

Endovascular Therapy for Overcoming Challenges Presented With Blunt Abdominal Aortic Injury

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Abstract

Blunt abdominal aortic injury (BAAI) is a rare and lethal injury requiring surgical management. Injury patterns can be complex and surgical strategy should accommodate specific case circumstances. Endovascular solutions appear appropriate and preferred in certain cases of BAAI, which, however, may not be applicable due to device limitations in regard to patient anatomy and limited operating room capability. However, endovascular therapy can be pursued with limited fluoroscopy capability and consumable availability providing a solution that is expeditious and effective for select cases of BAAI.

Keywords

blunt, aorta, trauma, abdomen

Introduction

Blunt abdominal aortic injury (BAAI) is an exceptionally rare injury that has been shown to occur in 0.05% of blunt abdominal trauma cases and represents 5% of all blunt aortic injuries.¹ Among the initial survivors, the presentation can be variable and if left untreated mortality rates² approach 75%. Nearly two thirds of cases occur in the presence of other abdominal injuries.³ However, open surgical repair has been the mainstay of treatment, which can be challenging in the setting of peritoneal contamination or previous surgery. Endovascular solutions offer advantages to open repair in this setting; however, their application remains constrained by anatomic criteria for current commercially available devices and by access to endovascular assets in the operating room. We present a case of BAAI with associated bowel injuries and peritoneal contamination treated via an intraoperative endovascular approach using a commercially available iliac limb device due to small aortic size thereby further expanding the feasibility and applicability of endovascular therapy for BAAI in challenging circumstances.

Case Report

An otherwise healthy 35-year-old male presented to the emergency department after being involved in a high-speed motor vehicle accident (MVA). The patient was awake and oriented complaining of severe abdominal and low back pain without neurological deficits. Initial blood pressure was 90/60 mm

Hg with palpable pulses in all extremities. Across the lower abdomen was a significant seatbelt sign and a chest tube was placed for a unilateral pneumothorax. A computed tomography (CT) scan of the chest, abdomen, and pelvis in contrast demonstrated transverse disruption of the abdominal wall, large amount of free fluid in the abdomen, L2 Chance fracture, a retroperitoneal hematoma, and findings consistent with BAAI at the level of the inferior mesenteric artery (IMA). The aortic diameter measured 16 mm below the renal arteries and 13 mm right above the aortic bifurcation with an infrarenal aortic distance of 7 cm (Figure 1). He was taken to the operating room for emergent laparotomy. Exploration revealed peritoneal contamination with small bowel injury that was resected leaving 150 cm remaining in discontinuity, significant abdominal wall defect, and a nonexpanding retroperitoneal hematoma inferior to the transverse mesocolon. With complete exploration, the abdomen was temporarily closed and the patient was prepared for an endovascular repair of the BAAI. Using percutaneous right groin access and open left groin access, an ESLE 16 × 55 mm and an ESLE 20 × 55 mm iliac limb endoprosthesis (Cook Medical Inc, Bloomington, Indiana) were

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Figure 1. Initial computed tomography scan shows evidence of aortic injury as seen on axial (A) and maximal intensity projection (MIP) (B) projections.

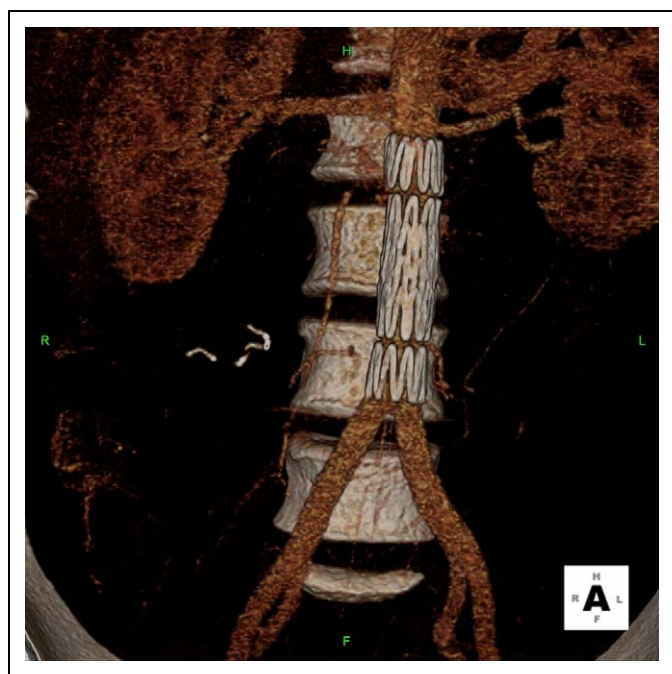


Figure 2. Follow-up computed tomography scan showing successful repair of aortic injury.

sequentially deployed successfully across the area of injury achieving adequate seal. Delayed abdominal wall and bowel reconstruction was performed followed by repair of the L2 burst fracture. Once recovered from all injuries, the patient was discharged home. Follow-up CT scan demonstrates continued successful aortic repair (Figure 2) and he has since returned to work and resumed normal activity.

Discussion

Despite being a rare entity, BAAI can be characterized through observed patterns surrounding this injury. Half of the injuries are due to MVA and there is an association with seat belt use, hence the term “seat belt aorta.”⁴ As a result, a unique clinical finding is a transverse ecchymotic band across the abdomen

seen in some cases. Early presenting signs include acute arterial insufficiency (81%), acute abdomen (55%), motor deficit (47%), and abdominal wall defect (19%).⁵ Concurrent abdominal injuries are present in 58% of cases.² Therefore, contamination of the peritoneal cavity is possible and can vary in extent. Anatomically, blunt abdominal aortic injuries are most commonly located within the infrarenal aorta either near the origin of the IMA or just proximal to the aortic bifurcation.⁵

The BAAI represents a spectrum of injuries to the aorta ranging through intimal disruption with or without thrombosis, which is most common, intramural hematoma, aortic pseudoaneurysm, and aortic transection with exsanguinating hemorrhage.⁶ Successful recovery requires prompt injury recognition with hemorrhage control and restoration of blood flow.⁷ Ideally, suspected patients are diagnosed prior to exploration via imaging; however, given that patients can be hemodynamically unstable, this may not be possible. Suspicion may be raised intraoperatively by the presence of a periaortic hematoma. A decision must be made to pursue with further operative investigation followed by repair or to complete the exploration and utilize endovascular therapy. The latter choice is much more practical, if some form of intraoperative fluoroscopy capability exists and consumables are available ideally. This allows both trauma and vascular surgeons to simultaneously address concurrent injuries via both open and endovascular approaches in a manner that is time and resource efficient.

Open surgical techniques required to treat lesions associated with BAAI include intimal flap suturing, thromboendarterectomy, interposition bypass grafting, and ligation with extra-anatomic bypass grafting.⁸ Circumstances that present challenges in performing open repairs are extensive peritoneal contamination, difficulty in exposure due to previous surgery, and the presence of comorbid conditions precluding aortic cross-clamping.⁹ This series of challenges forms the impetus for pursuing endovascular alternatives, which include balloon fenestration, bare metal stenting, and stentgrafting.

For intimal injuries and luminal compromise, bare metal stenting appears adequate with acceptable results.² However, if the aortic wall is compromised or in the presence of hemorrhage, aortic stentgrafting is warranted. A variety of commercial devices are available for “off-label” use and must be properly selected based on individual patient anatomy. Measurements important for consideration are aortic diameter above and below the injury, distance away from the lowest renal artery and aortic bifurcation and diameters of the iliac arteries. A thorough understanding of available devices is required to ensure proper device selection and deployment. A variety of available ancillary devices can be utilized successfully to treat various aortic trauma when standard aortic devices do not accommodate patient anatomy^{10,11} as well as other vascular injuries when standard devices are not applicable.

Our patient presented with signs classically consistent with BAAI and significant mechanism of injury. Preoperative CT scan was allowable and demonstrated aortic injury at the level of the IMA. Immediate exploration was performed that demonstrated significant peritoneal contamination as well as the need

for subsequent abdominal procedures with additional contamination. Therefore, an endovascular solution was pursued and facilitated by the presence of a C-arm and a fluoroscopy bed within the trauma operating room. Review of the CT scan showed aortic diameters not amenable to standard aortic endografts, which would likely result in significant infolding in a 13- to 16-mm aorta. Proximal and distal seal zones were adequate; however, the overall length of infrarenal aorta measured 7 cm. Given the patient's anatomy, ESLE iliac limbs were selected to perform the repair rather than using an aortic device. The ELSE iliac limbs are available in smaller diameters than standard aortic devices and their short length (55 cm) makes them an obvious choice for this case. Furthermore, unlike most other available iliac limbs, ELSE limbs are nontapered throughout their length which allows more device customization when overlapping multiple limbs. However, the IMA obviously covered was not expected to and did not produce clinical sequelae.

Conclusion

The BAAI is a rare condition that has historically been most commonly been managed with open repair. At times, circumstances associated with this entity such as intraperitoneal contamination make open surgical repair less than desirable. Endovascular therapy can offer a simple, expeditious, and efficacious alternative treatment to overcome the challenges of open repair in BAAI. Furthermore, procedures can be performed in the operating room with basic imaging capability and consumable availability while simultaneously addressing other injuries in these often critically ill patients.

Declaration of Conflicting Interests

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