Endovascular Repair of a Blunt Abdominal Aortic Injury

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Abstract

Keywords

- blunt trauma
- aortic injury
- endovascular repair

Blunt abdominal aortic injury is an uncommon traumatic finding. In the past, treatment options have traditionally consisted of open operative repair; however, the development of endovascular surgery has created new interventional possibilities. This case is presented to demonstrate the applications of endovascular abdominal aortic repair for a blunt traumatic injury.

Blunt abdominal aortic injury (BAAI) is not common. Although several mechanisms of injury may be responsible,^{1–3} it is usually seen in restrained victims of a high-speed motor vehicle accident where aortic intimal injury occurs by either a longitudinal deceleration force or direct compression of the abdominal aorta against the vertebrae.^{1,2} Intimal injury can result in aortic dissection, pseudoaneurysm, tributary vessel occlusion, or rupture.¹ Traditionally such complications have been managed with direct surgical repair.⁴ Advances in minimally invasive techniques have led to the use of endovascular techniques to treat aortic pathology.⁵ Such techniques have been sparingly described in the management of blunt aortic trauma.² We report a percutaneous deployment of an aortic stentgraft to treat BAAI after a high-speed motor vehicle collision.

Case Report

A 21-year-old man was a restrained driver in an estimated 100 miles per hour, rollover, motor vehicle accident. He was intubated at the scene and transported via helicopter to the emergency room. On arrival his systolic blood pressure and heart rate were 80 mm Hg and 90 beats per minute, respectively. On examination he had ecchymoses across the left anterior chest and abdomen consistent with a typical “seat-belt sign.” Computed tomography angiography (CTA) scan revealed a dissection in the aorta at the level of the inferior mesenteric artery, a small, associated pseudoaneurysm, and periaortic stranding (►Fig. 1). Other injuries included a traumatic abdominal wall hernia, free intraperitoneal fluid, pulmonary contusion, and left humeral head dislocation. The

patient was taken to the operating room for exploratory laparotomy. Intraoperatively, a jejunal perforation was identified. Evaluation of the infrarenal aorta revealed the presence of a small aortic bleb associated with an intramural hematoma. The injured small bowel required resection and given the potential for graft contamination and the patient's stability, it was decided to perform a delayed endovascular repair of the aorta. The patient's abdomen was therefore closed and he was transferred to the intensive care unit for strict blood pressure control.

On hospital day 3, he was taken to the interventional radiology suite and an endovascular repair of his BAAI was performed using an aortic stentgraft. Both common femoral arteries were accessed percutaneously and Perclose (Abbott, Abbott Park, IL) devices were predeployed.⁶ An aortogram demonstrated a dissection and pseudoaneurysm at the level of the inferior mesenteric artery (►Fig. 2). A unibody, bifurcated stentgraft (Powerlink 22 × 13 × 120 mm; Endologix, Irvine, CA) was deployed in the infrarenal aorta. Completion aortogram showed coverage of the aortic injury, as well as patent renal, and hypogastric arteries bilaterally (►Fig. 3). The patient did well and was discharged on postoperative day 10. Follow-up CTA at 2 months showed successful exclusion of his aortic injury by the endograft (►Fig. 4).

Discussion

BAAs are rare, occurring in 0.05% of blunt abdominal trauma.⁷ The abdominal aorta is fairly well protected and as a result significant forces, as high as 2500 mm Hg, are needed to cause significant injury or rupture.¹ The most common

Figure 1 Computed tomography scan shows evidence of blunt aortic injury at the level of inferior mesenteric artery with dissection, small pseudoaneurysm, and stranding around the aorta (arrow).

mechanism of injury leading to abdominal aortic injury is motor vehicle collision.¹ The “seat belt aorta” is a well-known phenomenon that was first described by Garret and Brounstein in 1962 and later readdressed in detail by Randhawa and Menzoian.^{8,9} As such, 50% of abdominal aortic injuries have been attributed to seat belt-associated trauma.⁷

Figure 2 Aortogram reveals an infrarenal aortic dissection and pseudoaneurysm (arrow).

Figure 3 Completion aortogram after endograft deployment reveals exclusion of the blunt aortic injury. The endograft fabric, loosely attached to the metal stentgraft exoskeleton expands into the pseudoaneurysm cavity (arrow).

Circumferential disruption of the intima leads to intramural hematoma, which can occlude the aortic lumen.⁹ The injury is usually infrarenal because the suprarenal aorta is protected by the lower bony thorax.⁹ Most of the injuries (33%) occur at the level of the inferior mesenteric artery, 24% near the renal arteries, 19% between the inferior mesenteric artery and bifurcation, and the rest at other locations.¹⁰ Because most occur below the renal arteries some authors believe that they are caused by the displacement of the aorta against the vertebral bodies.¹ Others report acute stretch

Figure 4 Follow-up computed tomography angiography at 2 months shows the stentgraft in place across the area of aortic injury and a thrombosed pseudoaneurysm (arrow).

injury or differential deceleration of the abdominal aorta fixed at the lumbar arteries and vertebral column as being important.¹ Atheromatous plaques may potentiate this process by decreasing the force required to cause intimal injury.¹¹

Although many patients present without symptoms, those who are symptomatic may present with an acute abdomen, neurological deficits, and end organ and limb ischemia.¹² A published literature review of 11 blunt aortic injuries demonstrated that two-thirds of cases present in the early post-injury period and one-third present in a delayed fashion up to 1 year after injury.⁹ Diagnosis is usually made on computed tomography (CT), which has become the modality of choice for a comprehensive evaluation of patients after blunt trauma.¹⁰ The most common CT findings include presence of an intimal flap, thrombosis, or pseudoaneurysm.¹⁰ Free aortic rupture is rarely seen as mortality is almost immediate. Complications of abdominal aortic injuries are severe, and mortality with or without treatment can be as high as 37%.¹

Treatment includes surgical or endovascular repair. Non-operative management is usually not considered because it is associated with up to 75% mortality rate.¹³ However, operative planning can be difficult because 58% of BAAI are associated with other abdominal injuries.^{7,11} Small bowel disruption, large bowel disruption, and mesenteric tears occur at rates of 18, 16, and 10%, respectively.¹¹ Open surgical treatment using a prosthetic graft in a contaminated field is less than ideal due to risk of graft infection.⁷

Open operative treatment includes direct flap repair, thromboendarterectomy, and aortic replacement using a prosthetic graft.¹¹ Complications of open repair are high and mortality rate is reported to be 27%.¹² Endovascular treatment of abdominal aortic aneurysms was described in 1991,¹⁴ and has been routinely applied to the management of aneurysms and dissections.⁵ Its use is predicated to favorable arterial anatomy for both stentgraft delivery and deployment. In 1996, Marty-Ané et al, described the first endovascular repair of a traumatic infrarenal aortic dissection.¹⁵ Since then, there have been several other reported cases and series with good results supporting the use of endovascular techniques.^{2,3,7,12,16,17} Complications of endovascular repair include further aortic wall injury, access complications, and contrast-induced nephropathy,^{7,11} but it is associated with significantly less perioperative morbidity and mortality.^{18,19}

The patient described in this case met anatomical consideration for endovascular aortic repair because his iliac arteries were large enough to allow passage of the stentgraft delivery sheath. Furthermore, the aorta could accommodate delivery and seal of the stentgraft. Although we considered repairing his aorta with a prosthetic graft at the time of the initial laparotomy, the small bowel injury requiring resection cast concerns of potential graft infection. We therefore elected to close the patient, stabilize him in the intensive care unit, and then bring him back for endovascular repair. Delayed repair in this relatively stable patient was determined to be the best option to avoid the risk of graft contamination by bowel contents and potential graft infection. The subsequent endovascular procedure was performed

percutaneously and without complications. Follow-up imaging revealed the graft to be in excellent position.

Summary

BAAI is uncommon but can be fatal. Endovascular repair with commercially available endografts can safely and effectively treat BAAI and may be the preferred modality in the setting of concomitant bowel injury. The modern vascular surgeon has a wide armamentarium of techniques to treat vascular trauma. In our case, the potential risk of graft contamination led to the decision to not address the aortic injury using open surgical techniques despite the fact that the aortic injury was accessible through the open laparotomy. Instead a minimally invasive approach with decreased risk of graft infection was successfully employed in a delayed fashion.

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