

Successful conservative treatment of acute traumatic occlusions of the celiac artery and superior mesenteric artery

A case report emphasizing the importance of the visceral collateral circulations

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Abstract

Rationale: Blunt injury of major visceral arteries such as celiac artery (CA) and superior mesenteric artery (SMA) are very rare but fatal, therefore, these injuries are challenging to trauma surgeons. The patient with occlusion of CA or SMA is theoretically viable by visceral collateral circulation. However, there are very rare cases in clinics. To date, there have been few reports of both CA and SMA occlusions after blunt trauma. Herein we describe our successful conservative treatment of patients with both CA and SMA occlusions.

Patient concerns: Fifteen-year-old girl suffering from schizophrenia was transferred to our hospital after a fall from 3-floor-height with a purpose of suicide.

Diagnoses: An abdominal computed tomography (CT) scan with contrast enhancement showed proximal CA and proximal SMA occlusions with surrounding retroperitoneal hematoma, however, distal parts of occlusion were supplied by the collateral vessels (enlarged marginal artery of left colon from inferior mesenteric artery and pancreaticoduodenal arcade).

Interventions: She was treated by only supportive care without anticoagulant due to retroperitoneal hematoma.

Outcomes: The patient was discharged 25 days after admission without complications.

Lessons: We think that our patient could survive because her vascular status was healthy and collateral circulations were plenty according to the young age. We believe that this case can provide a basis for ligation in these forbidding and handless major visceral arterial injuries such as CA or SMA.

Abbreviations: ALT = alanine transaminase, AST = aspartate transaminase, CA = celiac artery, CT = computed tomography, IMA = inferior mesenteric artery, SMA = superior mesenteric artery.

Keywords: acute occlusion, blunt trauma, celiac artery, marginal artery of Drummond, pancreaticoduodenal arcade, superior mesenteric artery

1. Introduction

Injuries to the abdominal major visceral vessels such as the celiac artery (CA) and superior mesenteric artery (SMA) are uncommon but devastating, with extremely high mortality rates.^[1] Because these injuries are both rare and lethal, they are difficult and challenging for trauma surgeons. The most common cause of abdominal vascular injury is penetrating trauma rather than

blunt trauma, and the most frequent location of these injuries is the SMA.^[2] In contrast, involvement of the CA is extremely rare, and, to our knowledge, concomitant injuries to both vessels from blunt trauma have never been reported. This report describes the presentation and management of a patient with complete occlusion of both the CA and SMA at the origin due to blunt abdominal trauma. Ethical approval was waived by the medical ethics committee of Kyungpook National University Hospital to publish this study and the informed consents were given.

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2. Case report

A 15-year-old girl with schizophrenia was transferred to our hospital after falling from a 3-floor-height in suicide attempt. On admission, her vital signs were stable immediately after fluid resuscitation. She was alert and complained only of abdominal pain in the epigastric area. An abdominal computed tomography (CT) scan with contrast enhancement showed proximal CA and proximal SMA occlusions with surrounding retroperitoneal hematoma (Fig. 1A). However, distal areas of occlusion were supplied by the collateral vessels, including an enlarged inferior mesenteric artery (IMA) and the marginal artery of the left colon. She was admitted to the intensive care unit. She was closely observed, with frequent abdominal physical examination because

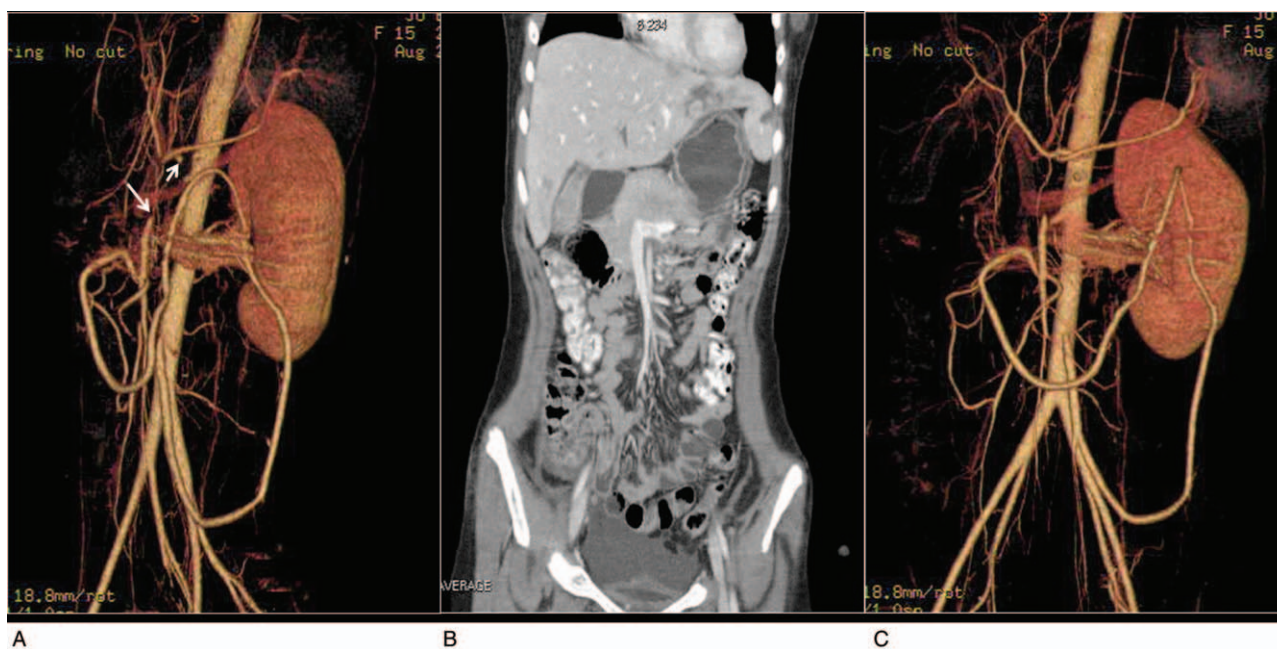


Figure 1. (A) Occlusions of the CA (short arrow) and SMA (long arrow) at their origins. (B) Good perfusion of intraabdominal organs. (C) Blood supply to the CA by the pancreaticoduodenal arcade from the distal SMA and inferior phrenic artery, and SMA was supplied from IMA via marginal artery of Drummond.

of the possibility of bowel ischemia. Blood transfusion was not necessary. She was treated by only supportive care without anticoagulant due to retroperitoneal hematoma. On day 3, mild abdominal pain disappeared after gas passage and her serum concentration of alanine transaminase (ALT) began to decrease (Fig. 2). A follow-up CT scan after 1 month showed that the CA and SMA remained occluded at the origin, but her liver, gallbladder, spleen, and small bowel were distally perfused (Fig. 1B). The CA was supplied by the pancreaticoduodenal arcade from the distal SMA and inferior phrenic artery, and the SMA by the IMA via the marginal artery of Drummond (Fig. 1C). She was discharged 25 days after admission with no complications.

3. Discussion

The most common cause of abdominal vascular injury is penetrating trauma such as gunshot or stabbing injuries. Blunt

abdominal vascular injuries are less frequent, accounting for approximately 5% to 10% of all abdominal vascular injuries.^[1] The most frequent location of these injuries is the SMA, whereas involvement of the CA is extremely rare. Mortality rates are high in patients with these injuries, owing to intense consequences of disturbance of the mesenteric circulation and the technical difficulty of rapidly exposing and repairing these vessels, exacerbated by the severely compromised physiologic conditions of these patients.^[3]

Blunt SMA injury is a devastating entity with mortality rates 57% to 63%.^[3,4] This injury results in exsanguinating hemorrhage or secondary sepsis, as well as multiple organ failure from the sequelae of ischemic bowel. Injuries to the SMA may occur at any level along its course by Fullen’s zone.^[5] Theoretically, injuries from the aortic orifice to Zone II may be accompanied by preservation of flow into the midgut from collaterals originating from other visceral arteries. However, intense vasoconstriction or delayed opening of collateral vessels may result in loss of viability of the midgut. Flow to the SMA in our patient was maintained by blood supplied from the IMA via an enlarged marginal artery of Drummond (Fig. 1C), the latter the major collateral arcade between the SMA and IMA. In the absence of mesenteric arterial occlusion, the marginal artery of Drummond remains trivial in diameter, but may become greatly enlarged when the IMA or SMA is occluded.^[6]

CA injuries are very rare, constituting 0.01% to 0.1% of all visceral vascular injuries, but have a high overall mortality rate estimated at 38.5%.^[7,8] Until 2017, blunt CA injuries were reported in 14 patients.^[9] The suggested pathophysiology of CA injuries includes compression of the CA against the median arcuate ligament as to elevation of the diaphragm according to sudden increase of intraabdominal pressure. This compression could lead to a dissecting intimal flap, or, in patients with avulsion, a fulcrum for a point of tearing.^[10] The force of the fall in our patients likely contributed to her CA injury. Simple ligation of the CA is considered superior to surgical repair in achieving

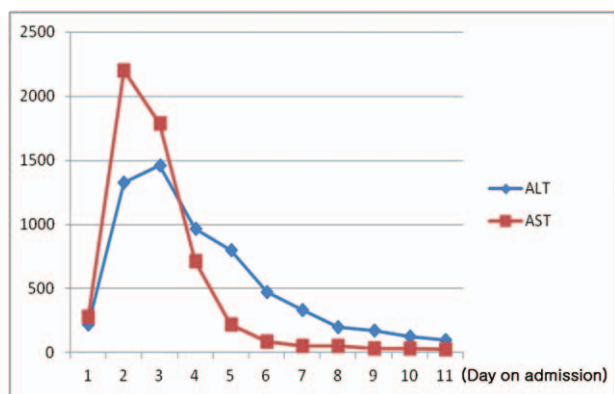


Figure 2. Serum concentrations of alanine transaminase and aspartate transaminase following admission of our patient. Both began to decrease 3 days after admission.

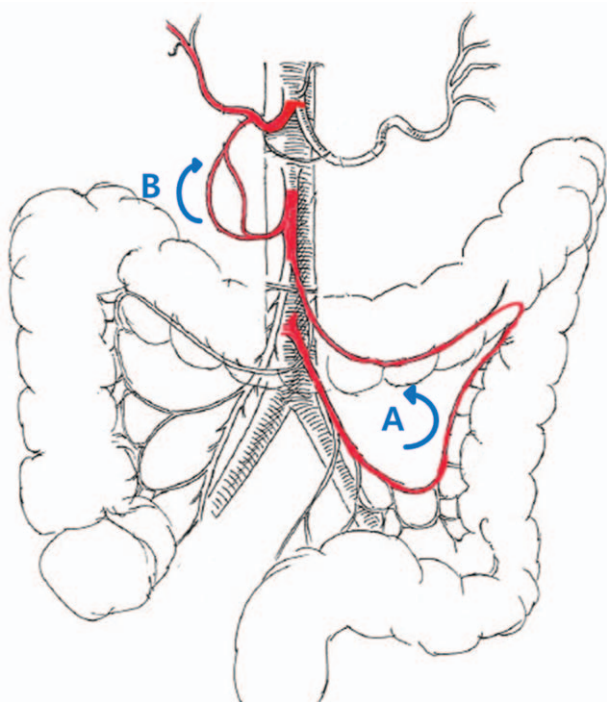


Figure 3. Visceral collateral circulation in our patient, showing blood flow along the pathway (IMA → marginal artery of Drummond → midcolic artery → SMA → pancreaticoduodenal arcade → CA). (A) Marginal artery of Drummond, (B) pancreaticoduodenal arcade.

hemostasis in patients with CA injuries. CA ligation may be enhanced by the rich collateral blood flow from the SMA through the pancreaticoduodenal arteries as well as branches from the esophagus, and diaphragm. However, these collateral blood flows are not always possible. Consequences of ligation or occlusion of the CA can include hepatic failure and necrosis of the gallbladder and spleen.^[10,11]

Concomitant injuries to both the CA and SMA are extremely rare, but entail very serious damage. Theoretically, occlusion or ligation of the CA and SMA at their origins may be compensated by collateral visceral circulations. However, mortality rates of these patients were high due to acute hepatic failure or bowel ischemia. Moreover, survival of patients with both major visceral arteries (CA and SMA) occluded by blunt injury has not been previously reported. One patient who experienced simultaneous CA and SMA ligation during left nephrectomy and later underwent successfully reimplantation of the SMA died of postoperative multiorgan failure.^[12] In contrast, 2 patients who underwent ligation of both the CA and SMA at their origins during elective surgery showed no evidence of intestinal ischemia.^[13,14] An angiogram showed that the IMA, via a large left colic marginal artery, continued to supply blood to the entire gastrointestinal tract. Similarly, in our patient, the main route of the collateral circulation to the midgut was through the IMA by way of the middle colic artery to the SMA. Moreover, the CA was

supplied by the SMA through the pancreaticoduodenal arcade and the inferior phrenic artery (Fig. 3).

To our knowledge, this patient is the first reported to have survived simultaneous blunt trauma injury to the CA and SMA. Survival of our patient may have been due to her healthy vascular status and the plenitude of her collateral circulations, both of which were associated with her young age. Findings in this patient may provide a basis for ligation in patients with blunt trauma caused by injury to the forbidding and handles major visceral arteries, including the CA and SMA.

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Author contributions

Conceptualization: Kyoung Hoon Lim.
Writing – original draft: Kyoung Hoon Lim.
Writing – review & editing: Jinyoung Park.

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