

# Traumatic Aortic Injury

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11/13/19

Diagnostic Radiology: RAD4001

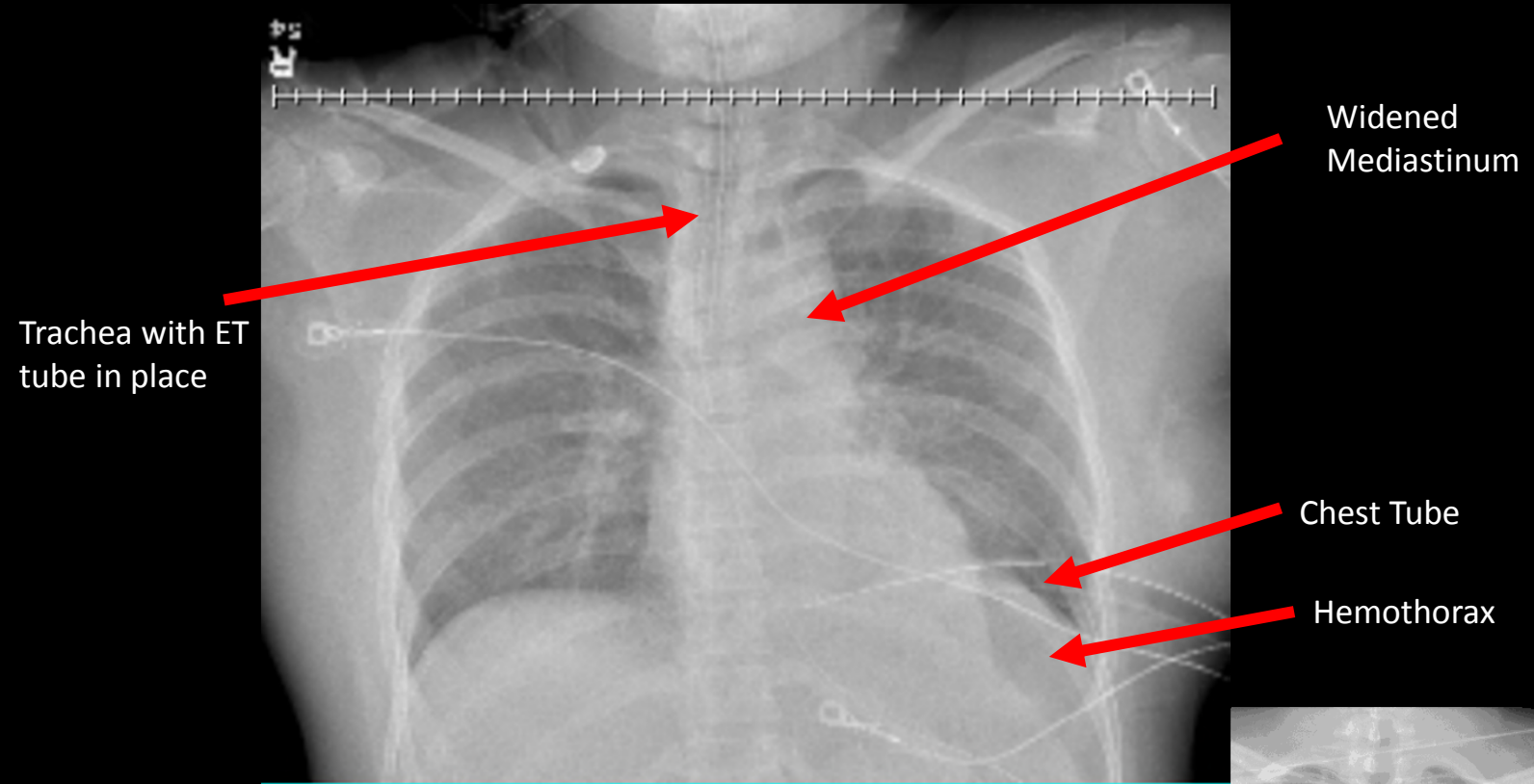
Dr. Latifa Sanhaji

# Clinical History

- 26 year old woman in MVC with no seatbelt.
  - Initially responsive to voice, but became unresponsive
  - Intubated for airway protection
  - Hypotensive 66/46, Tachycardic to 120s
  - BP and HR responsive to 2 units whole blood
  - Fast exam negative
  - Deformity of Right leg
  - L hemothorax- chest tube placed with output of 200 cc blood
- Unknown past medical history
- Initial workup- CXR, Abdominal XR, Right leg XRs, CT head without contrast, CT CAP with contrast, CT cervical spine without contrast

# Chest X-Ray

- Chest X-Ray, AP supine, 1 view, 11/9/19 0800
- ET tube 1.3 cm above the carina
- Left hemothorax with chest tube in place
- Widened upper mediastinal silhouette



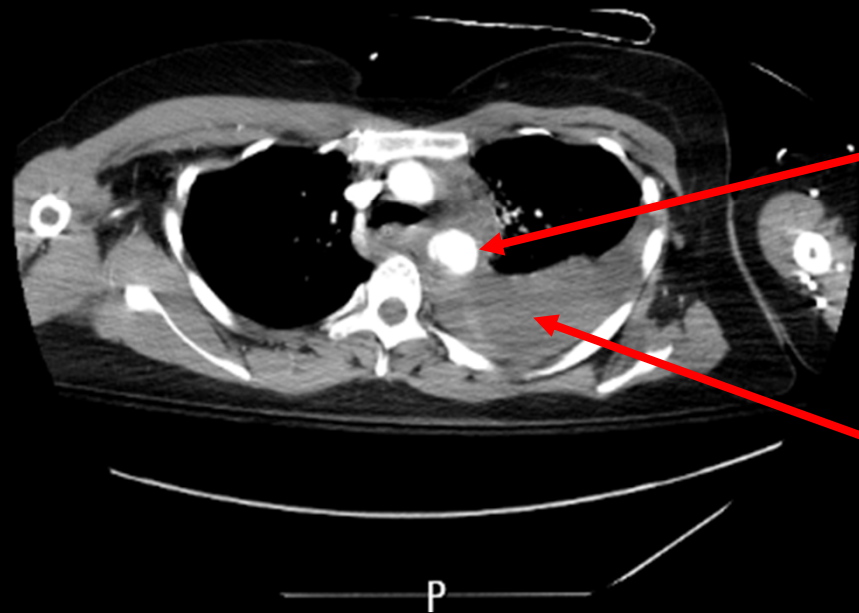
Normal CXR



# CT Chest/Abdomen/Pelvis W/ Contrast

Axial  
A

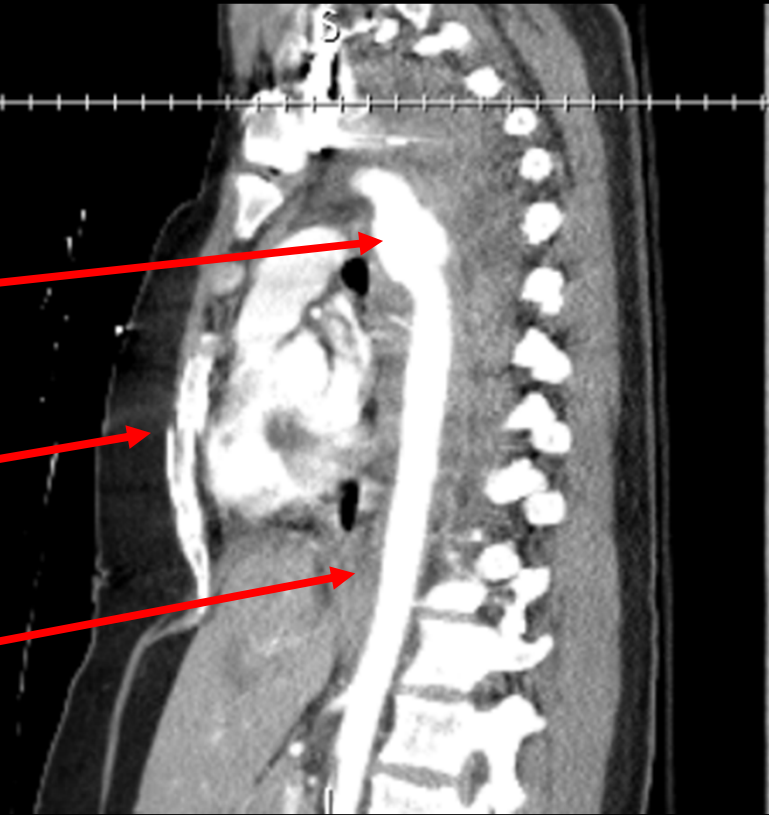
Sagittal  
B



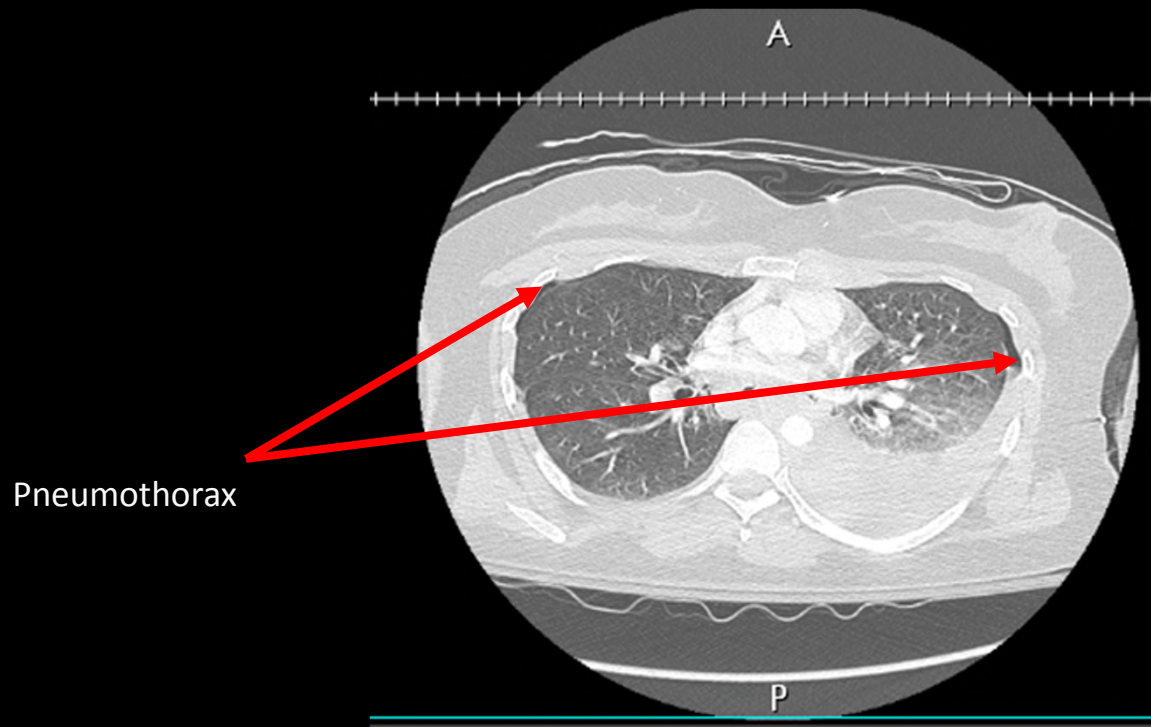
Aortic Transection  
of proximal  
descending aorta

Fractured Sternum

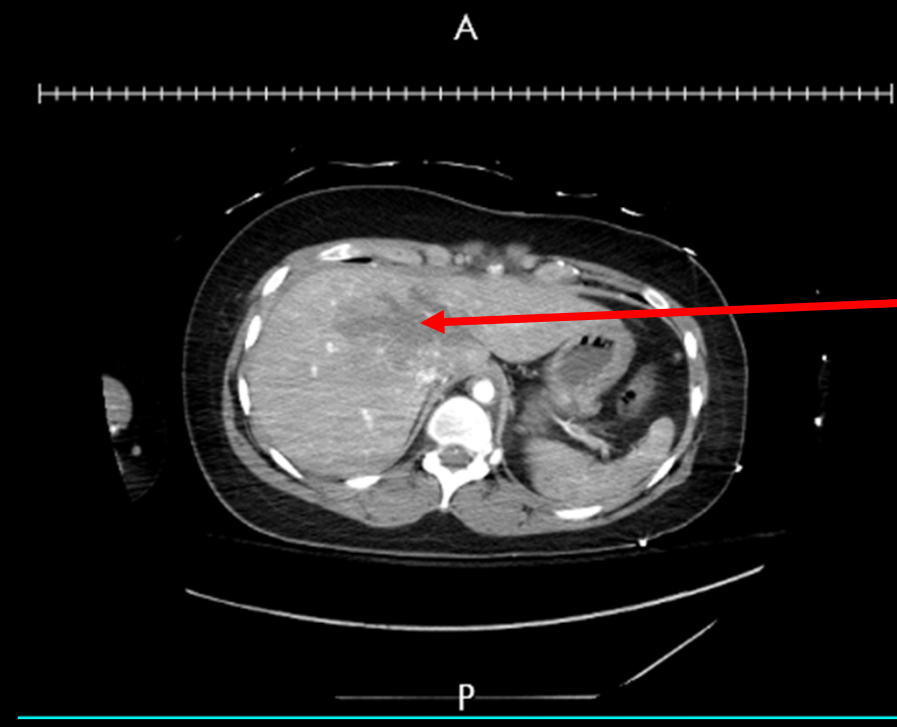
Hemothorax



# CT Chest/Abdomen/Pelvis W/ Contrast



Pneumothorax



Liver Laceration

# Key Findings

- Major Trauma
- **Hypotension**
- **Aortic Transection** of proximal descending aorta not involving the left subclavian with mediastinal hematoma- Grade III (aortic transection with pseudoaneurysm)
- Left pleural hemorrhage- hemothorax with chest tube in place
- Small bilateral pneumothoraces
- Hepatic laceration without active extravasation
- Multiple skeletal injuries

# Differential Diagnosis of Widened Mediastinum on CXR

- Traumatic Aortic Injury
  - Aortic Aneurysm or Dissection
- Vascular Anomalies
- Masses- lung or mediastinal
- Thymus
- Lymphadenopathy
- Technical factors- rotation, poor inspiration<sup>1</sup>

# Discussion

- In a patient in a major trauma, a widened mediastinum is extremely concerning for aortic injury, especially in the setting of hypotension
- Injury can progress to free rupture which is almost always fatal
- Grading Blunt Aortic Injury
  - Grade I: A- intimal tear B- intramural hematoma
  - Grade II: intimal injury with periaortic hematoma
  - Grade III: A- aortic transection with pseudoaneurysm B- multiple aortic injuries
  - Grade IV: free rupture
- Management
  - Grade I can be managed conservatively with B-blockers for BP control and antiplatelets to prevent thrombus formation
  - Grade II should have repeat CTA within 48-72 hours to evaluate for need for repair
  - Grade III should be repaired urgently, but can be delayed if other injuries are more pressing
  - Grade IV should go straight to open surgery, but has a 100% mortality in some studies
  - For Grade II and higher, successful repair leads to better outcomes <sup>2,3</sup>



# Discussion

- Repair

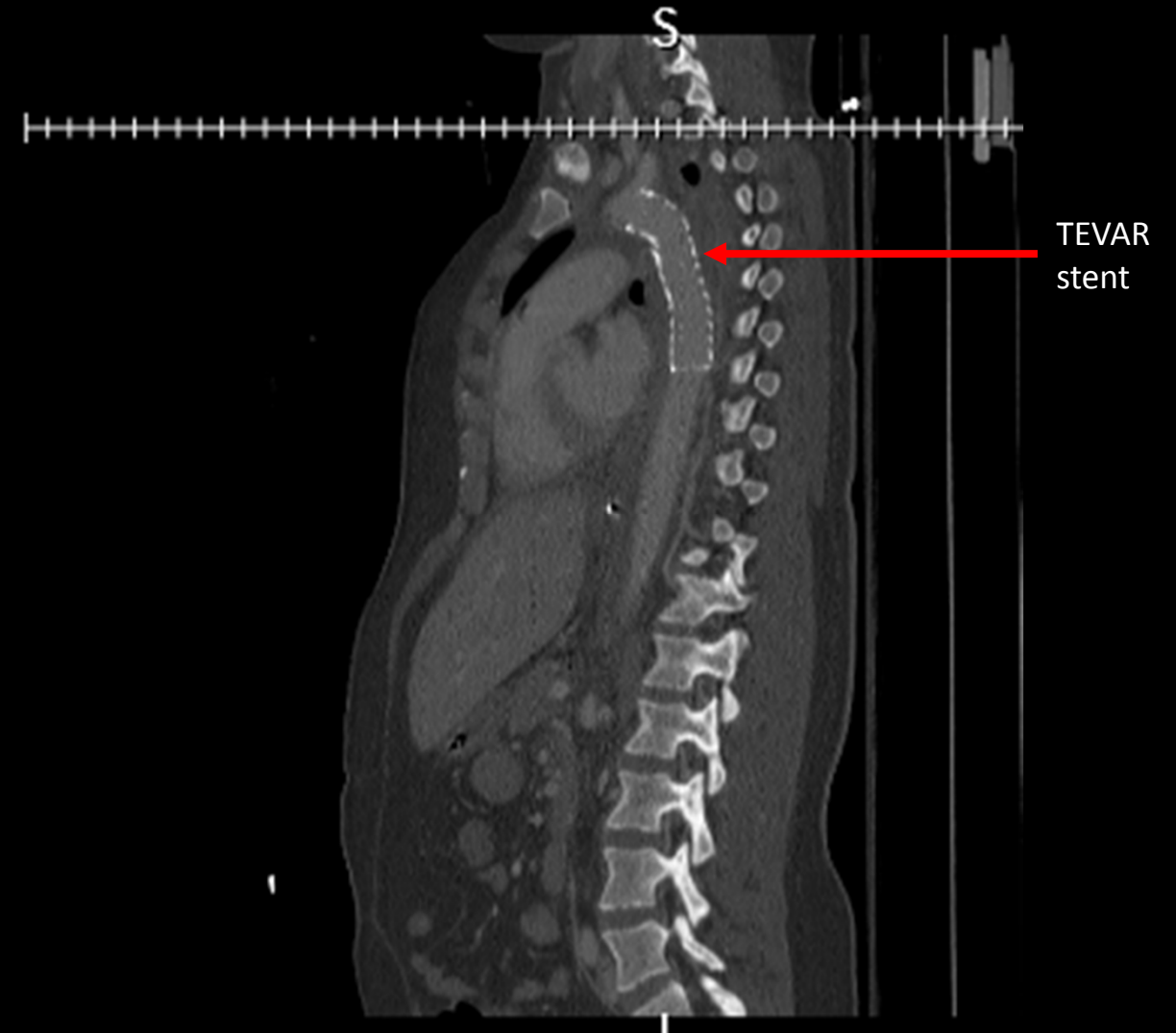
- Open surgery or TEVAR (thoracic endovascular aortic repair)
- TEVAR is limited by the anatomy of the location of the injury
  - Multiple injuries and injuries involving branches of the aorta may be better suited to open surgery
- Recovery time from TEVAR compared to open surgery is much shorter
- TEVAR is associated with repair mortality rates of 1.9 to 2.1%, compared with 5.7 to 11.7% with open repair (all cases, not just trauma) <sup>7</sup>
- Post TEVAR patient needs lifelong imaging follow up with CTA or MRA to look for leaks <sup>5,7</sup>

# Final Diagnosis

- Grade III Blunt Aortic Injury: Aortic transection of proximal descending aorta with pseudoaneurysm
- Hypotension/Shock

# Treatment

- In the setting of hypotension with an aortic injury, the patient was taken emergently to the OR where she underwent TEVAR (thoracic endovascular aortic repair)
- Post-op imaging shows stent in place in descending aorta
- Patient still in STICU, however aortic injury stable
- Mortality for patients with blunt aortic injury is very high
  - 23% die before or during triage
  - Mortality for patients who underwent TEVAR due to blunt aortic injury was 18%<sup>4</sup>
- Further Work up
  - Treat other injuries
    - Patient also underwent multiple surgeries for skeletal injuries (C2 fracture, femur fracture, radial fracture)
    - Liver Laceration not actively bleeding



# ACR appropriateness Criteria

**Variant 1:** Major blunt trauma. Hemodynamically unstable. Initial imaging.

| Procedure   | Appropriateness Category | Relative Radiation Level |
|---|--------------------------|--------------------------|
| Radiography trauma series                           | Usually Appropriate      | ☼☼☼                      |
| US FAST scan chest abdomen pelvis                   | Usually Appropriate      | ○                        |
| CT whole body with IV contrast                      | May Be Appropriate       | ☼☼☼☼                     |
| CT whole body without IV contrast                   | May Be Appropriate       | ☼☼☼☼                     |
| MRI abdomen and pelvis without and with IV contrast | Usually Not Appropriate  | ○                        |
| MRI abdomen and pelvis without IV contrast          | Usually Not Appropriate  | ○                        |

**Variant 2:** Major blunt trauma. Hemodynamically stable. Not otherwise specified. Initial imaging.

| Procedure   | Appropriateness Category | Relative Radiation Level |
|---|--------------------------|--------------------------|
| CT whole body with IV contrast                      | Usually Appropriate      | ☼☼☼☼                     |
| Radiography trauma series                           | Usually Appropriate      | ☼☼☼                      |
| US FAST scan chest abdomen pelvis                   | Usually Appropriate      | ○                        |
| CT whole body without IV contrast                   | May Be Appropriate       | ☼☼☼☼                     |
| Fluoroscopy retrograde urethrography                | Usually Not Appropriate  | ☼☼☼                      |
| MRI abdomen and pelvis without and with IV contrast | Usually Not Appropriate  | ○                        |
| MRI abdomen and pelvis without IV contrast          | Usually Not Appropriate  | ○                        |

**Clinical Condition:** Blunt Chest Trauma

**Variant 1:** First-line evaluation. High-energy mechanism.

| Radiologic Procedure                   | Rating | Comments   | RRL* |
|--|--------|--|------|
| X-ray chest                            | 9      | Chest x-ray and CT/CTA are complementary examinations.   | ☼    |
| CT chest with IV contrast              | 9      | Ideally, this procedure should be performed with CTA. Chest x-ray and CT/CTA are complementary examinations. | ☼☼☼  |
| CTA chest with IV contrast             | 9      | Chest x-ray and CT/CTA are complementary examinations.   | ☼☼☼  |
| CT chest without IV contrast           | 5      |  | ☼☼☼  |
| US chest                               | 5      |  | ○    |
| CT chest without and with IV contrast  | 2      |  | ☼☼☼  |
| MRI chest without and with IV contrast | 2      |  | ○    |
| MRI chest without IV contrast          | 1      |  | ○    |

**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

\*Relative Radiation Level

- In this major trauma case, CXR and CT chest with contrast were very appropriate studies

# Cost

| Procedure                    | Total Cost | Cost to Insured Patient | Cost to Uninsured Patient |
|------------------------------|------------|-------------------------|---------------------------|
| CXR, 1 view                  | \$683      | \$250                   | \$246                     |
| CT Chest w/ contrast         | \$3,936    | \$432                   | \$1,417                   |
| CT Abd/Pelvis w/<br>contrast | \$7,998    | \$480                   | \$2,879                   |
| TEVAR                        | \$150,000  | \$348                   | \$60,000                  |

<https://www.memorialhermann.org/patients-caregivers/pricing-estimates-and-information/>

# Take Home Points

- Trauma with widened mediastinum-suspect aortic injury
- Blunt aortic injury has very high mortality rates that improve with successful repair
- TEVAR leads to better mortality outcomes and shorter recovery time when compared with open surgery

# References

1. <https://radiopaedia.org/>
2. Reddy KN, Matatov T, Doucet LD, Heldmann M, Zhao CX, Zhang WW. Grading system modification and management of blunt aortic injury. *Chin Med J (Engl)*. 2013 Feb;126(3):442-5.
3. Shalhub S, Starnes BW, Tran NT, Hatsukami TS, Lundgren RS, Davis CW, Quade S, Gunn M. Blunt abdominal aortic injury. *J Vasc Surg*. 2012 May;55(5):1277-85.
4. Arthurs ZM, Starnes BW, Sohn VY, et al. Functional and survival outcomes in traumatic blunt thoracic aortic injuries: An analysis of the National Trauma Databank. *J Vasc Surg*. 2009 Apr;49(4):988-94.
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6. <https://www.memorialhermann.org/patients-caregivers/pricing-estimates-and-information/>
7. Nation DA, Wang GJ. TEVAR: Endovascular Repair of the Thoracic Aorta. *Semin Intervent Radiol*. 2015;32(3):265–271.



Questions?