

THORACIC AND ABDOMINOPELVIC VASCULAR INJURIES IN TRAUMA

An Overview of Anatomy, Classification and Management

JACQUES VAN HEERDEN, MD, COLBEY TAYLOR, MD, SAVVAS
NICOLAOU, MD, NICOLAS MURRAY, MD

EMERGENCY AND TRAUMA RADIOLOGY
VANCOUVER GENERAL HOSPITAL, UNIVERSITY OF BRITISH COLUMBIA



LEARNING OBJECTIVES

- 1) To explore clinically relevant anatomy involved in thoracic and abdominopelvic vascular injuries in trauma
- 2) To identify the typical radiologic manifestations and classification of thoracic and abdominopelvic vascular injuries in trauma
- 3) To recognize the importance of imaging protocol parameters in detection of vascular injuries
- 4) To discuss various management options, namely surgical versus interventional radiologic approaches



DISCLOSURE OF CONFLICT OF INTEREST

Authors do not have a relationship with a for-profit and/or a not-for-profit organization to disclose

CLASSIFICATION OF VESSEL INJURY

Based on Society for Vascular Surgery (SVS) Guidelines

Grade I: Intimal tear

Separation of intima from adjacent media

Grade II: Intramural hematoma / Large Intimal Flap

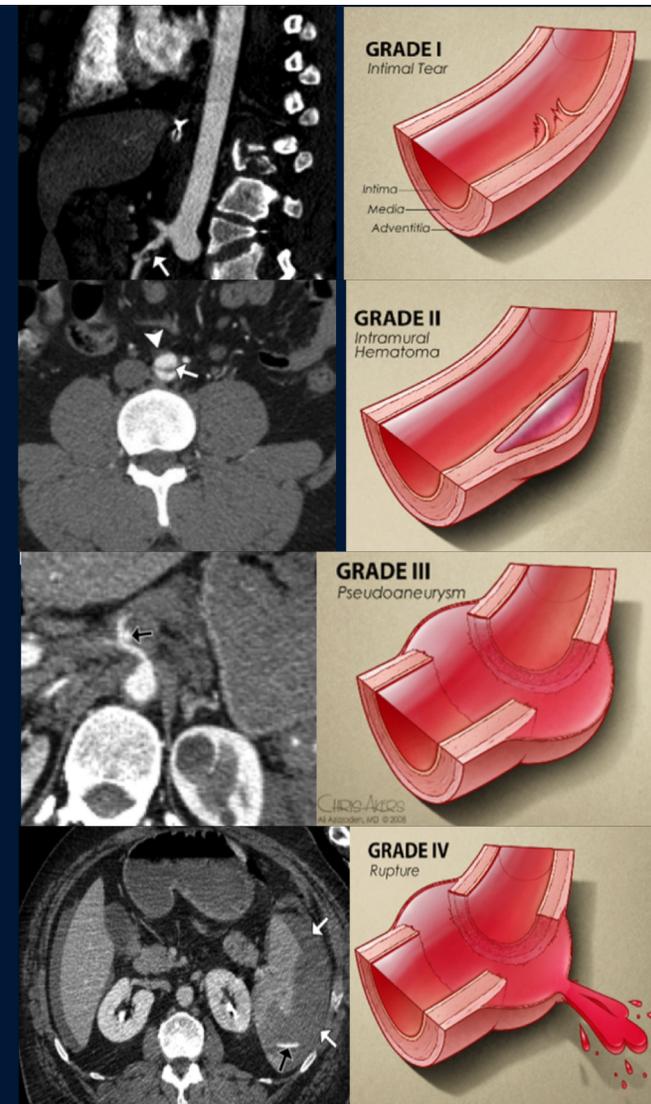
Blood collects between vessel wall layers

Grade III: Pseudoaneurysm

Injury to intima and media resulting in flowing blood contained by adventitia

Grade IV: Rupture

Injury to all layers of a vessel wall resulting in extravasation of blood



Classification of traumatic aortic injury (J Vasc Surg 2011;53:187-92.)

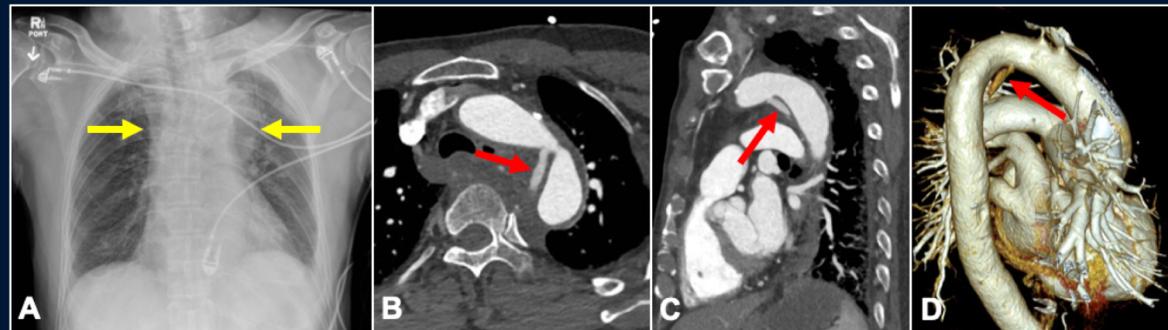
INJURY MECHANISMS

Thoracic Aorta

- **Rapid deceleration:** Shifting of structures results in shear stress on tethered portions
- **Osseous pinch:** Compression of aorta between structures
- **Hydrostatic forces:** Tears at aortic root and isthmus caused by sudden rise in intrathoracic pressure

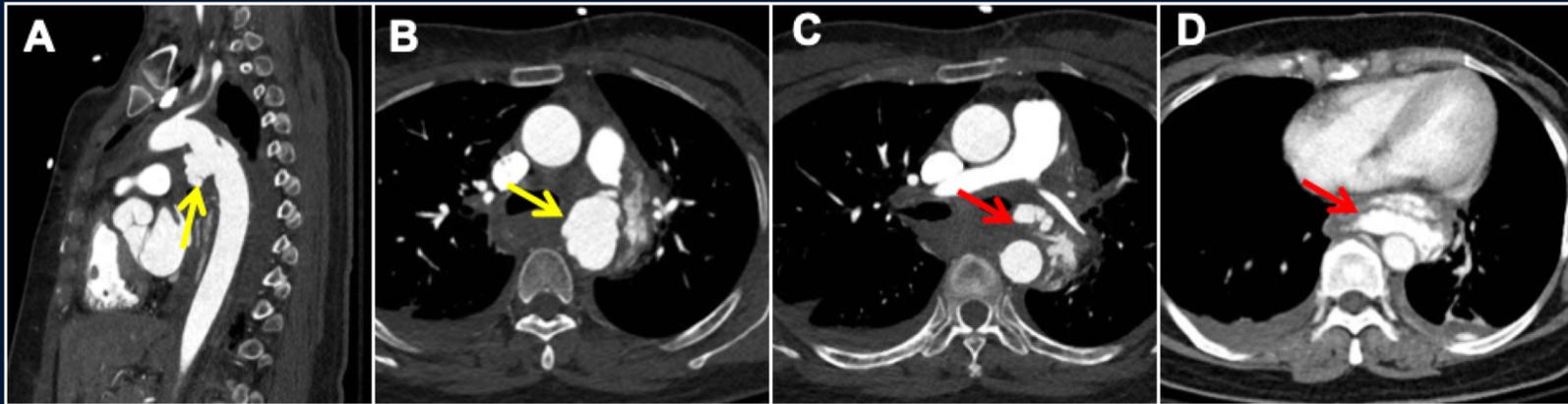


A) Mediastinal widening is demonstrated on radiograph (**arrows**). B) and C) CTA showing aortic injury involving the undersurface of the transverse aorta, with opacification along the ligament arteriosum, also nicely demonstrated on the 3D volume rendering image (**arrows**).



Abdominal Aorta

- **Crush injury:** Compression of internal organs may occur between abdominal wall, posterior thoracic cage and spine
- **Shear injury:** Rapid deceleration causes force vectors in areas where vessels are fixed (tears, dissection, laceration)
- **Burst injury:** Sudden rise in intraluminal pressure of hollow viscus organs



A) to D) A large pseudoaneurysm of the transverse aorta is seen (**arrows**) in addition to a large area of active contrast extravasation within the mediastinum (**arrows**), in keeping with a grade 4 (severe) aortic injury.

MANAGEMENT

MINIMAL	MODERATE	SEVERE
<ul style="list-style-type: none"> No external contour abnormality Intimal tear and/or thrombus <10mm 	<ul style="list-style-type: none"> External contour abnormality or intimal tear >10mm 	<ul style="list-style-type: none"> Active extravasation Left subclavian artery hematoma >15mm
<p>NO INTERVENTION</p> <ul style="list-style-type: none"> Optional follow-up imaging 	<p>SEMI-ELECTIVE REPAIR</p> <ul style="list-style-type: none"> Stabilization of concomitant injuries Impulse control 	<p>IMMEDIATE REPAIR</p> <ul style="list-style-type: none"> BAI takes first priority

TRAUMA PROTOCOL AT VANCOUVER GENERAL HOSPITAL

CT RIPIT (Rapid Imaging Protocol In Trauma)

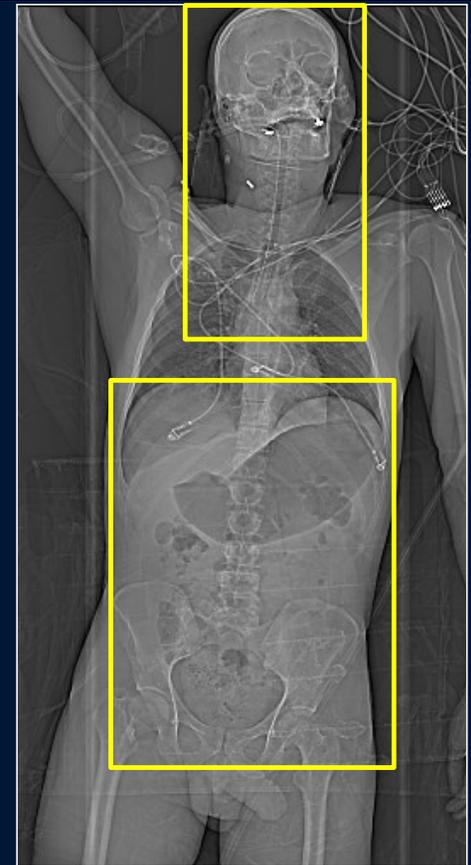
- CT Head, CTA Arch-to-vertex + C-Spine MPR
- CTA Chest, abdomen and pelvis
- CT Abdomen and pelvis venous phase 70 sec + L-Spine MPR
- CT Abdomen and pelvis delayed phase (5-10 min) if suspected vascular or ureteral injury

Blunt Abdominopelvic Trauma

- CT abdomen and pelvis from dome of diaphragm to greater trochanters in portal venous phase – 70 second delay following contrast injection
- CTA with 23 second delay added if vascular injury or fracture suspected

Blunt Chest Trauma

- CTA from thoracic inlet to level of SMA – 30 second delay following contrast injection
- Allows for visualization of upper abdominal arteries, liver and spleen



REFERENCES

1. Baghdanian, Arthur H. et al. "CT Of Major Vascular Injury In Blunt Abdominopelvic Trauma". *Radiographics*, vol 36, no. 3, 2016, pp. 872-890. *Radiological Society Of North America (RSNA)*, doi:10.1148/rg.2016150160. Accessed 25 Mar 2019.
2. Heneghan, Rachel E. et al. "Call For A New Classification System And Treatment Strategy In Blunt Aortic Injury". *Journal Of Vascular Surgery*, vol 64, no. 1, 2016, pp. 171-176. *Elsevier BV*, doi:10.1016/j.jvs.2016.02.047. Accessed 25 Mar 2019 
3. Lee, W. Anthony et al. "Endovascular Repair Of Traumatic Thoracic Aortic Injury: Clinical Practice Guidelines Of The Society For Vascular Surgery". *Journal Of Vascular Surgery*, vol 53, no. 1, 2011, pp. 187-192. *Elsevier BV*, doi:10.1016/j.jvs.2010.08.027. Accessed 25 Mar 2019.
4. Starnes, Benjamin W. et al. "A New Classification Scheme For Treating Blunt Aortic Injury". *Journal Of Vascular Surgery*, vol 55, no. 1, 2012, pp. 47-54. *Elsevier BV*, doi:10.1016/j.jvs.2011.07.073. Accessed 25 Mar 2019.

CONTACT

- JACQUES VAN HEERDEN, MD - J.VANHEERDEN@USASK.CA
- NICOLAS MURRAY, MD – NICOLAS.MURRAY@VCH.CA