen revealed full-thickness mucosal necrosis without evidence of gross perforation (Figure D). Histopathological examination confirmed mucosal ischemia of the ascending colon with focal necrosis (Figure E). Mechanical factor-induced mucosal injury did not accompany the infarction. Postoperatively, the patient recovered uneventfully.

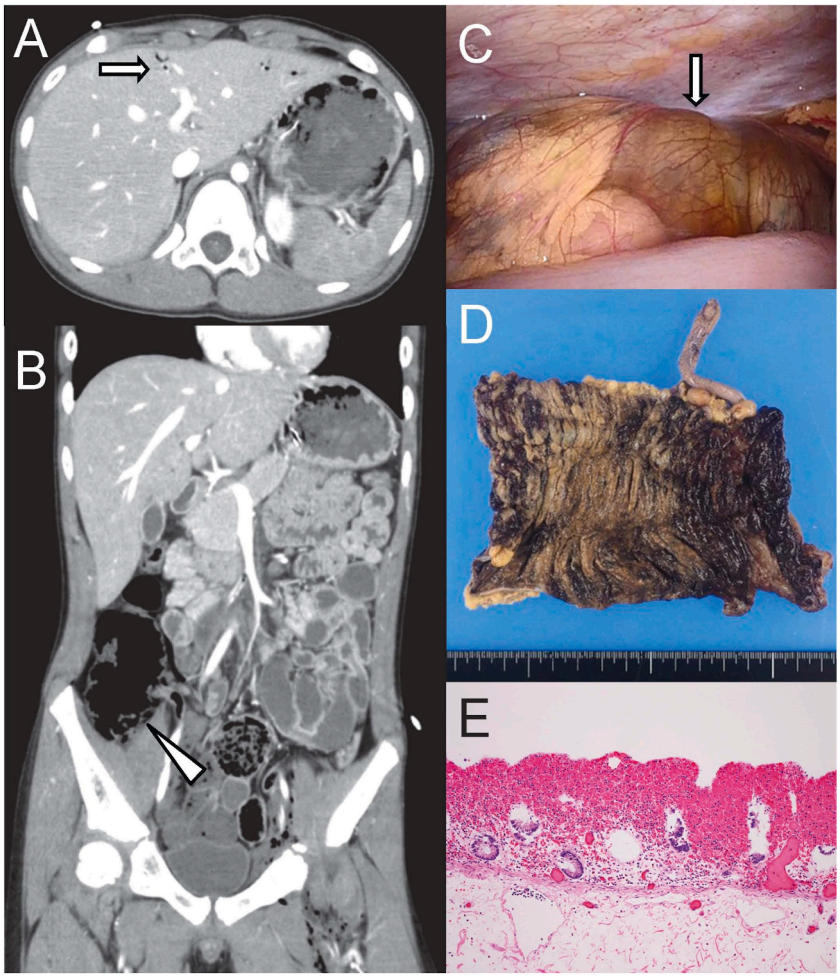

Fig. 1. A, B. Representative contrast-enhanced CT demonstrating intrahepatic portal venous gas (A, arrow) and hypodense thickening of the ascending colon wall (B, arrowhead).
C. Laparoscopic findings revealed diffuse expansion of the intestine and ischemic ascending colon.
D. Gross examination of the resected specimen revealed full-thickness mucosal necrosis without evidence of gross perforation.
E. Histopathological examination demonstrated mucosal ischemia of the ascending colon with focal necrosis (hematoxylin & eosin, x400).

3. Discussion

NOMI is frequently a consequence of a hemodynamic, critical, unstable condition induced by heart failure, sepsis, and hypovolemia in patients of any age. Mesenteric vasoconstriction may occur as soon as 10 minutes after the start of hypovolemic hypotension [1]. Pharmaceutical agents often used during intensive care, including epinephrine, diuretics, neuroleptics, and antidepressants, may trigger the development of NOMI [5–7]. The major pathologic mechanisms involved in the development of NOMI represent a normal, exaggerated physiological response to maintain vital organ perfusion at the expense of mesenteric perfusion. A mismatch between supply and demand allows persistent mesenteric vasoconstriction to develop, resulting in extensive reduction or maldistribution of blood flow and oxygen delivery to the intestine, leading to compromised integrity of the mucosal layer and subsequent bacterial translocation. This mismatch can be worsened by increased intra-abdominal pressure. In our patient, persistent mesenteric vasoconstriction causing decreased blood flow and oxygen delivery to the intestine may have caused NOMI, leading to ascending colon necrosis. As seen in our patient, NOMI often happens in the right colon, since the area between the terminal ileum and the right colon is prone to reduced blood flow during shock due to the lack of collateral vessels [8].

It is challenging to recognize NOMI in critically ill patients, as physical exams are frequently limited by sedation, consciousness disorders, and mechanical ventilation. Acute abdominal pain may be the only early presenting sign of mesenteric ischemia. Laboratory examinations reflecting tissue ischemia, including leukocytosis and anion gap acidosis, may help with the diagnosis. Elevation of plasma lactate, lactate dehydrogenase, aspartate aminotransferase, and creatine phosphokinase also can reinforce NOMI suspicion; however, these values are non-specific and not sensitive for early detection of NOMI as shown in our patient [9,10].

Contrast-enhanced abdominal CT supports the identification of NOMI. The absence of bowel wall enhancement is the most consistent CT characteristic of transmural necrosis [11]. Hepatic portal venous gas is a sign of intestinal necrosis in NOMI [12]. However, clinicians must be aware that 25% of patients exhibit mesenteric ischemia with no suggestive radiological signs [10].

Need for and timing of surgery are the most crucial factors in the treatment process. Surgery should not be delayed when intestinal infarction or perforation is suspected with radiographic features [13,14]. The decision to perform urgent surgery because of a lack of accurate diagnostic tools is sometimes challenging; however, multiple signs of bowel ischemia have been recognized. Single incision laparoscopy may be a good option for clinicians to promptly determine the optimal surgical strategy. Growing evidence suggests that laparoscopy is feasible in trauma patients and safe, feasible, and effective in treating hemodynamically stable patients with penetrating and blunt abdominal trauma. It enables a thorough and complete evaluation of the intra-abdominal viscera, decreases the incidence of nontherapeutic surgeries, and enables therapeutic intervention to repair a variety of injuries [15]. Of note, the lack of a clear boundary between necrotic and viable tissue makes surgical treatment complex. Ischemic lesions are frequently patchy or diffuse and extensive resections are then carried out when deemed relevant, which often is not the case after laparoscopic evaluation.

4. Conclusion

The development of bowel necrosis due to NOMI in previously healthy children following resuscitation from hemorrhagic shock is extremely uncommon. Our experience highlights the importance of proceeding to urgent treatment since functional and vital complications develop quickly.

Contributors

Masaaki Kagoura, Kazuhiro Yoshida, Kosei Takagi, Yuzo Umeda, Yoshitada Kishi, Junko Kobayashi, Hiroyuki Yanai

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Ethical approval

This case study was approved by the ethical committee of Okayama University.

Consent

Fully informed written consent was obtained.

Author contribution

Kenji Aoshima, Tetsuya Yumoto, Tsuyoshi Nojima, Masaaki Kagoura, Kazuhiro Yoshida, Kosei Takagi, Yuzo Umeda, Yoshitada Kishi, Junko Kobayashi, Atsunori Nakao and Hiromichi Naito treated the patient and collected data. Kenji Aoshima and Atsunori Nakao wrote the paper.

Registration of research studies

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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