SMTU: Traumatic Aortic Transection Management Clinical Guideline

Scope

Site	Department, division, or operational area	Applicable to
Royal Perth Hospital (RPH)	State Major Trauma Service (SMTU), Emergency Department (ED)	Medical, Nursing

Definitive treatment of traumatic aortic ruptures is ordinarily managed by endovascular means, in coordination with the Vascular Surgeons. Open surgeries may also require input from the Cardiothoracic Surgeons.
Note that Cardiothoracic Services at RPH are provided as an outreach by the team based at Fiona Stanley Hospital (FSH). This service is available 24/7 via the FSH switchboard.

Definition

Blunt traumatic aortic injury (BTAI)	Complete transection, or small or partial thickness tears of the aorta with pseudoaneurysm formation, as a result of blunt trauma mechanism (a combination of shear and stretch forces, rapid deceleration, increased intravascular pressure and compression of the aorta between the anterior chest wall and vertebrae)[1]

Rationale

Blunt trauma to the thoracic aorta is rare but has been implicated as the second most common cause of trauma deaths after intracranial haemorrhage. Blunt trauma to the thoracic aorta accounts for <1% of adult admissions to a Level 1 trauma centre and often occurs due to high impact or a high velocity motor vehicle crash, falls from heights, or compression between the sternum and the spine. A combination of sudden deceleration and shearing at the relatively immobile aortic isthmus is the most common reason for these injuries, although any portion of the aorta is at risk.

Most of these patients (up to 80%) die at the scene from complete aortic transection[5]. Patients who survive to hospital usually have small or partial thickness tears of the aorta, with pseudoaneurysm formation. These patients often present with multiple associated injuries, including cardiac injury, rib fractures, haemothoraces, and intra-abdominal injuries. Out of these greater than 50% die within 24 hours. It is imperative that these injuries are recognised early on, and strategies, procedures and protocols are put in place for holistic and multidisciplinary management of these critically ill patients.[2]

Management

Diagnosis

Suspicion and concerns about aortic transection should be highlighted in the ED Resuscitation Bay based on:

- Mechanism of injury
- Clinical examination which may not reveal any obvious findings, but, uncommonly, difference in blood pressures (BPs) in both arms (pseudo-coarctation)
    - Chest X-ray (ideally erect posteroanterior (PA) if clinically appropriate and once the spine has been cleared), (low sensitivity) widened or abnormal mediastinum (a mediastinal width greater than 8cm at the level of the arch is considered abnormal; a clear aortic knob outline has a 72% sensitivity, 47% specificity and 87% negative predictive value).
    - Tracheal deviation to the right
    - Oesophageal or nasogastric (NG) tube deviation to the right
    - Left apical or pleural cap
    - Disruption of the calcium ring in the aortic knob (broken-halo sign)
    - Left main-stem bronchus depression
    - Widened right paravertebral stripe
    - Left haemothorax (arterial)
- CT Angiogram of the chest is the standard for the diagnosis (or exclusion) of this injury.

Initial management

If the aorta is injured, but is not the source of active haemorrhage, it should be low on the list of management priorities – in the absence of active haemorrhage, it is not usually the cause of shock.

Initial management is based on:

- Rapid identification and control of ongoing haemorrhage from other potential injury sites, avoiding over-resuscitation (i.e. excessive volume)
- Controlling BP and maintaining a systolic BP of equal to or less than 100mmHg. Beware of head injury as lowering the BP may be hazardous for Cerebral Perfusion Pressure (in consultation with Neurosurgery). This can be extremely hazardous if the patient doesn't have an aortic injury (e.g. haemorrhagic shock, or a major head injury), and **should only be instituted after definitive demonstration of the injury.**
- Maintaining pulse rate equal to or less than 100 BPM[2]
- Use of intravenous (IV) beta blockers (Metoprolol in small doses – titrated to the target systolic BP equal to or less than 100mmHg). Depending on the grade of the injury, this intervention serves as either a definitive or a temporizing measure[2]
- Analgesia
- Correction of Coagulation abnormalities
- Insertion of arterial line in the right radial artery. **not** in left arm or femoral arteries due to potential access requirement (stent) and the issue of inaccurate blood pressure readings on that side due to the injury. Also, IVC contrast administration through the left arm usually degrades the information about the subclavian artery adjacent to the vein (full of contrast)

Initial management cont'd

- Other sources of blood loss should be ruled out as pulse may not be a good indicator after beta blocking.

Investigations[2]

- The initial imaging modality is a chest x-ray (CXR). Suggestive radiographic findings include a widened/abnormal mediastinum (may be seen in up to 93% of patients with traumatic aortic injuries), left pleural effusion, first and second rib fractures, tracheal deviation, a depressed left bronchus, an indistinct aortic knob, or apical capping. With reported sensitivities as low as 41% (particularly with supine CXR[4]), CXR is better used to assess for other life-threatening injuries, such as tension pneumothorax and a large haemothorax requiring immediate drainage[5], whilst clinical suspicion based on mechanism, or signs, should lead to a low threshold for performing a computed tomography (CT) scan
- CT scan of mediastinum, and abdominal/pelvic scan to look for other injuries, as well as the caliber of femoral arteries for further intervention. As CT technology has developed it has established itself as the best screening modality for aortic injury. The sensitivity of modern CT scanners is reported at 97-100%, with a negative predictive value of 100% and specificity of 83-99%
- Computed tomographic angiography (CTA): imaging modality of choice with reported sensitivities of 95-100%, with negative predictive values ranging from 99-100%.
- Transoesophageal echocardiography (TOE): (sensitivity of 63% and specificity of 84%[4]) an option for unstable patients unable to be transported to radiology for CTA.[1]
- Focused abdominal sonography in trauma (FAST): Low sensitivity/specificity and representative of late signs, with demonstration of free rupture of the aorta leading to left haemothorax and pericardial effusion leading to tamponade.[1]

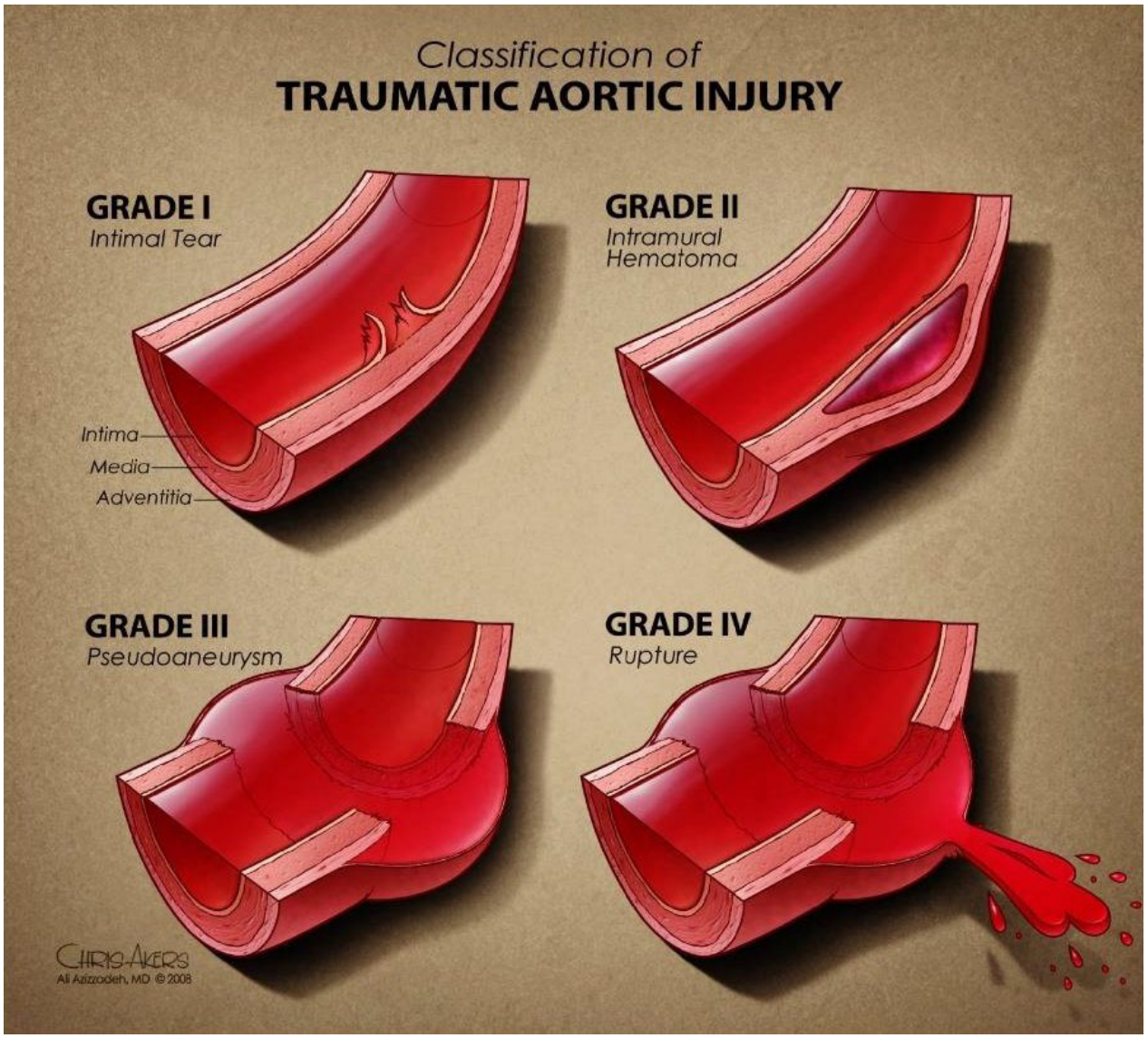
Monitoring and observation

- Ideally, confirmation of aortic transection (or otherwise) should be made by a senior radiologist before the patient's final disposition from Radiology
- If this is not immediately possible, then the patient should be haemodynamically monitored according to pre-set parameters, until formal confirmation
- Patient's disposition should be either ED resuscitation, SMTU High Acuity or Intensive Care Unit (ICU)
- All other surgical procedures should be delayed until diagnosis of aortic transection has been ruled out
- Patient should always be accompanied by senior doctors of the Trauma and Emergency Team
- If aortic transection is confirmed, Vascular, Cardio-thoracic, Anaesthesia and ICU teams should be consulted
- Patient should be transferred to ICU if the BP and pulse are difficult to manage, or if there is a delay to definitive management of their injury (interventional, surgical, or conservative).

Physiological staging of blunt traumatic aortic injury [2]

BTAI represents a spectrum of lesions that is based on the anatomical layers involved:

- Intimal tear (grade I)
- Intramural hematoma (grade II)
- Pseudoaneurysm (grade III), and
- Rupture (grade IV)



Azizzadeh A, et al.[3]

Definitive management

Understanding the pathophysiology facilitates diagnosis, staging, and treatment of aortic injuries.

- Thoracic endovascular aortic repair (TEVAR) - endovascular stenting by vascular team; may be delayed if clinically appropriate for optimal outcome [6]
- Open thoracotomy and aortic grafting (in patients with haemodynamic instability; large volume haemorrhage from chest tubes; contrast extravasation on CT or rapidly expanding mediastinal haematoma; penetrating aortic injury)

Definitive management cont'd

- Anti-platelet therapy (check with Vascular Team) to be considered in the context of other injuries
- Patients should remain on beta-blockers for a minimum of six months and should have outpatient follow up by Vascular Surgery.

Facilitator

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Legislative requirements, the evidence, and the standard

For information relating to the legislative requirements and standards that RPBG policy documents must adhere to, and regarding the logos and levels of evidence used within RPBG policy documents, refer to Legislative Requirements, the Evidence and the Standard (live link) on the Policy Hub.

Related national standards

ACSQHC NSQHS Standards 2nd Edition (2021):
Standard 4: Medication Safety
Standard 8: Recognising and Responding to Acute Deterioration

References

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