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Isolated celiac artery avulsion from blunt abdominal trauma

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ABSTRACT

Introduction: Trauma-related celiac artery injuries are a rare and life-threatening pathology that often requires urgent multidisciplinary care. Rarer still are cases of celiac artery avulsion in the setting of blunt trauma. There is little literature describing such injury patterns. The farthest-reaching is a case series by Kronich et al. 2017, which compiles eleven cases. The majority of these injuries were incomplete intimal injuries only appreciated on admission imaging. A further literature review reveals five cases of full avulsions in the setting of blunt trauma. Management varied dramatically among these cases. The multidisciplinary nature of vascular trauma, in combination with new vascular repair techniques provides a paradox of choice regarding acute management in unusual presentations. With intuitional review board approval, we report a case of blunt trauma with complete celiac trunk avulsion in a patient with aberrant visceral vascular anatomy, managed with open exploration and ligation.

Case report

A 58-year-old male presented by ambulance to an American College of Surgeons Verified Level I Trauma Center as the highest level of activation, after being hit by a car on a motorcycle while wearing a helmet. The primary survey was intact and reassuring. The chest x-ray in the trauma bay was unrevealing, and a Focused Assessment with Sonography in Trauma (F.A.S.T.) failed to demonstrate free intra-abdominal fluid.

During the start of the secondary exam, the patient became increasingly tachycardic and hypotensive, with systolic blood pressures dipping into the 80s. Resuscitation was initiated with blood products. His abdominal exam remained benign. His left lower extremity was mangled with an obvious palpable femur fracture and open tibia fractures. Repeat F.A.S.T. was negative, and a pelvic film demonstrated a closed pelvic ring without fracture. The patient ultimately required three units of packed red blood cells and four units of fresh frozen plasma. With the presumed source of hemorrhage in the thigh, the secondary exam was completed efficiently, with scattered facial abrasions and the aforementioned open orthopedic fractures. The patient had preserved distal pulses. Orthopedic surgery was consulted urgently due to the anticipated need for operative fixation.

After stabilization with blood product resuscitation, the patient safely underwent CT head, CTA chest, abdomen, and pelvis with bilateral runoff of the lower extremities. Imaging suggested that the patient had a traumatic arterial dissection/occlusion of the celiac artery just after its origin, with distal reconstitution with an extensive retroperitoneal hematoma, [Fig. 1](#). He also had a dissection at the origin of the replaced common hepatic artery. His replaced common hepatic artery arose from the superior mesenteric artery (SMA). The left lower extremity had comminuted fracture deformities of the distal left femur and the left mid-tibia and fibula with patent

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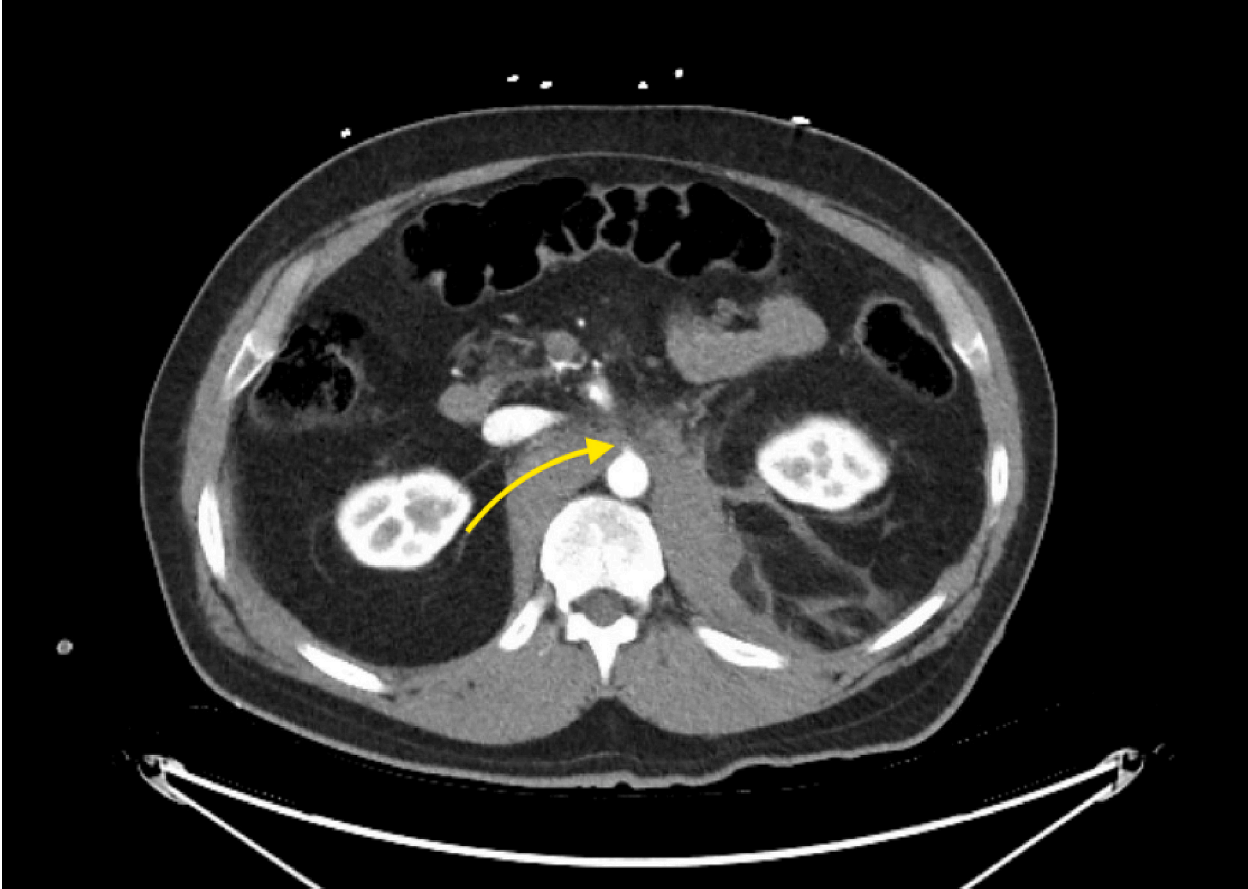


Fig. 1. Axial CT imaging from presentation. Yellow arrow denotes avulsed celiac trunk surrounding retroperitoneal hematoma. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

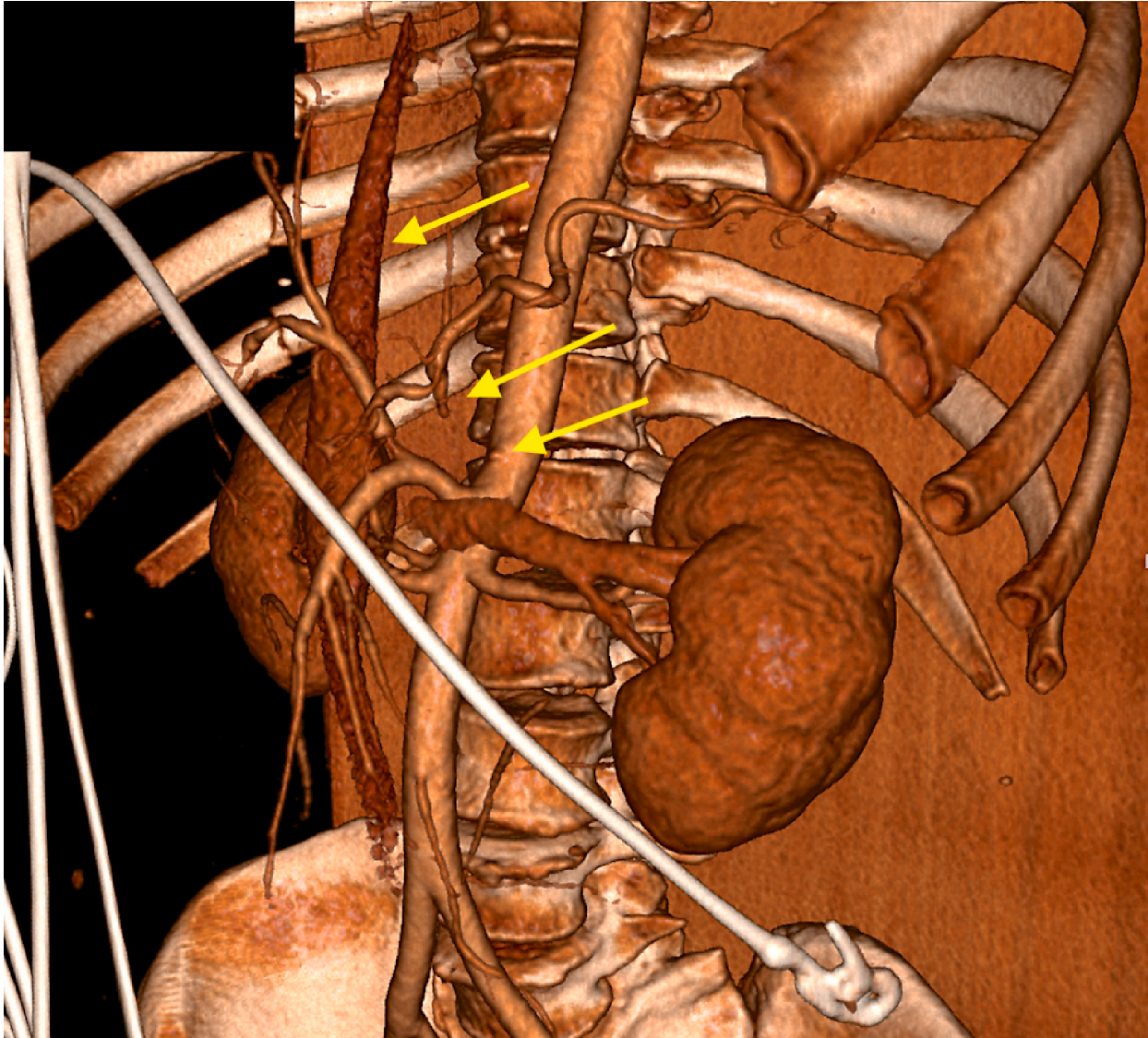


Fig. 2. *Post-hoc 3D reconstruction of avulsed celiac trunk and surrounding retroperitoneal hematoma. Inferior most arrow points toward celiac stump. Middle arrow points toward the distal avulsed celiac. The superior most arrow points toward the retroperitoneal hematoma. The replaced common hepatic off the SMA travels into the plane of the photo.*

vasculature.

The patient proceeded immediately to the operating room with vascular and trauma surgery due to concern for hemorrhage from a celiac artery injury. A c-arm was brought into the OR for endovascular fluoroscopy. The right common femoral artery was accessed using ultrasound guidance. A Storq wire with a 6-French sheath was maintained in the distal thoracic aorta in anticipation of needing an occlusion balloon. A midline laparotomy was performed without immediate findings of hemoperitoneum. The abdomen was explored thoroughly. The patient had an apparent zone-one hematoma and two sub-centimeter splenic capsule tears which were hemostatic. There were no bowel injuries and no zone two or three hematomas (Fig. 2).

With the zone one hematoma identified, the vascular sheath was upsized, and an aortic occlusion balloon was positioned in the supraceliac aorta. We performed a left medial visceral rotation mobilizing the left colon and kidney to the midline. There was profuse arterial bleeding from the origin of the celiac artery, which lessened with insufflation of the occlusion balloon. We identified an avulsion of the celiac trunk, the origin of which was oversewn with 4–0 prolene. The distal portion of the celiac transection was identified and similarly oversewn with 4–0 prolene.

With hemostasis achieved, we took down the triangular ligament to reflect the left lobe of the liver and entered the lesser sac, where a hematoma was encountered and evacuated without signs of ongoing bleeding. The hepatoduodenal ligament had palpable arterial flow. A splenectomy was not performed. The abdomen was irrigated and left open with negative pressure wound therapy. The right femoral access site was closed with a percutaneous closure device. Total abdominal aortic occlusion time with the balloon was ten minutes. With intra-abdominal hemostasis achieved and stable hemodynamics, orthopedic surgery placed an external fixation device on the mangled lower extremity.

The patient recovered appropriately with hemodynamic stability. He returned to the operating room for a second look exploration the next day without identification of additional injuries and was subsequently closed. He returned to the operating room with orthopedic surgery for internal fixation of his left femur, patella, and tibia, which ultimately required free flap reconstruction with plastic surgery.

Discussion

We have presented a case of isolated celiac artery avulsion in the setting of blunt trauma. This is an exceedingly rare injury pattern without management consensus [1]. The patient's prompt and balanced resuscitation with blood products and his ensuing relative hemodynamic stability allowed for pre-operative completion imaging identifying the celiac artery avulsion that may have otherwise gone undetected, given his benign abdominal exam and negative F.A.S.T.

This patient had aberrant visceral vascular anatomy with a completely replaced common hepatic artery off the SMA. As such, hepatic perfusion was preserved without relying on collateral flow. The splenic artery was supplied by the right gastric with gastroduodenal and the right gastroepiploic after ligation of the celiac axis. We hypothesized that even while the celiac artery was intact, much of this patient's visceral arterial supply may have originated from the SMA. At baseline, the celiac trunk may have provided very little blood supply, allowing for significant vasospasm and relative hemodynamic stability on presentation.

The limited literature on isolated celiac artery injuries is explained by the relatively protected anatomy the celiac enjoys [2–5]. Not only is its depth challenging to reach with penetrating injuries, but the tight location in the upper abdomen limits the inertia of deceleration injuries in blunt trauma. True prevalence in the trauma surgery literature is likely limited by pre-hospital mortality; heavy selection bias such that most patients may succumb to injuries prior to presentation or arrive in extremis for which the definitive cause of bleeding is never formally identified. As such, patients with identified celiac artery injuries may constitute a particularly unusual proportion of the population whose anatomy can shunt long enough to be formally identified and treated.

Traditional teaching suggests that the celiac artery can be ligated liberally as the rich network of collaterals in patients with native anatomy should adequately compensate. However, patients who present stable enough to have celiac artery injuries, appropriately identified by CT, may have aberrant anatomy for which a more nuanced approach might be necessary. Isolated cases of acute celiac artery occlusions have been associated with liver failure [6]. This may be particularly important in patients with an atherosclerotic disease whose circulation patterns may also be adulterated.

More research is needed to estimate the true incidence of celiac artery injuries in trauma. Epidemiological data regarding penetrating and blunt mechanisms could provide valuable insight into anticipated injury patterns and the relative bias of current isolated reports. Additional research could guide practice as the combination of vascular repair and trauma management for patients with unusual anatomy prompts more questions than answers [7].

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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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