TRAUMATIC THORACIC AORTIC INJURY

Presented by Dr. F. Heelan PGY3
Case courtesy of Dr. R. Berry

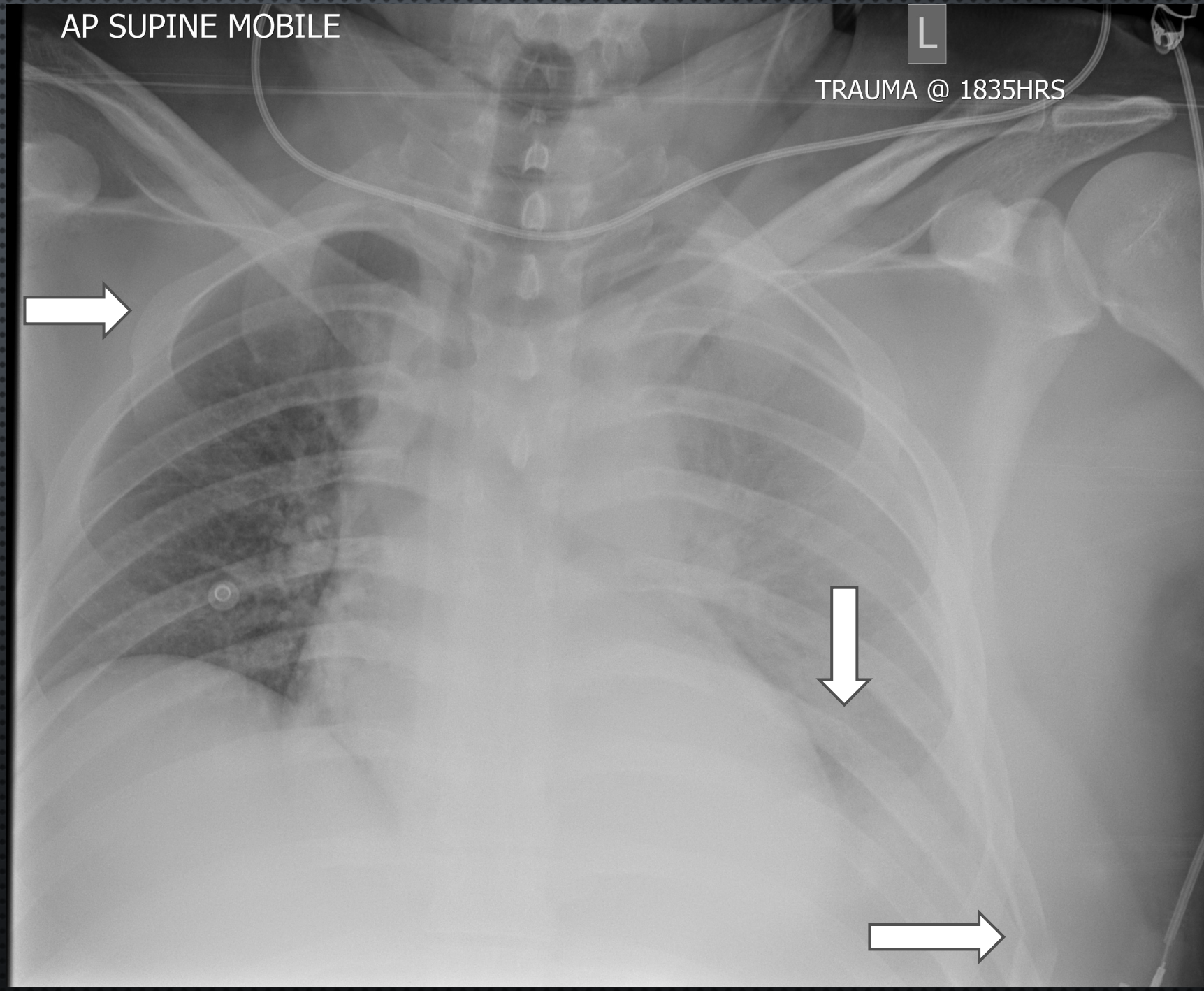
Clinical History

ID: 24 yo M in High speed head on collision

Sternal pain. Hypotensive on Scene

INITIAL RADIOGRAPH

- Widening of mediastinum
- Aortic arch not well seen, inferior displacement left mainstem bronchus
- Left Hemothorax
- Rib fractures



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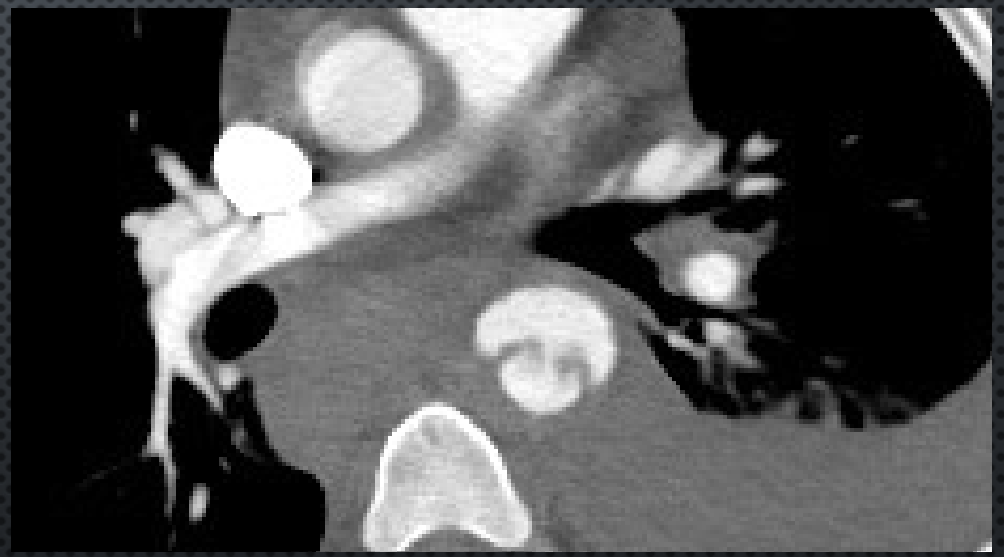


MAJOR FINDING

- ACUTE TRAUMATIC GRADE IV AORTIC INJURY (AORTIC RUPTURE)
- ALSO CALLED AORTIC TRANSECTION

Society for Vascular Surgery criteria:

Classification	Description	Notes
Grade 1	Intimal tear	Minimal Aortic Injury
Grade 2	Intramural hematoma or large intimal flap	
Grade 3	Pseudoaneurysm	
Grade 4	Rupture	

MANAGEMENT

Urgent cardiac surgery consult obtained

In discussion with IR, plan was made to proceed with TEVAR (thoracic endovascular aortic repair) of the blunt aortic injury

FEMORAL APPROACH: TECHNIQUE

- General anesthesia
- Single plane angiography unit

Technique- Access and DSA

- Open surgical exposure R CFA
  - Insertion of J wire into descending thoracic aorta
- US guided L CFA access obtained
  - Insertion of J wire into descending thoracic aorta

TEVAR: TECHNIQUE

5 Fr sheath over J wire on L side

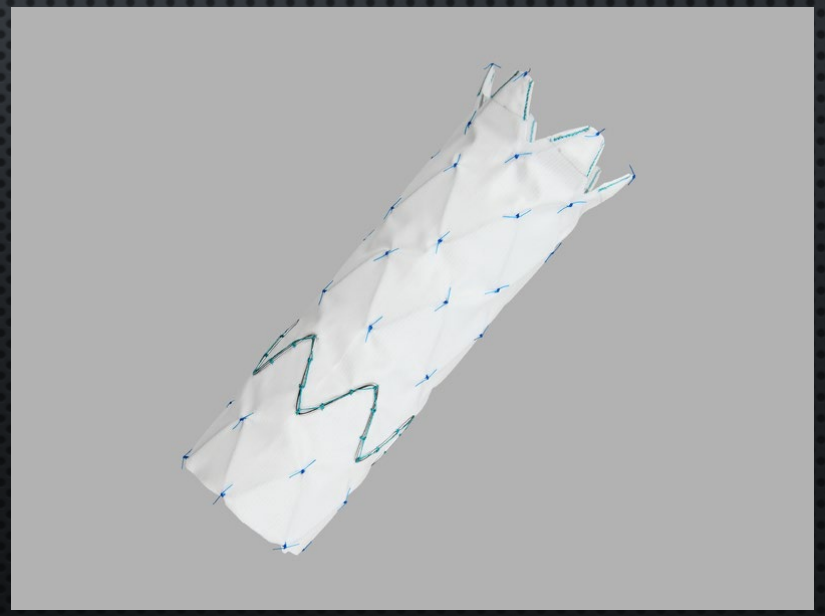
- J wire advanced to the site of injury. J wire exchanged for a Glidewire which was advanced to the ascending aorta
- KMP catheter advanced over Glidewire through the sheath and advanced to the ascending aorta
- Glidewire exchanged for a J wire. KMP catheter removed, pigtail catheter inserted over J wire
- Aortogram

Same approach on the right, J wire then exchanged for a Lunderquist wire

Patient was subsequently heparinized

TEVAR: TECHNIQUE

28 x 155 mm Cook Alpha thoracic endograft was advanced over a Lunderquist guidewire and positioned with fabric beyond left common carotid with intentional coverage left subclavian artery



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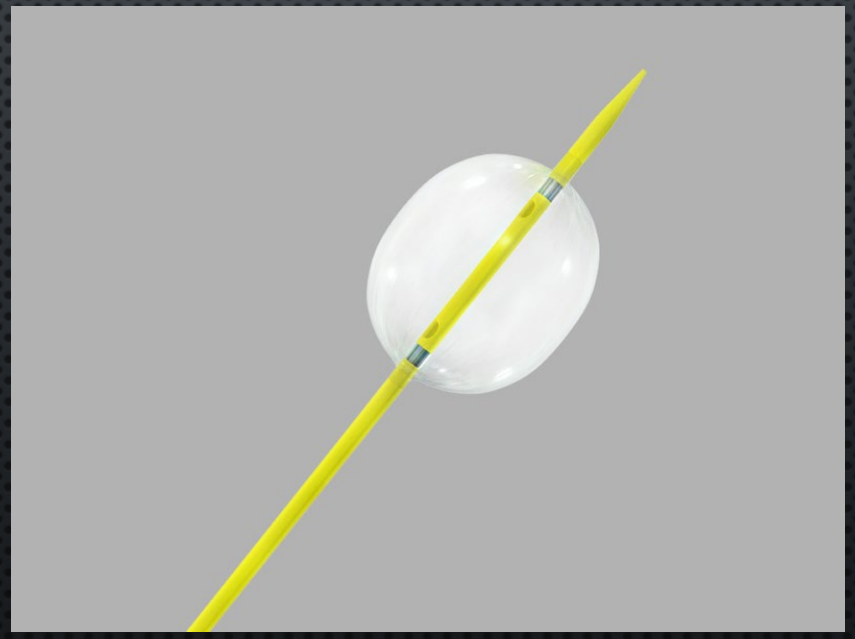
LT

Aortogram showed slow filling of the proximal descending thoracic aorta outside the endograft and filling of the left subclavian artery

ANGIOPLASTY: TECHNIQUE

THROUGH A 12 FR SHEATH, A CODA MOLDING BALLOON WAS INTRODUCED AND ANGIOPLASTY OF PROXIMAL AND DISTAL LANDING ZONES PERFORMED



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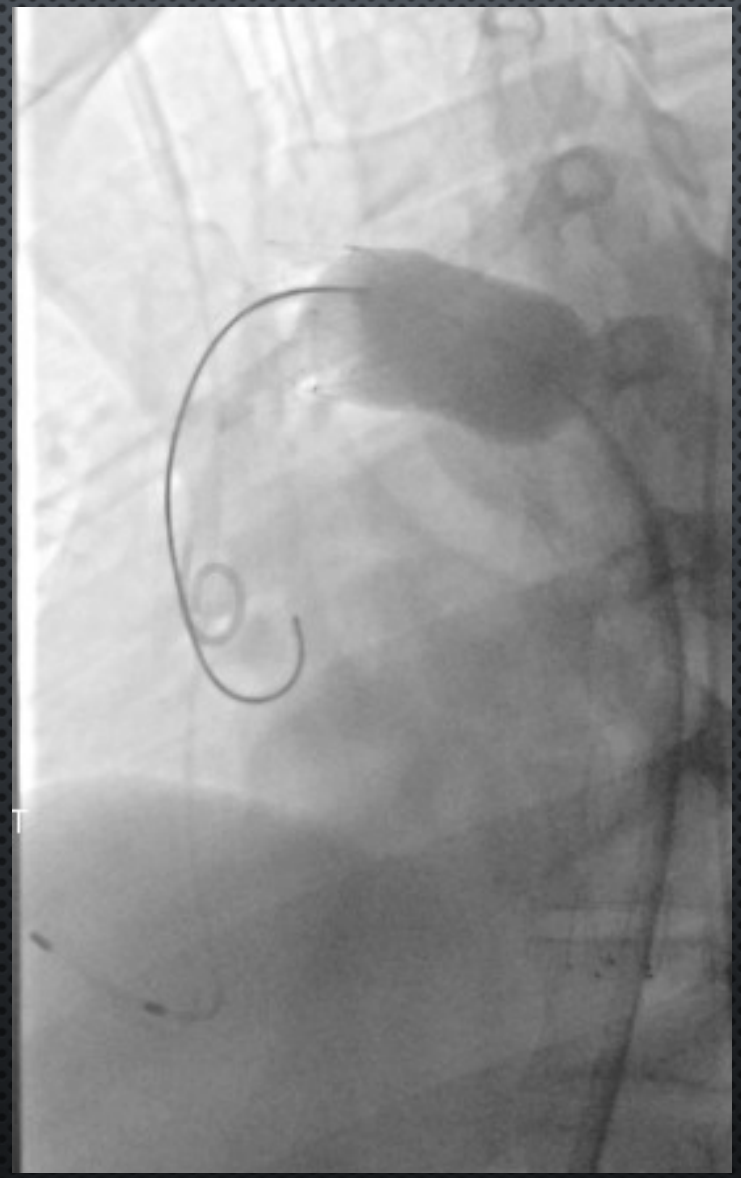
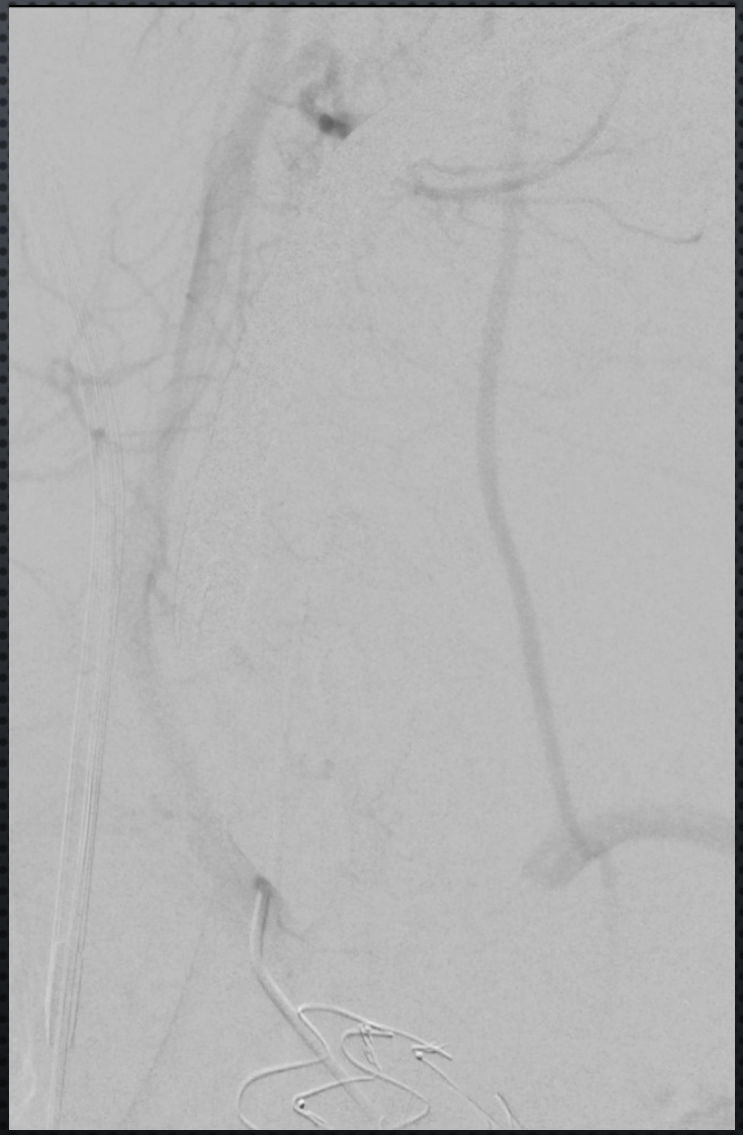


Subsequent aortogram showed much less filling outside the graft in the proximal descending aorta

SUBCLAVIAN AORTOGRAM: TECHNIQUE

SELECTIVE RIGHT BRACHIOCEPHALIC ARTERY ANGIOGRAM PERFORMED

SHOWED REVERSED FLOW DOWN THE LEFT VERTEBRAL→ LEFT SUBCLAVIAN



TRAUMATIC THORACIC AORTIC TRANSECTION

Second most common cause of trauma related deaths

Up to 85% of patients die before they reach hospital

- Of those that survive, 50% die in <24 hours

Traumatic thoracic aortic transection

Blunt trauma is the leading cause of thoracic aortic transection

Rapid deceleration results in shear stress on aortic wall

Aortic transection involves all 3 layers of the vessel wall

Classified as a Grade IV traumatic aortic injury

Endovascular vs. Open Repair for Traumatic Aortic Injuries

It has been cited in the literature that in endovascular repair there is:

- **Lower mortality**
  - 7.6% in endovascular repair vs. 15.2 % in open repair (Tang et al.)
- **Less Spinal cord ischemia**
  - 3% in endovascular repair vs. 9% in open repair (Murad et al.)
- **Lower stroke rate**
  - 0.8% in endovascular repair vs. 5.3% in open repair (Tang et al.)
- **Less Respiratory complications**
  - 24% in endovascular repair vs. 38% in open repair (Jonker et al.)

Endovascular vs. Open Repair for Traumatic Aortic Injuries

- In endovascular repair one avoids:
  - High posterolateral thoracotomy
    - +/- Cardiac bypass
    - aortic cross clamping
  - Single lung ventilation

Procedural Planning for Endovascular Repair

- Ruptures frequently involve the aortic isthmus which is 10-22 mm distal to the ostium of the left subclavian artery

- Need proximal aortic neck length of 20 mm between ostium left common carotid artery and the tear
  - If length is insufficient, may need to cover left subclavian
  - Suggestion in literature of a shorter landing zone between 10 and 20 mm may be safe and feasible for maintaining a patent LSA (*Skripochnick 2017 et al.*)

UNRESOLVED ISSUES REGARDING TEVAR IN TRAUMATIC AORTIC INJURIES

- Need to cover left subclavian artery
- Natural history of the repair
- Conformation to the arch

Excluding the left subclavian artery

Up to 40% of patients may require exclusion of the left subclavian artery (Dubose et al.)

Risks:

- posterior circulation stroke
- acute left arm ischemia & claudication
- paraplegia from radicular and supreme intercostal arteries which supply the spinal cord

Excluding the left subclavian artery

Revascularization typically occurs in the form of a left common carotid to subclavian bypass. Insertion of a subclavian chimney graft is also an option

Indications for bypass in patients in which left subclavian artery is excluded:

- Dominant left vertebral artery and there is a lack of reflux to the left PICA after right brachiocephalic angiogram
- Acute left arm ischemia post device insertion

Future developments may consist of off the shelf single branch grafts to allow preserved flow to the left subclavian artery while extending the proximal seal zone to just beyond the left common carotid artery

Limitations of Endovascular Repair

Lack of long term data

Aortic evolution with time

- Neck diameters increase by 3.3 ± 1.5 mm in 10 years (Ludovic et al.)

Younger patient population have smaller aortas and more acute angulation of Distal arch

- Smallest diameter graft is 21 mm
- Oversizing should not exceed device specifications and if oversized could result in INfolding which could lead to endoleak or death due to occlusion

Complications of Endovascular Repair for Traumatic Aortic Injuries

- Access complications
  - Femoral artery size <7 mm increases risk
  - Postoperative occlusion, wound infection, hematoma, and unplanned conversion to open cut down
  - Can lead to acute limb ischemia

- Graft related: Endoleak, Migration, Bird beak, device collapse and fracture
  - Graft related complications Typically happen within the first year
  - Rate of reintervention varies in literature ranging from 2.7% (Madigan et al. 2021) to 15% (steuer et al. 2014)

Society of Vascular Surgery Guidelines

"The committee suggests that endovascular repair of traumatic thoracic aortic injuries be performed preferentially over open surgical repair or nonoperative management. This recommendation is based on very low quality evidence (Grade 2, Level C)"

RESOURCES

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