Blunt Thoracic Aortic Injury

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September 2004
Blunt Aortic Injury

- ~8000 deaths/year in the U.S.
- Most common cause of sudden death following:
  - high-speed MVA
  - fall from a great height
- Rapid deceleration results in shear forces along the aortic arch and aortic rupture
Mechanism of Injury

- 2 main proposed mechanisms (Marcura et al):
  
  **Differential deceleration**
  - ascending and descending aorta mobile
  - aortic arch relatively fixed by brachiocephalic vessels
  - maximal stress at attachment points, aortic isthmus, and aortic root

  **Osseous pinch theory**
  - aorta pinched between spine and anterior bony thorax

From Gray, Henry. *Anatomy of the Human Body*
Traumatic Aortic Injury

- Spectrum of injury:
  - Intima + media + adventitia $\rightarrow$ transection
  - Intima + media $\rightarrow$ pseudoaneurysm
  - Intima $\rightarrow$ dissection
Epidemiology

- 75-90% of patients die at accident scene
  - Complete rupture (all three layers of aorta) with rapid exsanguination
- Survivors form a pseudoaneurysm
  - Without treatment, 50% die within a week (includes deaths due to comorbid injuries)
  - With treatment, mortality decreases to <20%
- Sites most commonly affected:
  - Aortic Isthmus (distal to left subclavian) ~ 95%
  - Ascending aorta ~ 5%
  - Diaphragmatic hiatus ~ 1 to 3%
Clinical Presentation

- Symptoms variable and nonspecific
  - Include chest or midscapular pain, dyspnea, hoarseness, dysphagia

- PE often noncontributory
  - 5% of patients have decreased L arm pressure
  - 50% have no external signs of chest trauma

- Diagnosis based on radiographic studies
Imaging Modalities

- CXR
- CT
- Angiography
- Transesophageal echocardiography (TEE)
- *MRI – not currently in clinical use
CXR used initially to screen for aortic injury

Main factor determining subsequent studies is patient’s hemodynamic stability

http://www.trauma.org/thoracic/CHESTaorta.html
Findings on CXR

- Widened superior mediastinum (mediastinal/chest ratio greater than 1:4 at aortic knob)
- Apical cap
- Abnormal contour of the aortic knob
- Tracheal/NG tube deviation to right of the T4 spinous process
- Depression of the left mainstream bronchus greater than 40° from horizontal or greater than 140° from the tracheal axis
- Left hemothorax without rib fracture
- Fracture of the first and second ribs, indicative of a high velocity injury
‘Funny-looking’ Mediastinum

Differential diagnosis:

- Hemorrhage or hematoma – sternal or vertebral fractures, venous and arterial tears, ruptured aneurysm
- Hiatal hernia (large)
- Lymphadenopathy – TB, sarcoidosis, lymphoma, histoplasmosis
- Mediastinal cyst or tumor
- Pneumomediastinum – spontaneous, traumatic
- Vascular abnormality – aneurysm, dissection or coarctation of the aorta; dilated SVC

Normal CXR has 98% negative predictive value

Technical consideration – 40% of widened mediastinums normalize when patient is upright
Patient M.G.

- 17-year-old female restrained back seat passenger involved in high-speed “T-bone” accident on 8/28/04
- **Lost consciousness** at the scene of the accident, prolonged time to extraction
- **Hypotensive**, low O2 saturation with **decreased BS on right**
- Transferred to BIDMC ED – hemodynamically stable upon arrival with SBP in the 90s and HR of 103
- In ED, awake and able to move all 4 extremities but **no response to painful stimuli**
What next...?

- What injuries are we concerned about?
  - Aortic Injury
  - Brain and/or spinal cord injury
  - Pneumothorax
  - Fractures
  - Hemorrhage

- What test should we order first?
  - CXR
Chest Radiograph – Patient MG

- Portable AP view
- No identifiable pneumothorax or rib fractures
- Widened upper mediastinum
- Indistinct aortic knob with opacification of aorto-pulmonary window
- Tracheal deviation to the right of T4 spinous process

From PACS, BIDMC
CT – Patient MG

- High density material in mediastinum consistent with hemorrhage
- Dependent atelectasis in both lungs

From PACS, BIDMC
CT – Patient MG (2)

- **Pseudoaneurysm** of descending aorta — note the unusual contour
- **R lung** contusion
- **R lung** hemothorax with *chest tube*

From PACS, BIDMC
CT Reformations – Patient MG

- Excellent visualization of pseudoaneurysm
- Watch out for aortic ductus diverticulum fakeout
Angiogram – Patient MG

- **Gold standard in assessing aortic injuries for many years**

- **Advantage:**
  - Wonderful visualization of other great vessels and their branches

- **Disadvantage:**
  - Invasive and time-consuming with 1-10% complication rate
**TEE**

**Advantages:**
- Portable
- Study can be performed on unstable patients

**Disadvantages:**
- Operator-dependent
- Requires patient sedation
- Difficult to visualize distal ascending aorta and proximal arch
- Interpretation confounded by presence of atherosclerosis

Small arrow indicates pseudoaneurysm

Similar blood flow velocities seen on either side of “medial flap.” Mosaic of colors represents turbulent flow at site of tear.

*Images from Lang and Vignon, 2004*
Treatment

- Two options for aortic repair:
  1. Open surgical repair
  2. Endovascular stent-graft
- Surgery risks include early mortality (15-29%), paraplegia (25%) & recurrent laryngeal nerve injury (~8%).
- Fewer short term complications with endovascular repair but long term risks unknown.
- Small pseudoaneurysms may be managed medically but risk of delayed rupture
- Comorbid injuries increase mortality and morbidity risk both pre and post-operatively

From Fujikawa, T, et al. *J of Trauma* Feb. 2001; 50(2)223-9
Patient MG

- Endovascular stent graft repair of pseudoaneurysm on 8/30/04 without complication
- IVC filter placement and open reduction-internal fixation of pelvic fracture on 9/2/04
- Patient is now ambulatory but will require weeks of PT

From Fujikawa, T, et al. *J of Trauma* Feb. 2001; 50(2)223-9
Key Points

- Rapid deceleration event - high index of suspicion for thoracic aortic rupture
- Diagnostic algorithm – imaging modality determined by patient stability
- Rapid treatment imperative given high mortality risk (Don’t forget comorbid injuries!)
References

Acknowledgements

- Erik Stien, MD
- Gillian Lieberman, MD
- Pamela Lepkowskki
- Larry Barbaras our Webmaster