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CASE REPORT

# Blunt Mesenteric Vascular Injuries: Endovascular Management and Midterm Outcomes

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**Introduction:** Visceral artery injuries are rare but lethal entities that pose significant management challenges in a patient who presents with blunt trauma. There is a paucity of specific guidelines both in the trauma and vascular literature regarding the management of blunt intra-abdominal vascular injuries. The midterm outcomes of two cases of blunt traumatic visceral artery injuries managed successfully with endovascular interventions are presented.

**Report:** An 18 year old male victim of a motor vehicle accident was found to have infrarenal aortic, coeliac artery (CA), and superior mesenteric artery (SMA) injuries. The second patient was a 15 year old male who presented with traumatic occlusion of the CA after an all terrain vehicle collision. Both patients had other associated abdominal and bony injuries. All vascular injuries were addressed endovascularly, which was followed by repair of other associated injuries. In the first case, a self expanding non-covered nitinol stent was used in the injured but tortuous CA; for repair of the SMA, a covered balloon expandable stent was used. In the second patient, a balloon expandable non-covered stent was used to repair the CA occlusion. In both cases, the 12 month post-operative follow up showed that all stents were patent and the patients were asymptomatic.

**Discussion:** Endovascular repair of the mesenteric arteries following traumatic injury can be achieved safely, with good midterm outcomes. More data are needed to define the indications for and long term safety and patency of stents used in traumatic visceral artery injuries.



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## INTRODUCTION

Blunt traumatic visceral vascular injuries can have devastating consequences and require prompt diagnosis and expeditious management to achieve the best outcomes.

Current management protocols are based on a small number of case reports which describe treatment strategies ranging from non-operative medical management to open bypass operations to endovascular interventions.[1]

The experience of two patients suffering blunt abdominal traumas with mesenteric artery injuries managed by endovascular therapy and their one year follow up findings are presented.

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## REPORT

### *Patient 1*

An 18 year old male was presented after a high speed motor vehicle accident. The primary and secondary surveys revealed a Glasgow Coma Scale (GCS) of 15, abrasions on the chest and abdomen consistent with the seatbelt sign, and abdominal tenderness. Initial vital signs showed haemodynamic stability. A computed tomography scan (CT) of the chest, abdomen, and pelvis revealed an infrarenal abdominal aortic dissection, a peri-aortic retroperitoneal haematoma, and free fluid in the abdomen. Additionally, he also had a sternal fracture and three column fracture of the third lumbar vertebral body (L3) with bony retropulsion into the spinal canal, correlating with the level of the aortic injury. The initial CT also revealed focal narrowing of the coeliac artery (CA) at its origin, with opacification of the vessel distally, and patent superior and inferior mesenteric arteries. An emergency aortogram in the operating room confirmed an infrarenal aortic injury with active

extravasation. A 23 mm × 70 mm long Endurant aortic cuff (Medtronic, Minneapolis, MN, USA) was placed, with resolution of the aortic extravasation. However, the patient continued to be hypotensive with no other obvious source of bleeding, which prompted an exploratory laparotomy. This revealed multiple small intestinal mesenteric tears and a 20 cm length of devascularised jejunum that was resected. The intra-operative examination and mesenteric Doppler evaluation confirmed adequate perfusion of the remaining small bowel. The patient improved haemodynamically, a primary bowel repair was performed, and he was transferred to the intensive care unit (ICU) for further care.

By post-operative day six, the patient's laboratory values revealed an elevated aspartate transaminase (AST; 488 U/L [normal range 4—35 U/L]) and alanine transaminase (ALT; 1 174 U/L [normal range 6—55 U/L]). Total and direct bilirubin levels were 16.5 and 11.5 mg/dL, respectively, and the international normalised ratio was 1.4. His white blood cell count (WBC) and serum lactic acid level were normal. A CT angiogram (CTA) of the abdomen and pelvis showed severe focal stenosis of the proximal CA and superior mesenteric artery (SMA) with small bowel dilation, inflammation, and evidence of liver hypoperfusion. With a diagnosis of post-traumatic dissection of visceral arteries the patient was brought to the hybrid operating room for emergency revascularisation. On table bilateral saphenous vein mapping was done with a low threshold for conversion to open bypass surgery. A mesenteric angiogram via left brachial artery access confirmed severe stenosis in the proximal SMA (Fig. 1A) and CA (Fig. 2A). A 7 × 22 mm iCAST (Atrium, Hudson, NH, USA) covered balloon expandable stent was placed in the SMA and the CA stenosis was treated with two 8 × 20 mm and 9 × 20 mm self expanding non-covered Epic nitinol stents (Boston Scientific, Marlborough, MA, USA) accommodating the tortuosity of the CA at the dissection site. Completion angiography showed an excellent radiographic result with brisk flow in the SMA and CA (Figs. 1B and 2B). For the remainder of his hospitalisation, the patient required decompression of the lumbar spine with vertebral fusion for spinal injuries resulting from the initial accident, and a right hemicolectomy and ileostomy for a presumed iatrogenic injury at the index abdominal exploration. Sixty-nine days after presentation, he was discharged to a rehabilitation centre with normalised gut function.

### *Patient 2*

A 15 year old male presented to the hospital after an all terrain vehicle accident. After a brief loss of consciousness at the scene, he arrived at the hospital awake and alert, with normal vital signs and a GCS of 15. Secondary and tertiary surveys revealed abrasions over the chest and abdominal wall, with a right leg deformity. Imaging revealed fractures of the right acetabulum, right proximal tibia, and left clavicle. Other injuries included a grade two liver laceration and a L5 vertebral body fracture with no neurological deficit. The patient was admitted to the trauma ICU and within a span of 6—8 hours developed progressive abdominal tenderness and hypotension. CTA of the abdomen and pelvis revealed a dissection of the proximal CA with an abrupt truncation distally. Biochemical testing showed elevated AST (195 U/L) and ALT (138 U/L), and serum lactic acid levels of 3.5 mmol/L. His serum bilirubin level and WBC remained normal. Emergent revascularisation of the CA occlusion (Fig. 3A) was performed in the hybrid operating room using a 6 × 18 mm Express balloon expandable non-covered stent (Boston Scientific). The proximal portion of the stent was flared out to match the

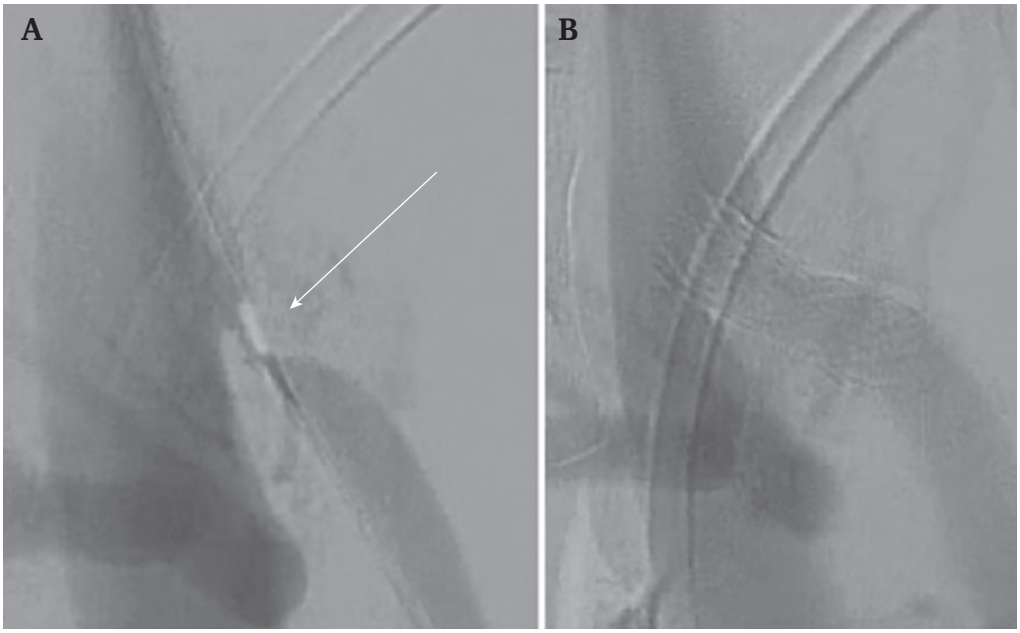


**Figure 1.** (A) Superior mesenteric artery stenosis (white arrow). (B) Recanalisation of the superior mesenteric artery (SMA) after endovascular stent repair.

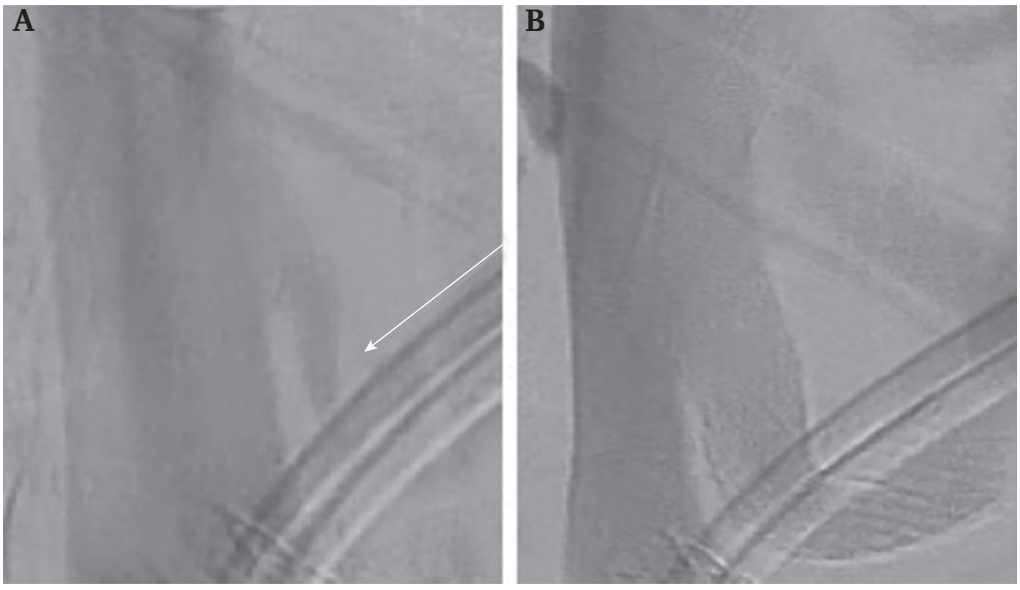


**Figure 2.** (A) Coeliac artery (CA) stenosis (white arrow). (B) Recanalisation of the CA after endovascular stent repair.

proximal CA, based on the measurements from the CT scan (Fig. 3B). Additionally, a diagnostic laparoscopy converted to an open laparotomy was performed to exclude hollow viscus injury in the setting of free intra-abdominal fluid detected on CT. Intra-operatively, a grade two pancreatic injury was diagnosed; this was addressed by placing drains in the lesser sac. The patient recovered well and his liver function tests had normalised by post-operative day 2. Thereafter, the patient underwent orthopaedic interventions for bony injuries, had an uneventful hospital recovery, and was discharged to a rehabilitation facility on post-operative day 9.

Both patients remained on dual antiplatelet therapy (DAPT) with daily oral aspirin 81mg and clopidogrel 75 mg.

Regarding follow up surveillance, patient 1 had a CTA performed four and 12 weeks post-repair, which showed a widely patent aortic stent graft, and SMA and CA stents. Duplex ultrasound (DUS) evaluations at 6, 12, and 24 months post-operatively showed patent stents without evidence of stenosis.

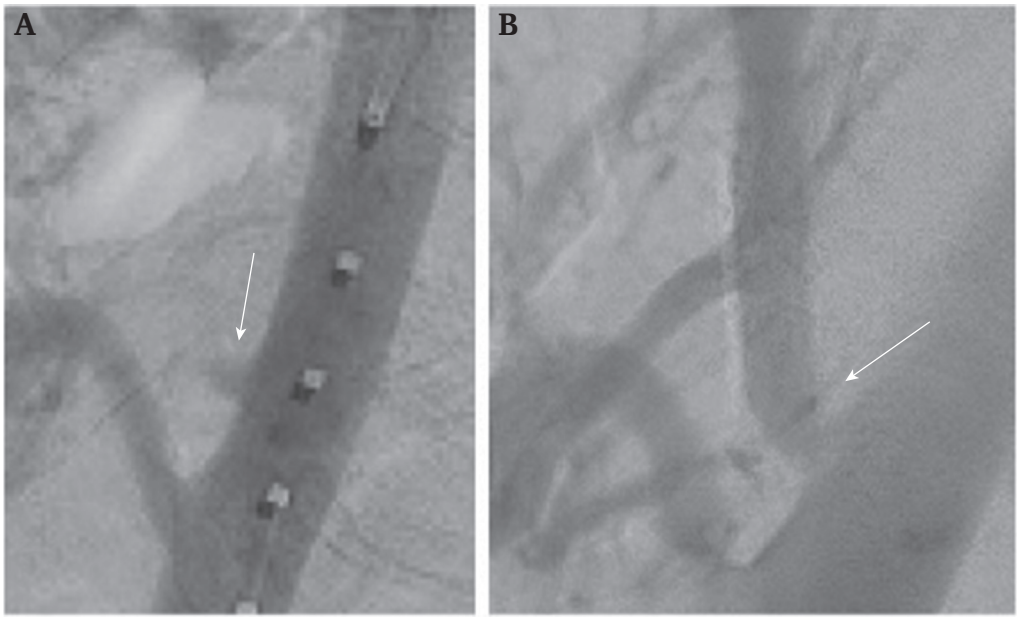


**Figure 3.** (A) Abrupt occlusion of coeliac artery (CA) blood flow (white arrow). (B) Recanalisation of the CA after endovascular repair.

Patient 2 had a CTA at four weeks, and then DUS at 12 weeks, six months, and 12 months, which showed a patent CA stent. At 12 months, the peak systolic velocities in the coeliac trunk stent were recorded as 231 cm/second *vs.* 173 cm/second at six months. He was asymptomatic and a shorter follow up interval was recommended.

## DISCUSSION

Blunt injury to the mesenteric vessels in the form of dissection with thrombosis, vessel contusion, pseudoaneurysm formation, and complete vessel transection have been reported.[1] Haemorrhagic shock is the primary cause of early death. This is followed by multisystem organ failure in the later phase if the bleeding cannot be controlled.[2]

Fulminant hepatic failure has been described in patients with acute traumatic compromise of the CA.[3] In some cases, the symptoms of isolated CA occlusion may be less obvious owing to collaterals from the SMA, and phrenic and subcoastal arteries. It has been shown that acute coverage of the CA by thoracic aortic stent grafts for thoraco-abdominal aortic interventions does not always lead to a clinically obvious insult.[4]

Apart from an emergency laparotomy and haemorrhage control in a patient with mesenteric arterial avulsion and haemorrhagic shock, there are no specific guidelines to direct the choice of intervention for blunt mesenteric arterial occlusions. Historically, surgical interventions such as mesenteric arterial bypass or ligation were the only treatment options available and are associated with significant intra- and peri-operative morbidities.[1]

A high index of suspicion should be exercised in all cases of blunt flexion distraction type vertebral injuries as these "seatbelt" fractures have about a 50% incidence of concomitant intra-abdominal injury.[5] A CTA may detect an evolving, or even missed, CA injury with compromised hepatic flow. The authors strongly believe that in the setting of major visceral vessel compromise with signs of end organ ischaemia, the mere presence of good collateral flow on imaging should not delay vessel revascularisation.

In the authors' approach to obstructive blunt mesenteric injuries, intra-operative visceral vessel angiography is a critical step in decision making used to delineate the extent of the injury and provide therapeutic options. The authors are prepared for open intervention either as an initial therapy or as a bailout for the endovascular procedure, with patient preparation in a hybrid operating room including on table saphenous vein mapping. Additionally, co-existing non-vascular injuries, haemodynamic status, and medical comorbidities are discussed with the critical care team to formulate the care plan. This approach was used in both patients in this report, with the decision on the initial endovascular approach based on the vascular surgeon's recommendations and clinical findings.

Stent selection was aimed at matching the patient's vessel size and anatomy at the site of injury. Balloon expandable stents have been found to be more useful for precise deployment near ostial lesions and branches. Self expanding stents are preferred when the vessel is tortuous.[6,7]

The use of covered stents in the mesenteric vessels has been described and studied in chronic mesenteric ischaemia, where it has been shown to have better midterm patency and lower re-intervention rates than non-covered stents.[8] In the setting of trauma, no recommendations are available owing to the rarity of the condition and paucity of data. In the authors' opinion, a covered stent is safer to prevent clot dislodgement, and distal embolisation if it can be deployed without covering any essential branches, as was done in patient 1.

The technical feasibility of endovascular interventions in blunt mesenteric arterial injuries has been described previously (patient 1).[9] The present report of two patients shows a 100% technical success rate, with no in hospital death or morbidity related to the vascular intervention. Excellent midterm stent patency with no stent failure and no re-interventions were observed during the observation period.

For all mesenteric interventions a robust follow up plan is suggested, with imaging at 1, 3, 6, and 12 months, and then annually thereafter. CTA can be used initially, followed by DUS on subsequent visits if image quality is adequate. The authors advocate the use of DAPT for 30 days, in order to maintain stent patency, and a single antiplatelet agent for life; however, the paucity of data supporting such an approach is noted.

In conclusion, endovascular management of traumatic CA injuries can yield excellent peri-operative and midterm results when performed by experienced operators in well selected patients where close post-operative follow up is feasible. To provide the best possible repair patency, more research is needed to better understand the long term safety and efficacy, and the preferred medical management.

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## CONFLICTS OF INTEREST

None.

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## REFERENCES

1 Kronick MD, Doben AR, Morris ME, Gross RI, Kravetz A, Nahmias JT. Blunt traumatic celiac artery avulsion managed with celiac artery ligation and open aorto-celiac bypass. *Trauma Case Rep* 2017;**11**:8–12.

2 Kobayashi LM, Costantini TW, Hamel MG, Dierksheide JE, Coimbra R. Abdominal vascular trauma. *Trauma Surg Acute Care Open* 2016;**1**:e000015.

3 Kirchhoff C, Stegmaier J, Krotz M, Muetzel E, Mutschler W, Kanz KG, et al. Celiac dissection after blunt abdominal trauma complicated by acute hepatic failure: case report and review of literature. *J Vasc Surg* 2007;**46**:576—80.
4 Mehta M, Darling III RC, Taggert JB, Roddy SP, Sternbach Y, Ozsvath KJ, et al. Outcomes of planned celiac artery coverage during TEVAR. *J Vasc Surg* 2010;**52**:1153—8.
5 Ceroni D, Mousny M, Lironi A, Kaelin A. Pediatric seatbelt injuries: unusual Chance's fracture associated with intra-abdominal lesions in a child. *Eur Spine J* 2004;**13**:167—71.
6 Boddu A, Balmuri A, Kamalesh M. Clinical utility of self-expanding stents in coronary artery disease. *Res Rep Clin Cardiol* 2015;**6**:117—22.
7 Charlton-Ouw KM, Davies MG, Lumsden AB. Intravascular stenting in aortoiliac arterial occlusive disease. In: Moore WS, Ahn SS, editors. *Endovascular surgery*. 4th ed. Philadelphia, PA: W.B. Saunders; 2011. p. 271—84.
8 Oderich GS, Erdoes LS, LeSar C, Mendes BC, Gloviczki P, Cha S, et al. Comparison of covered stents versus bare metal stents for treatment of chronic atherosclerotic mesenteric arterial disease. *J Vasc Surg* 2013;**58**:1316—24.
9 Zhang N, Prabhakaran K, Carroll F, Anderson P, Latifi R, Laskowski I. Blunt abdominal aorta, celiac artery, and superior mesenteric artery injuries treated endovascularly. *Am Surg* 2019;**85**:167—9.