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Case Report

Grade four blunt traumatic aortic injury with massive haemothorax: Resuscitation considerations during the primary survey

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ABSTRACT

Advanced Trauma Life Support principles prioritise the management of 'breathing' over 'circulation' in an acute trauma primary survey. In a tamponaded thoracic aortic rupture, however, this may lead to fatal haemorrhagic shock. In this case, we discuss the resuscitation and management of a patient with a massive left sided haemothorax secondary to a grade four blunt traumatic aortic injury. A 26-year-old male was involved in a high-speed motor vehicle crash and was hypoxic and hypotensive at the scene. His oxygenation and haemodynamics improved with supplemental oxygen and fluid resuscitation. He had a left intercostal catheter inserted after an urgent thoracic endovascular aortic repair was performed to prevent disruption of the contained haemothorax in the presence of a grade four thoracic aortic injury. It is vital to recognise the potential disruption of a tamponaded blunt traumatic aortic injury during consideration of thoracostomy and chest drain decompression.

Advanced Trauma Life Support (ATLS) principles prioritise the management of 'breathing' over 'circulation' in an acute trauma primary survey [1]. During 'breathing' resuscitation, a life threatening injury such as a massive haemothorax is managed by thoracostomy with intercostal catheter (ICC) insertion. This, however, may be problematic in the presence of an underlying aortic injury, where the principle of permissive hypotension and maintenance of the tamponade is required. Here we present a case of a massive left haemothorax secondary to an underlying grade four aortic injury and discuss the intricacies of its management.

Case

A 26-year-old male was intoxicated when he drove a car at high speed into a tree on a rural property. He was unrestrained with no airbags deployed. When paramedics arrived at the scene the patient had self-extricated and was maintaining his own airway with a Glasgow Coma Scale of 15. He was hypoxic at 85% oxygen saturation and hypotensive at 75/40 mmHg. He was brought to the nearest peripheral hospital and resuscitated with supplemental oxygen via Hudson mask, tranexamic acid and activation of massive transfusion protocol prior to being transferred to a tertiary hospital trauma centre. Upon arrival, his haemodynamics had improved with resuscitation to the point where he could proceed to a computed tomography (CT) pan scan which revealed significant chest trauma including a grade four thoracic aortic injury with circumferential adventitial irregularity and disruption, aortic dilatation and significant intraluminal thrombus (see Fig. 1), and associated massive left haemothorax (see Fig. 2). Concomitant chest injuries

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Fig. 1. Reconstructed CT angiogram of aortic arch demonstrating grade 4 aortic injury with associated intraluminal thrombus.

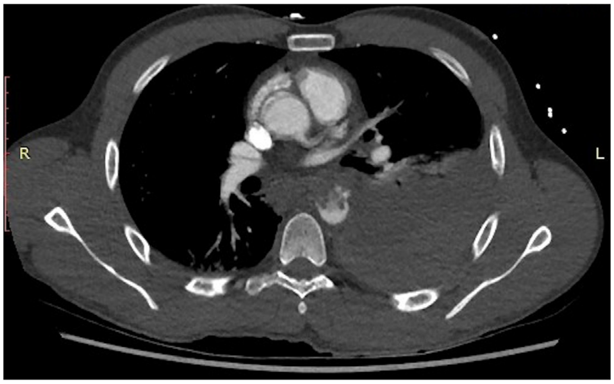

Fig. 2. Grade 4 aortic injury with associated massive left haemothorax.

included a minor right sided pneumothorax, minimally displaced left fourth to seventh rib fractures and right fourth to ninth rib fractures. He also sustained major intra-abdominal injuries including American Association for the Surgery of Trauma grade four liver and pancreatic injuries, grade two splenic injury, right adrenal haemorrhage, as well as infarction of both kidneys and multiple limb lacerations.

On repeat primary survey, the patient was still maintaining his own airway, tachypnoeic at 32 breaths per minute however saturating adequately at 100%, with blood pressure of 129/73 mmHg and heart rate 115 beats per minute. After consultation between the trauma, emergency and vascular surgical teams, decision was made to proceed to an urgent thoracic endovascular aortic repair (TEVAR) prior to ICC insertion for fear of disturbing the contained haemothorax in the presence of a grade four thoracic aortic injury (see Fig. 3). Due to anaesthetic concerns for positive pressure ventilation in the setting of a pneumothorax, the TEVAR was performed under local anaesthesia with light sedation and was well tolerated by the patient. A 24x80mm covered stent graft (Zenith TX2, Cook Medical, Limerick, Ireland) was placed with good coverage to the rupture site while preserving flow to the left subclavian artery (see Fig. 4). The distally located intraluminal thrombus was, however, unable to be covered due to the unavailability of a more appropriately sized stent. During the case, the thrombus dislodged and embolised to the left common and external iliac arteries. This was successfully suctioned out with subsequent return of good distal perfusion and no evidence of distal embolisation. The patient was not stable enough to undergo open or suction embolectomy of the bilateral renal emboli, as such procedure would have involved systemic heparinisation posing an unacceptable risk of further haemorrhage in the setting of multi-organ injury. Following the TEVAR, a left ICC was placed with an immediate estimated blood loss of 2.2 l. He was transferred to the intensive care unit requiring

Fig. 3. Intra-operative angiogram of grade 4 aortic injury with no active extravasation, procedure performed prior to drainage of haemothorax.

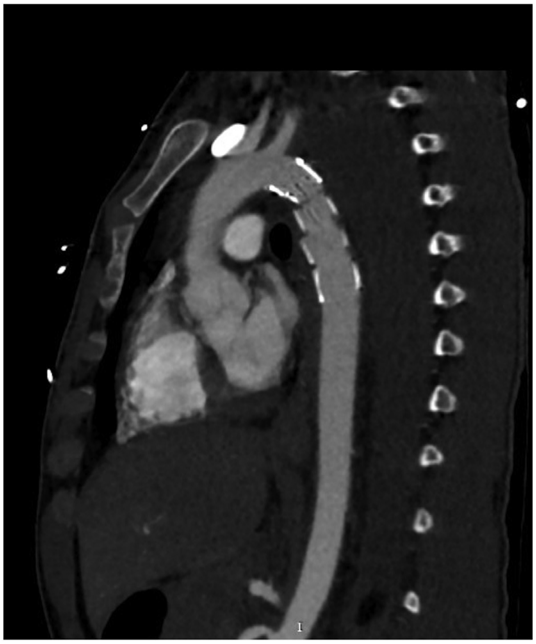

Fig. 4. Post-operative angiogram showing exclusion of aortic injury, preservation of left subclavian artery and no residual thrombus.

a short duration of inotropic support however remained haemodynamically stable. In the following days he received a pancreas neck resection after an MRI had confirmed a disruption of the pancreatic duct. Histology confirmed acute necrosis and continuity was restored by a Roux-Y reconstruction.

Discussion

The internationally practiced ATLS primary survey algorithm states that after establishment of a secure airway the patient's breathing must be optimized. Concurrent diagnosis and resuscitation of conditions causing threat to breathing or ventilation, such as tension or open pneumothorax or massive haemothorax, must be performed with immediate measures via chest decompression. Similarly, in the category of ‘circulatory’ problems, a massive haemothorax, cardiac tamponade or traumatic circulatory arrest causing haemodynamic instability and shock must be addressed prior to assessing disability and exposure.

In this scenario, the resuscitation priority of a patient with a massive left haemothorax secondary to an aortic injury involves carefully balancing breathing and ventilation optimization, without disruption of the tamponaded aortic injury that would otherwise significantly compromise haemodynamics. Should a haemothorax require drainage to improve ventilation, the treating centre should consider the availability of vascular surgeons to perform an urgent endovascular aortic repair.

Aortic injuries are associated with mechanisms involving penetrating and blunt trauma. Blunt traumatic aortic injuries (BTAI) of the thoracic aorta account for the second greatest cause of traumatic deaths with a significant impact to function amongst survivors [2–4]. Injuries occur mainly due to rapid deceleration with high-energy impact to the thorax, often involving motor vehicle and aircraft collisions, assaults, crush injuries and falls from significant heights [2,3]. Patients at greater risk of BTAI in vehicle collisions are those aged 60 years or older, unrestrained, or occupants of front seats [5,6]. Collisions to the front or near-side of the vehicle causing greater than 15 cm intrusion or crushing of the vehicle, or rapid deceleration of greater than 40 km per hour also pose higher risk of BTAI [5,6]. Recognising a BTAI may be challenging on initial evaluation due to co-existing injuries and a lack of history in a patient with a reduced GCS, it is therefore important to maintain a heightened clinical suspicion when these mechanisms and risk factors are involved.

Upon initial assessment of a patient with chest trauma, symptoms of chest or mid-scapular back pain, physical findings such as haemodynamic instability or external evidence of chest trauma, and plain chest supine radiographical features of mediastinal haematoma or presence of other chest injuries all raise suspicion of a BTAI. Further imaging investigation with chest CT angiography (CTA) is the modality of choice due to its availability, high sensitivity and specificity of detecting a BTAI, and ability to detect concomitant chest injuries. Other diagnostic modalities include digital subtraction angiography and trans-oesophageal echocardiography, however these are less readily available and operator skill-dependent respectively.

The Society for Vascular Surgery's BTAI classification system based on CTA findings defines injuries and their management as summarised in Table 1 [7]. It is worthy to note that grade four BTAI injuries may not necessarily present with active or free contrast extravasation on CTA, as the ruptured injury may be temporarily tamponaded by the adjacent haemothorax and subsequently not be exsanguinating. This is a commonly seen scenario in ruptured abdominal aortic aneurysms tamponaded by a retroperitoneal haematoma.

The initial evaluation of a patient with blunt chest trauma must involve a raised index of suspicion of BTAI and therefore judicious consideration of the sequence of further management. Failure to recognise a temporarily tamponaded grade four thoracic BTAI may lead to catastrophic consequences if thoracostomy or chest drain insertion are performed prior to definitive repair.

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Credit author statement

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Andrew Holmes: Conceptualisation, Writing – reviewing and editing

Table 1
BTAI classification based on CTA findings and management guidelines [7].

Grade	Description	Management[a]
Grade I: intimal tear	Intimal defect and/or thrombus less than 10 mm, without external aortic contour abnormality	• Observation • Interval follow-up CTA within 30 days
Grade II: large intimal flap	Intimal defect and/or thrombus equal or greater than 10 mm, without external aortic contour abnormality	• Observation • Interval follow-up CTA within 7 days • If evidence of progression, consider endovascular repair
Grade III: pseudoaneurysm	Presence of external aortic contour abnormality with contained rupture	• If hypotensive with aortic arch haematoma > 15 mm: urgent endovascular repair
Grade IV: rupture	Presence of external aortic contour abnormality with free contrast extravasation or haemothorax	• If stable and highly likely to survive from other injuries: endovascular repair within 1 week • Consider earlier endovascular repair if presence of traumatic brain injury requiring higher target mean arterial pressure • Follow-up CTA at 1 month, 6 months, 1 year, then every second year thereafter

[a] Beta-blocker and anti-platelet therapy should be administered for all blunt aortic injuries.

Gert Frahm-Jensen: Conceptualisation, Writing – reviewing and editing, Supervision.

Declaration of competing interest

None.

References

[1] American College of Surgeons, Advanced Trauma Life Support: Student Course Manual, Tenth edition, American College of Surgeons, Chicago (IL), 2018.
[2] X.N. Ho, I.J.Y. Wee, N. Syn, M. Harrison, L. Wilson, A.M. Choong, The endovascular repair of blunt traumatic thoracic aortic injury in Asia: a systematic review and meta-analysis, Vascular 27 (2) (2019) 213–223.
[3] D.G. Neschis, T.M. Scalea, W.R. Flinn, B.P. Griffith, Blunt aortic injury, N. Engl. J. Med. 359 (16) (2008) 1708–1716.
[4] Z.M. Arthus, B.W. Starnes, V.Y. Sohn, N. Singh, M.J. Martin, C.A. Andersen, Functional and survival outcomes in traumatic blunt thoracic aortic injuries: an analysis of the National Trauma Databank, J. Vasc. Surg. 49 (4) (2009) 988–994.
[5] G. McGwin Jr., D.A. Reiff, S.G. Moran, L.W. Rue 3rd, Incidence and characteristics of motor vehicle collision-related blunt thoracic aortic injury according to age, J. Trauma 52 (5) (2002) 859–865.
[6] M. Fitzharris, M. Franklyn, R. Frampton, K. Yang, A. Morris, B. Fildes, Thoracic aortic injury in motor vehicle crashes: the effect of impact direction, side of body struck, and seat belt use, J. Trauma 57 (3) (2004) 582–590.
[7] B.W. Starnes, R.S. Lundgren, M. Gunn, et al., A new classification scheme for treating blunt aortic injury, J. Vasc. Surg. 55 (1) (2012) 47–54.