The Blunt Abdominal Aortic Disruption experience in Hospital Kuala Lumpur: An aortic injury case report

Michael Arvind, DrGenSurg, Mohd Norhisham Azmi Abdul Rahman, MS, Hanif Hussein, MS

Vascular Surgery Unit, Department of General Surgery, Hospital Kuala Lumpur, Kuala Lumpur, Malaysia

SUMMARY

Blunt abdominal aortic disruption (BAAD) is an extremely rare and highly lethal diagnosis. It is rarely diagnosed in the adult population as mortality rates are extremely high. Most individuals with these injuries almost never make it to the hospital and those who do unfortunately are seldom diagnosed in time for any intervention. We present a case of a 44-year-old gentleman who presented with cardiopulmonary arrest requiring two cycles of cardiopulmonary resuscitation and successfully underwent an exploratory laparotomy which found a transected infrarenal aorta. He underwent open repair with a tube graft and was discharged home well after 2 weeks. The aim of this publication is to highlight the possibility of such a diagnosis which should be considered during first contact with the patient, along with the urgency in management, complexity involved with the intraoperative management without appropriate radiological investigation and post operative care.

INTRODUCTION

Blunt abdominal aortic injury (BAAI) or blunt abdominal aortic disruption is a rare injury with a literature review showing only case reports published over the last 10 years. Majority of patients do not make it to hospital, and those who do, almost one third of them do not survive the initial 24 hours.[1] Injury to the aorta is based on the direct and indirect mechanism, as the aorta is tethered to the spinal column, peritoneum and abdominal viscera. Due to these mechanisms, and according to the severity of the force, this can lead to aortic disruption. The level of the IMA (33%), renal arteries (24%) and between the IMA and aortic bifurcation (19%) are the most common sites for blunt aortic disruption.[2]

Majority of literature available with regards to this injury is from the paediatric age group, however the consensus is that there needs to be a high index of suspicion with prompt diagnosis and intervention for patient survival.[3] The aim of this report is to present the successful management of a middle age gentleman with a blunt abdominal aortic disruption along with a systematic literature review. The patient survived without any neuro-vascular related complications and remains well at 6 months follow up.

CASE PRESENTATION

A 44-year-old gentleman, with no medical illness, presented to the emergency department of a private hospital with severe abdominal pain and hypotension. Prior to presentation to hospital, he claimed to have gone to two local theme parks and went on their rides the day before, which involved a pendulum ride. He denied any other history of trauma preceding his admission. On presentation to the emergency department at a private hospital his GCS was full, and however due to severe abdominal pain he was planned for a contrast enhanced computed tomography (CT) abdomen and pelvis. However, while on the CT gantry he developed hypotension owing to which the procedure was abandoned, with only a plain CT being done (Figure 1). He was immediately transferred to the emergency department at Hospital Kuala Lumpur. On arrival to our centre, he was hypotensive with a blood pressure (BP) of 86/40, requiring high flow mask to maintain his oxygenation. In the emergency department his abdominal pain worsened, and due to respiratory distress was intubated for airway protection. Immediately following this, he had an episode of asystole, requiring CPR and initiation of inotropes. Bedside FAST scan showed generalised free fluid. His baseline haemoglobin was 4.1 g/dL with platelets of 71 × 10^9/L. Renal profile, liver function and coagulation profile were unremarkable. After discussion with the surgical team and family members, consent was obtained to proceed with an exploratory laparotomy. His BP crashed following induction, requiring another 5 mins of CPR and initiation of triple inotropes.

With a BP of 52/25, we proceeded with an exploratory laparotomy which showed a large hematoma over the left retroperitoneal region which subsequently ruptured during manipulation and required four quadrant abdominal packing. The massive transfusion protocol was initiated by the anaesthesia team along with the use of Level 1 rapid infuser, a device used for rapid infusion of fluids at a temperature close to 37°C. Intraoperatively it was noted that there was arterial bleeding from the left flank. A cross clamp was applied on the infrarenal aorta, and the aorta was skeletonised, which showed > 50% circumference of the aorta was transected between the IMA and the aortic bifurcation (Figure 2). He underwent an interposition Dacron tube graft placement (Figure 3) with successful return of bilateral femoral pulses and inotropes was tapered to low dose single inotropes. There was no laceration, rupture or perforation to the mesentery or bowel and his solid organs showed no evidence of blunt trauma. This further justifies that the mechanism of injury to the aorta was from blunt injury shearing stress due to the acceleration and deceleration

This article was accepted: 19 July 2024
Corresponding Author: Michael Arvind
Email: michaelarvind@gmail.com

Table I: Mechanism of abdominal aortic injury

Mechanism of injury	Examples	Pathophysiology
Direct impact	Seat belt compression, motorcycle handlebars, blunt weapons, steering wheel in MVA	Compression of aorta against the vertebrae
Shearing stress	MVA, acceleration – deceleration injury,	Intimal Injury, Dissection or Laceration
Increased intraluminal pressure (rare)	Blunt force against abdominal wall	1000 mmHg luminal pressure

Table II: Classification of traumatic aortic injury

Grade I	Intimal tear
Grade II	Intramural hematoma
Grade III	Pseudoaneurysm
Grade IV	Rupture

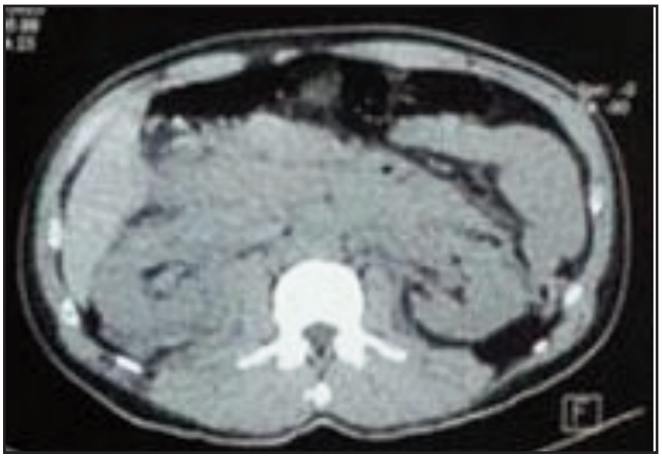


Fig. 1: Plain axial CT scan with presence of hematoma in retroperitoneum.



Fig. 2: Infrarenal abdominal aorta with transection (arrow).



Fig. 3: Post Interposition Dacron tube graft placement at transacted site.

nature of the pendulum ride. His EBL was 10 litres, requiring three DIVC cycles and 14 pints packed cell transfusion. He was monitored in the intensive care unit after surgery.

Post operatively he was extubated on day 4, but on day 8 he complained of abdominal pain, fever and diarrhoea. Due to the high risk of ischemic bowel, he underwent a relaparotomy, which showed that his bowel was viable, but had residual hematoma approximately 2 litres. The abdomen was irrigated with copious amounts of saline and closed. He was successfully extubated immediately post op, and on day 12 was tolerating normal diet, passing motion and had no renal impairment. He was discharged home day 14 after abdominal sutures was removed. On follow up 2 weeks after discharge he was doing well, with no further complications.

DISCUSSION

BAAD is a major cause of mortality after blunt trauma and is rarely diagnosed as most patients do not survive till diagnosis or intervention. The individuals who survive till presentation in hospital require rapid and urgent diagnosis which is crucial for prompt treatment.

In an analysis of the National Trauma Databank in 2009, the authors demonstrated over a 5-year period the incidence of blunt aortic injury was 0.3%. From this, 23% of the patients died on arrival or during triage.[4] Unsurprisingly the majority of patients, 72%, were males with a mean age of 41 (± 20) years.[4] This should be remembered when dealing with relatively young, fit patients, who present, as our patient did, in severe shock and hemodynamic instability after trivial preceding activities.

Teixeira et al. based on autopsy reports, reported that the sites affected in blunt aortic injury were the isthmus/descending thoracic aorta (66%), arch (11%), ascending (3%), root (2%) and multiple (18%).[5] Abdominal aorta injury is rare due to the retroperitoneal position which is covered anteriorly by the abdominal wall and visceral organs and posteriorly and laterally by the vertebrae and paravertebral muscles.[6] When injury of the abdominal aorta is present in blunt trauma, the mechanism of injury is mainly due to direct impact, shearing stress or increased intraluminal pressure (Table I).[7] As seen in our patient, the nature of injury to the aorta could possibly be due to the shearing stress he sustained while on the theme park pendulum rides, leading to only injury to the aorta and not the other intraperitoneal organs.

Traumatic aortic injury is classified into four grades based on the nature of injury[8] and is tabulated below in Table II.

The importance of having a universal classification for aortic injury is that it allows for diagnosis, uniformed management, and dictates the urgency for intervention. Stable grade I and II aortic injuries can undergo conservative management and allow for appropriate imaging. However, grade III and IV may require emergent intervention.

Computed tomography angiography (CTA) is commonly used as a screening tool due to the availability in most hospitals and the high sensitivity (95%) and high negative predictive value (99%). However, CTA can have a low specificity (40%).[8] Patients with an equivocal CTA often require additional imaging such as IVUS, aortography or transoesophageal echocardiography. IVUS provides real time circumferential images of the vessel, does not require contrast or radiation and can be performed from the same femoral puncture for angiography. The downside currently with IVUS is the high cost, limited availability and increased operating time.

If a CTA was successfully performed in this patient, it would have been able to identify the aortic injury and also determine the grade of the injury. This would have permitted a focussed approach in the management, meaning immediate control intraoperatively of the infrarenal aorta thus preventing further haemorrhage. Additionally, taking into account the hemodynamic instability of the patient, with a CTA of the aorta, the option for endovascular aortic repair (EVAR) would have been a viable and potentially less morbid approach in the management for this patient. In established endovascular centres equipped with hybrid operating theatres or angiography suites and with availability of stent grafts of the shelf, this procedure can be done via a minimally invasive approach. Unfortunately, due to financial constraints and limited infrastructure, this option currently is limited to elective or semi elective cases in our centre.

In patients who undergo surgery for BAAI, the common complications seen in this group of patients are acute kidney injury (AKI), ARDS, deep vein thrombosis, pulmonary embolism, pneumonia or ventilator associated pneumonia and mortality in up to 28% of patients.[9] Our patient developed AKI which resolved with hydration and did not require dialysis. The prognosis for patients who develop such injuries is very much dependent on the rapid diagnosis and intervention. However, one must be familiar with the dissection of the aorta if there is no vascular surgeon around. Although the incidence of such cases is rare, the morbidity and mortality of undiagnosed cases particularly grade III to IV is exponentially high. The limitation encountered by the authors in this case was the inadequate preoperative imaging, a plain CT abdomen, due to the hemodynamic instability which prevented the patient from having adequate imaging done. In a more stable patient, a complete contrast enhanced CT scan would have allowed the involved surgeons and anaesthesia team to anticipate the severity and take proactive measures prior to the patient undergoing surgery.

CONCLUSION

The aim of this report is to highlight the possibility of blunt abdominal aortic disruption in trivial injuries, without involvement of other intraabdominal organ injury. The case presented here underwent intervention based on the clinical presentation and diagnosis. However, although sparse, literature shows there is an established classification and recommended intervention for such cases. The authors acknowledge that the availability of vascular trained surgeons played a role in the positive outcome for this patient, however prompt diagnosis and referral to a vascular centre may also provide similar outcomes.

REFERENCES

1. Yau PO, Lewis E, Shah A, Stone Jr. ME, McNelis J. Blunt traumatic aortic injury in the elderly population. J Vasc Surg 2022; 77(1): P47-55.E1.
2. Shalhub S, Starnes BW, Tran NT, Hatsukami TS, Lundgren RS, Davis CW, et al. Blunt abdominal aortic injury. J Vasc Surg 2012; 55(5): 1277–85.
3. Anton-Martin P, Willis BC, Nigro JJ, Budolfson K, Raz D, Jamshidi R. Complete traumatic aortic transection. J Pediatr Surg Case Rep, 2018; 38: 4–8.
4. Arthurs ZM, Starnes BW, Sohn VY, Singh N, Martin MJ, Andersen CA. Functional and survival outcomes in traumatic blunt thoracic aortic injuries: an analysis of the National Trauma Databank. J Vasc Surg, 2009; 49(4): 988–94.

5. Teixeira PGR, Inaba K, Barmparas G, Georgiou C, Toms C, Noguchi TT, et al. Blunt thoracic aortic injuries: an autopsy study. J Trauma 2011; 70(1): 197–202.
6. Prado E, Chamorro EM, Marín A, Fuentes CG, Zhou ZC. CT features of blunt abdominal aortic injury: an infrequent but life-threatening event. Emerg Radiol 2022; 29(1): 187–95.
7. Baghdanian AH, Armetta AS, Baghdanian AA, LeBedis CA, Anderson SW, Soto JA. CT of major vascular injury in blunt abdominopelvic trauma. Radiograph 2016; 36(3): 872–90.
8. Azizzadeh A, Valdes J, Miller III CC, Nguyen LL, Estrera AL, Charlton-Ouw C, et al. The utility of intravascular ultrasound compared to angiography in the diagnosis of blunt traumatic aortic injury. J Vasc Surg 2011; 53(3): 608–14.
9. Sheehan BM, Grigorian A, de Virgilio C, Lekawa M, Schubl SD, Nahmias J, et al. Predictors of blunt abdominal aortic injury in trauma patients and mortality analysis. J Vascul Surg 2020; 71(6): 1858–66.