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Isolated superior mesenteric artery rupture caused by abdominal trauma

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The superior mesenteric artery (SMA) is one of the visceral branches of the abdominal aorta. It has multiple branches to supply blood and nutrition to the intestinal segment, and these form an anastomosis with each other. SMA injuries are usually classified as major visceral artery injuries, and have an incidence of <1%. The clinical manifestations of patients with SMA injuries include intra-abdominal bleeding and peritoneal irritation. The compromised blood supply can lead to intestinal ischemia and perforation. These injuries are often not diagnosed in time and have significant mortality rates of 25%–68% due to the lack of specific features (Maithel et al., 2020). Not only that, but patients with less severe trauma or no visible damage on initial examination may still have clinically significant intra-abdominal injuries (Nishijima et al., 2012). Emergency departments often encounter multiple cases that require urgent diagnosis and treatment (Li et al., 2021; Zhang et al., 2021; Zhou et al., 2021), and therefore, it is imperative to diagnose and manage these rare injuries expeditiously.

A 45-year-old male presented to the Emergency Department of the First Affiliated Hospital, School of Medicine, Zhejiang University, China with abdominal pain approximately 1 h after a rebar injury. The patient was hemodynamically stable, with a blood pressure of 137/84 mmHg (1 mmHg=133.182 Pa) and pulse rate of 113 beats/min (bpm). Laboratory tests showed that hemoglobin was 152 g/L. Also, physical

examination revealed abdominal skin without obvious damage or congestion (Fig. 1a). Lower-abdominal tenderness with no muscular defense or rebound tenderness was the most noticeable sign. Abdominal computed tomography (CT) was performed about 1 h after admission. The results showed active bleeding around the small intestine in the left lower abdomen even with pelvic hemorrhage, but no radiological sign of bowel perforation or ischemia (Figs. 1b and 1c).

In consideration of hemodynamic stability and nonspecific abdominal findings, we did not perform an exploratory laparotomy. After 3 h, the digital subtraction angiography (DSA) revealed extravasation of contrast medium in the intestinal artery (Figs. 1d and 1e, and Video S1), which confirmed the diagnosis of isolated SMA rupture and bleeding. Considering that the small intestine has excellent anastomotic loops, the patient subsequently underwent super-selective embolization (SSE) with emergency DSA to embolize the secondary arch of the SMA. This treatment strategy not only achieved a satisfactory hemostatic effect, but also preserved collateral perfusion of the small intestine. After treatment, an abdominal CT angiography showed no obvious emergency warning signs (Fig. 1f). An ultrasound demonstrated fluid in the left lower abdomen, with a width of about 5.8 cm×4.2 cm. Fortunately, the patient was asymptomatic and no complications were reported during follow-up.

Blunt abdominal trauma of major visceral arteries such as SMA is an exceedingly rare and deadly condition (Nolan et al., 1995; Asensio et al., 2002). In the vast majority of cases, it is caused by motor vehicle accidents or falls from heights (Bège et al., 2015). Moreover, the presence of aneurysms increases the

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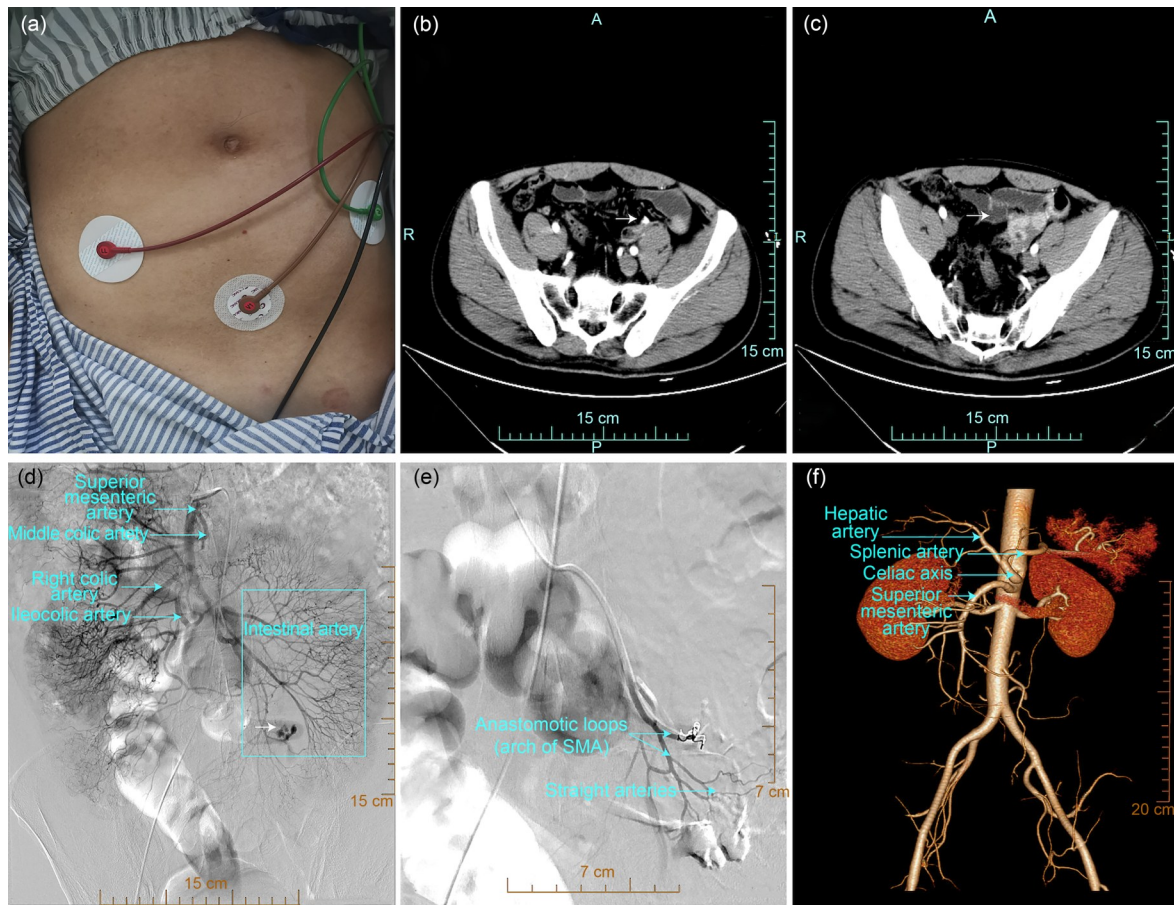


Fig. 1 Diagnosis and treatment of patient with isolated superior mesenteric artery rupture. (a) No abnormal changes were observed upon abdominal inspection. (b, c) The abdominal computed tomography (CT) suggested the ruptured superior mesenteric artery (arrow in b) and blood accumulation around the small intestine (arrow in c). (d) Digital subtraction angiography (DSA) revealed extravasation of contrast medium (white arrow). (e) No extravasation of contrast medium was seen on the angiographic review after treatment. (f) The lumens of the superior and inferior mesenteric arteries were well filled with contrast medium, and there were no signs of stenosis or dilation. A: anterior; R: right; L: left; P: posterior.

likelihood of a vascular rupture event (Lu et al., 2016). A mesenteric artery is rarely an isolated injury. A patient with SMA injuries has, on average, two to four additional intra-abdominal injuries (Lucas et al., 1981). This is the only reported case of an isolated SMA injury after a rebar accident.

Three basic mechanisms may cause bowel and mesenteric injuries after blunt abdominal trauma: (1) direct force may crush the gastrointestinal tract; (2) rapid deceleration may produce shearing force between fixed and mobile portions of the tract; (3) a sudden increase in intraluminal pressure may result in bursting injuries (Hughes and Elton, 2002).

In most clinical cases, isolated mesenteric injuries present in one of the following three ways: (1) immediate, due to bleeding; (2) delayed, due to

bowel infarction; (3) late, due to bowel stenosis or adhesion formation (Lau et al., 1987). In this case, the patient lacked immediate abdominal signs and symptoms other than abdominal pain, which further illustrated the occult nature of the disease.

Currently, diagnosis of mesenteric injuries remains challenging. Laboratory tests, ultrasound, diagnostic peritoneal lavage (DPL), and even exploratory laparotomy are important diagnostic tools with their specific advantages and drawbacks. CT has been shown to be accurate for diagnosis of bowel and mesenteric injuries and is the diagnostic test of choice in the evaluation of blunt abdominal trauma in hemodynamically stable patients (Bates et al., 2017). In this case, CT helped clinicians diagnose the isolated SMA injury and intervene in a timely way.

Treatment options for mesenteric injuries include operative, non-operative, and endovascular strategies. This case proved that SSE was a valuable alternative to surgery and should be applied in a hemodynamically stable patient with an isolated SMA injury. Knowing that embolization of mesenteric vessels might lead to a deficit of vascular supply and subsequent segmental intestinal ischemia, we performed CT angiography to examine the vessels after embolization and found that excellent collateral circulation was preserved at the border of the bowel wall. Close follow-up is suggested for all patients after mesenteric interventions. In this case, the patient recovered well during follow-up, with no delayed complications.

Although the risk of intestinal ischemia after embolization ranges from 0% to 22% in the literature (Schenker et al., 2001), SSE allows specific vasa recta to be identified and accessed, resulting in decreased rates of intestinal ischemia (Chan et al., 2016). Apart from the location of vessel occlusion, it is also crucial to choose a suitable embolic agent, which could be Gelfoam particles, coils, or polyvinyl alcohol. Coils appear to be a preferable embolic agent due to better clinical outcomes (Han et al., 1999). However, there is still a lack of specific guidelines for decision-making in intervention management for blunt mesenteric injuries.

In conclusion, the possibility of isolated mesenteric injuries should be considered in any patient presenting with blunt abdominal trauma, even with no evidence of any solid organ injury. SSE may be a promising therapy to treat mesenteric injuries, on account of the reduction in major complications and recurrent bleeding.

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Author contributions

Ping WANG studied the concept and prepared the first draft of the manuscript. Congying SONG made critical revisions to the article. Yuanqiang LU checked and confirmed the final version. All authors have read and approved the final manuscript, and therefore, have full access to all data relevant to the study and take responsibility for the integrity and security of such data.

Compliance with ethics guidelines

Ping WANG, Congying SONG, and Yuanqiang LU declare that they have no conflict of interest.

This research is approved by the First Affiliate Hospital, School of Medicine, Zhejiang University, Hangzhou, China (No. 2022623). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5). Informed consent was obtained from the patient for being included in the study. Additional informed consent was obtained from the patient for whom identifying information is included in this article.

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Supplementary information

Video S1