Project: Ghana Emergency Medicine Collaborative

Document Title: Acute Aortic Emergencies

Author(s): Carol Choe (University of Michigan), MD 2012

Attribution Key

for more information see: http://open.umich.edu/wiki/AttributionPolicy

Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }

- PD-GOV **Public Domain – Government**: Works that are produced by the U.S. Government. (17 USC § 105)
- PD-EXP **Public Domain – Expired**: Works that are no longer protected due to an expired copyright term.
- PD-SELF **Public Domain – Self Dedicated**: Works that a copyright holder has dedicated to the public domain.
- ZERO **Creative Commons – Zero Waiver**
- BY **Creative Commons – Attribution License**
- BY-SA **Creative Commons – Attribution Share Alike License**
- BY-NC **Creative Commons – Attribution Noncommercial License**
- BY-NC-SA **Creative Commons – Attribution Noncommercial Share Alike License**
- GNU-FDL **GNU – Free Documentation License**

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }

- PD-INEL **Public Domain – Ineligible**: Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ

{ Content Open.Michigan has used under a Fair Use determination. }

- FAIR USE **Fair Use**: Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ

  Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

  To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.

OBJECTIVES

- Discuss different types and pathologies of aortic disease.
- Determine treatment and management options for each state.
- Evaluate need for surgical intervention.
- Review prognosis and outcome.

The Aorta

- Largest artery in the body.
- Carries oxygen-rich blood away from the heart.
- Elastic (especially ascending aorta).
- 3 layers of tissue
  - Thin inner layer: tunica intima
  - Thick middle layer: tunica media
  - Thin outer layer: tunica adventitia

Common Causes of Aortic Disease

- Hypertension
- Atherosclerosis
- Bicuspid aortic valve (alters laminar flow)
- Cocaine or MDMA use
- Connective tissue disorders
- Infection (syphilis, TB, salmonella)
- Pregnancy
- Injury (iatrogenic and traumatic)

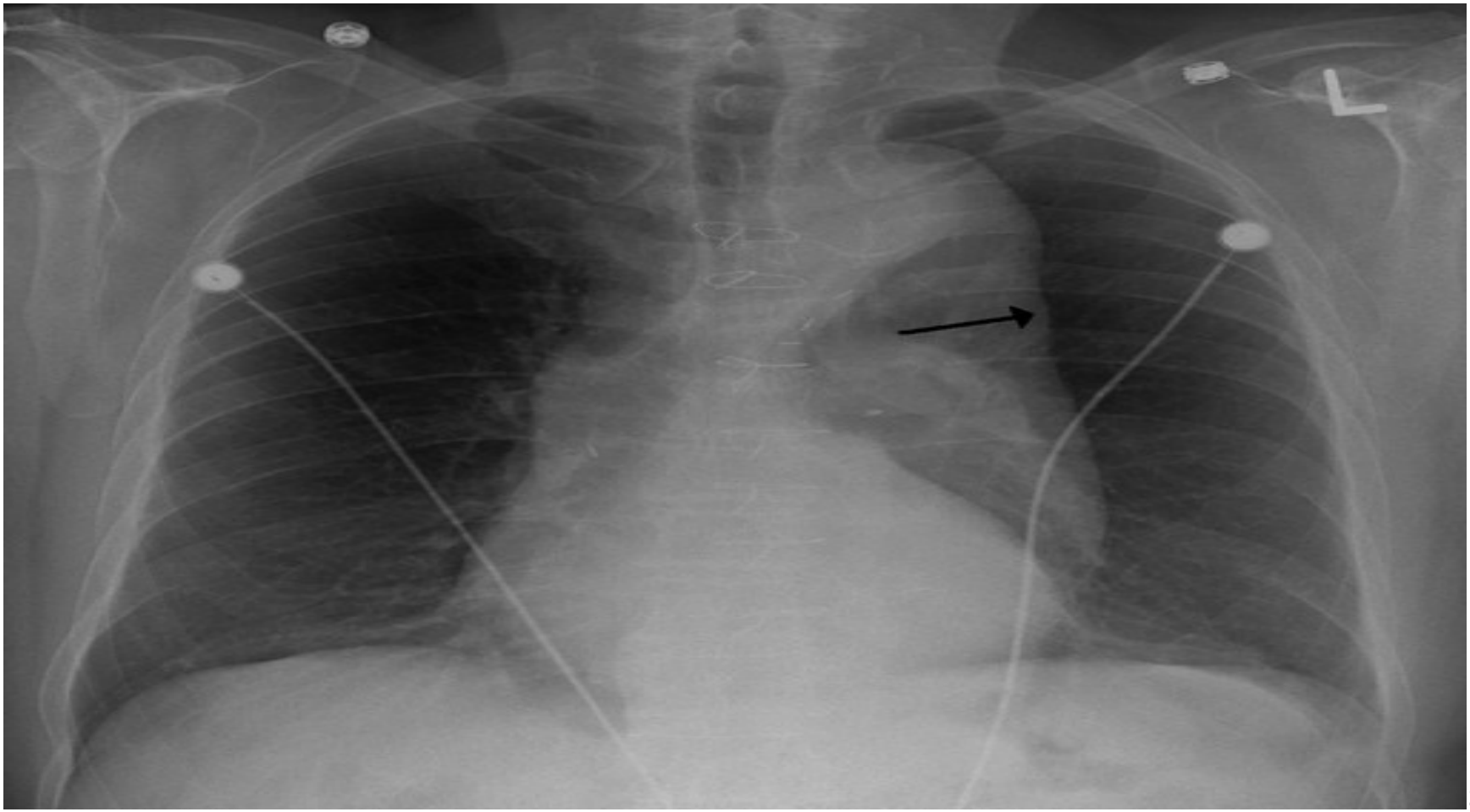
Case Presentation

- 76 year old woman with a history of hypertension presents to the emergency department with a sense of abdominal fullness.
- Symptoms have been persistent for several weeks.
- X-rays have been unremarkable.
- BP 94/48, HR 125, RR 20, SaO2 96%

Case Presentation

What is your differential diagnosis?

Aortic Aneurysm



Aortic Aneurysm

- Any abnormal dilation or out-pouching of the aorta, greater than 50% of normal diameter.
- Size matters:
  - Thoracic > 6cm
  - Abdominal > 5.5cm
  - Infrarenal aorta > 3cm
- 2 different shapes:
  - Fusiform
  - Saccular

Signs/Symptoms

- Hoarseness
- Dysphagia.
- Chest/back pain.
- Shortness of breath.
- Abdominal discomfort.
- Sense of fullness.
- ** Often asymptomatic until rupture.**

Physical Exam Findings

- Murmur if involving a valve.
- Tamponade
- Abdominal bruit (non-specific).
- Pulsatile abdominal mass.

Imaging Studies

- CXR
- Trans-thoracic echocardiogram
- Ultrasound (modality of choice)
- CT (non-contrast)
- CTA (pre-intervention)
- MRI/MRA
- Conventional aortography (rarely used)

Table 1 Clinical condition: pulsatile abdominal mass, suspected AAA

Radiologic procedure	Rating	Comments	RRL[a]
US aorta abdomen	9	Initial examination. May be limited by body habitus or acoustic window	O
CT abdomen without contrast	8	Preferred for symptomatic patients. Suitable for patients in whom US is not useful	☢☢☢
CTA abdomen with contrast	7	Also enables preinterventional planning	☢☢☢
MRA abdomen without contrast	6	Alternative to CTA. Unable to detect calcium. Site-specific expertise important	O
MRA abdomen without and with contrast	6	Alternative to CTA. Unable to detect calcium. Site-specific expertise important. See statement regarding contrast in text under "anticipated exceptions"	O
Aortography abdomen	2	Essentially replaced by cross-sectional imaging for diagnostic purposes. May be used for preinterventional planning	☢☢☢
FDG-PET/CT abdomen	2		☢☢☢☢

Rating scale: *1–3* usually not appropriate, *4–6* may be appropriate, *7–9* usually appropriate

[a] Relative radiation level

Author unknown, http://www.ncbi.nlm.nih.gov/pubmed/22644671

Aortic Aneurysm

Aortic Aneurysm

Risk factors:

- Smoking
- Males: Females 3:1
- Age
- Hypertension
- Hyperlipidemia
- COPD
- Family history

Aortic Aneurysm

- Management:

  Mortality related to size.

  Medical management of small aneurysms measuring <4.0-5.5 cm.

Aortic Aneurysm

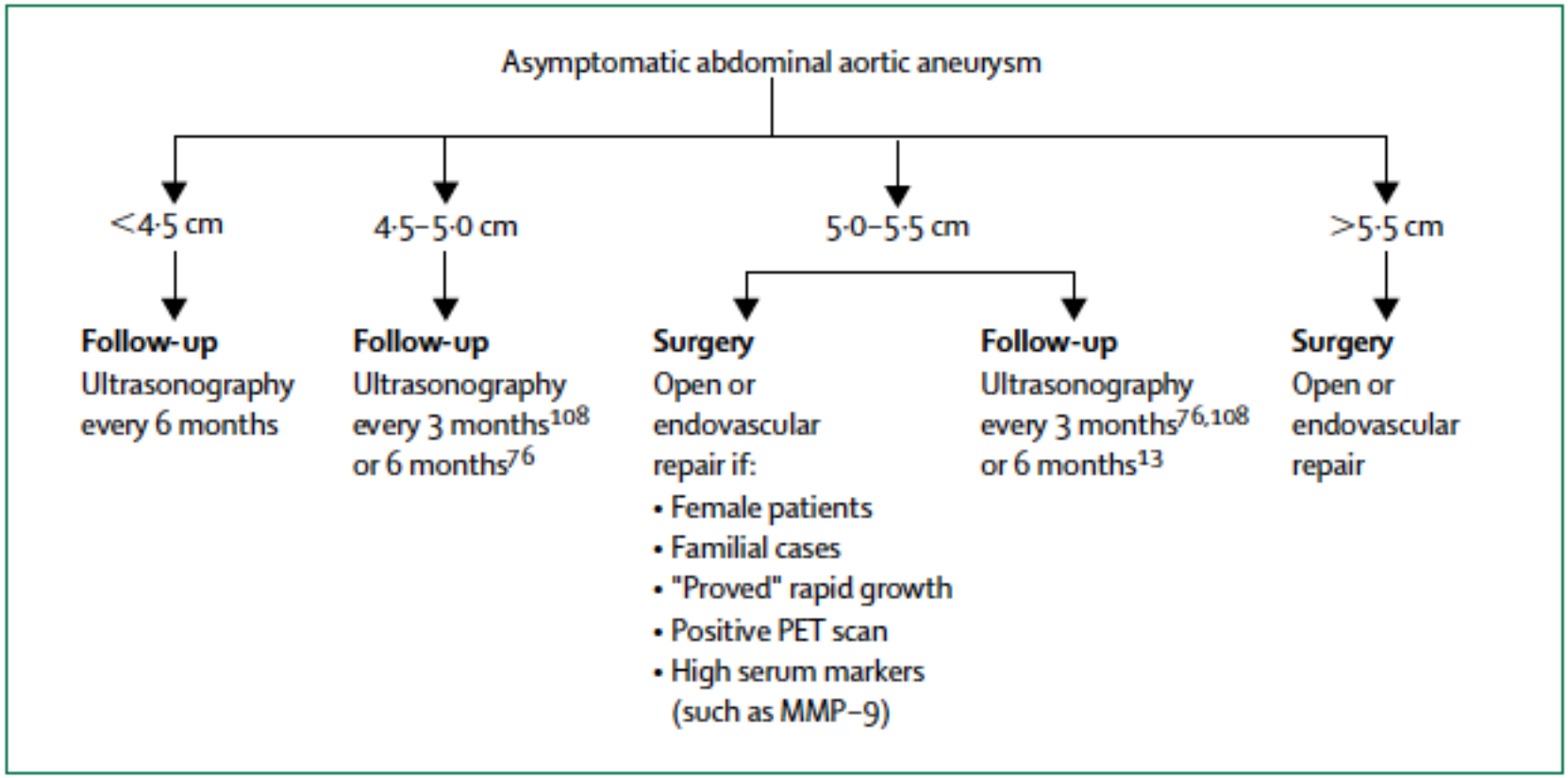
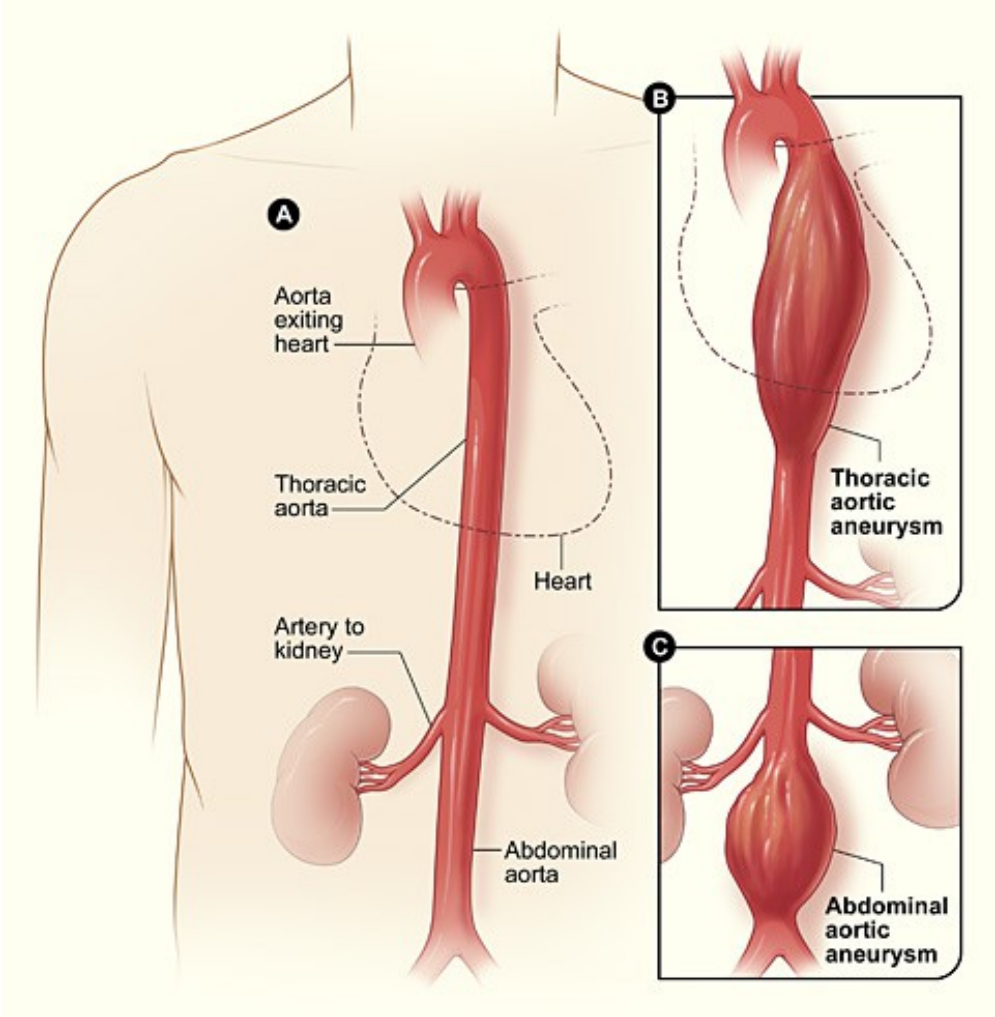


Figure 7: **Proposed management of an asymptomatic abdominal aortic aneurysm**

Sakhalihasan, N et al, Abdominal aortic aneurysm. *The Lancet.* 2005;365(9470):1577–1589.



Aortic Aneurysm

- Management:

  Surgical repair commonly performed if aorta >5.5cm.

  - No mortality benefit to earlier surgical intervention.
  - Mortality from surgical intervention varies from 1.1-7%.

Aortic Aneurysm

- Risk of rupture:

  If <5 cm, is <1% per year.

  If 5 cm, is 3-5% per year.

  If >5 cm, is as high as 5% per year.

- For ascending aortic aneurysms, ***yearly*** risk of rupture, dissection, or death at 6 cm is 14.1%!

Aortic Aneurysm

- Open Surgical Intervention
  - Reported failure rate of 0.3%.
- Endovascular repair
  - Preferred for elderly patients.
  - Reduced perioperative morbidity and mortality
  - Possible failure rate of 3% with multiple complications possible.

Aortic Aneurysm

- Risk factors for death from ruptured aortic aneurysm:
  - Age >76 years
  - Cr >190umol/L
  - Hgb <9 g/dL
  - LOC
  - EKG evidence of ischemia.

Aortic Aneurysm

- Mortality from ruptured aortic aneurysm:
  - 100% mortality if 3+ risk factors.
  - 48% 2 risk factors.
  - 28% 1 risk factor.
  - 18% with no risk factors.

Aortic Aneurysm

- Prevention:

  Stop smoking!

  β-blockers may reduce the extent of growth for large >5.0cm aneurysms.

  Statins may reduce mortality post-operatively.

Case Presentation

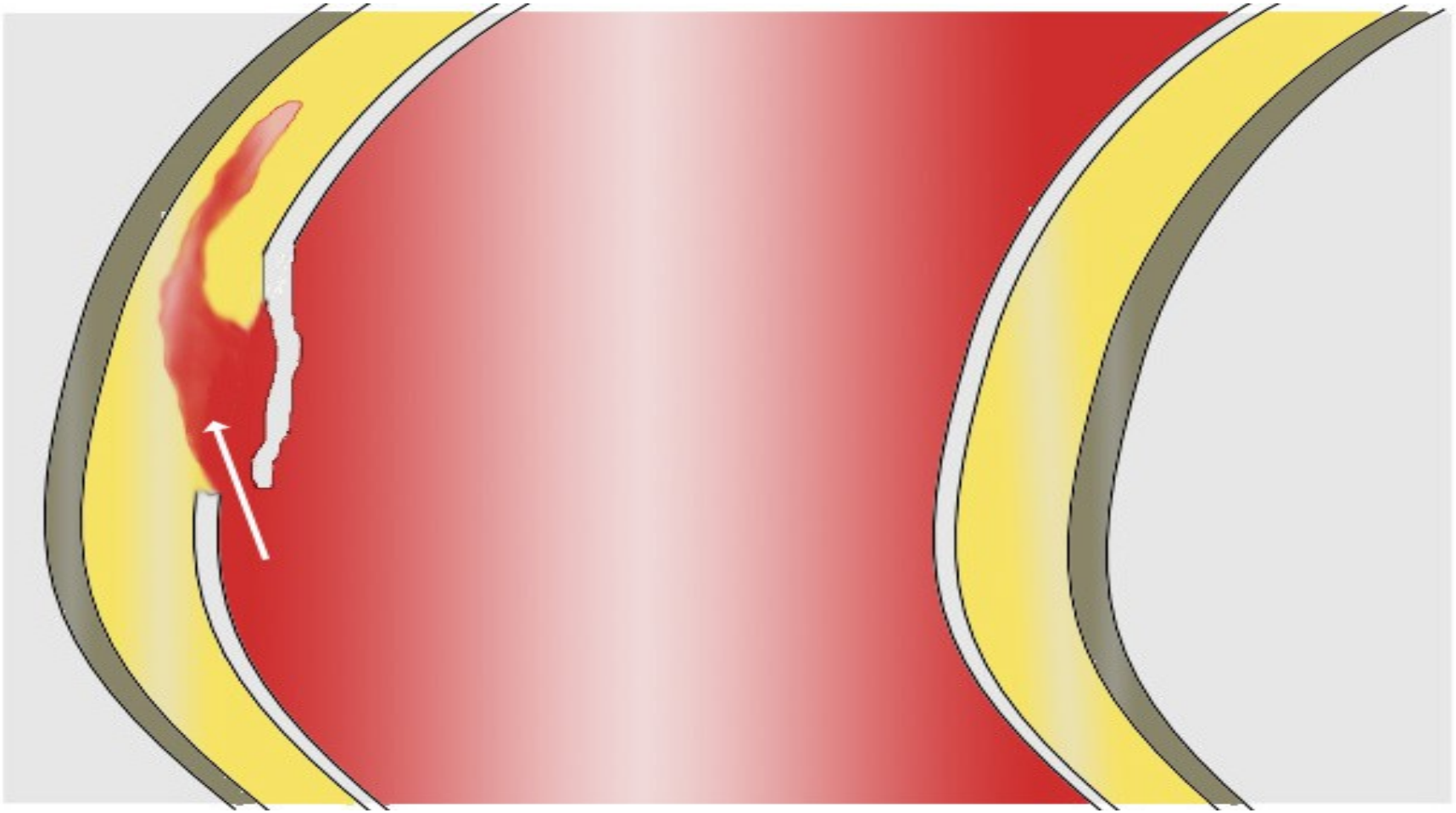
- 54 year old man presents with sudden onset of pain between his shoulder blades which started when he lifted his wife.
- X-ray has been unremarkable.
- VITALS:

  BP 201/169 HR 104 RR 24 SaO2 96%RA

Case Presentation

What is your differential diagnosis?

Aortic Dissection



Aortic Dissection

- Medial degeneration.
- A tear in the tunica intima allows blood to dissect between the intima and media.
- True incidence of the disease is unknown.

Aortic Dissection

- DeBakey Classification:
  - Type I: Ascending and descending aorta.
  - Type II: Ascending aorta only.
  - Type III: Descending aorta distal to the L. subclavian.
- Stanford Classification:
  - Type A: Involving the ascending aorta.
  - Type B: Involving the descending aorta distal to the L. subclavian artery.

Aortic Dissection

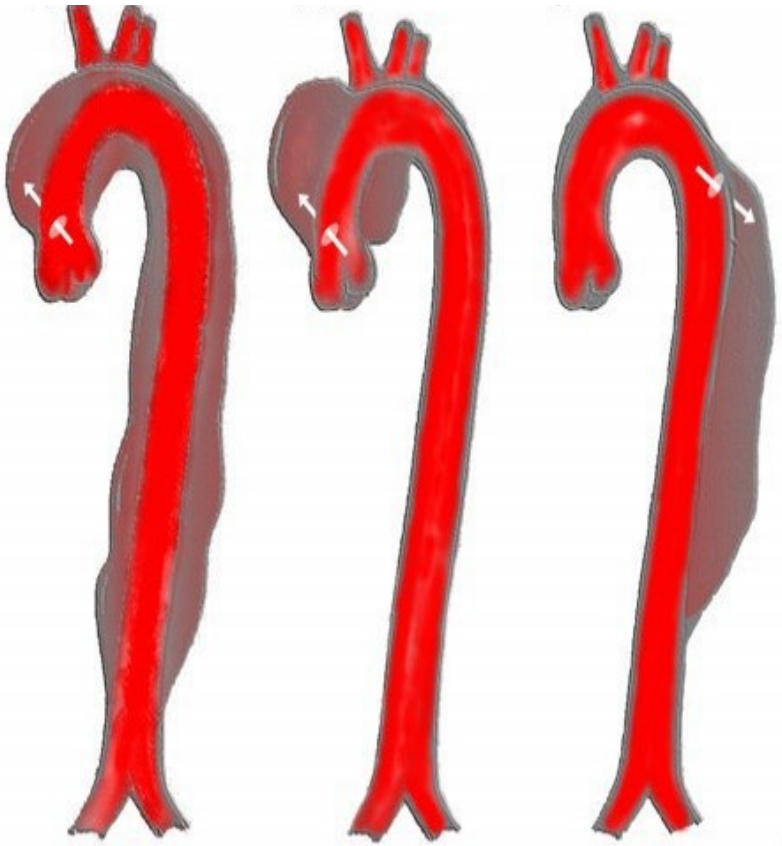
- Type A dissection often begins just above the coronary arteries where the aorta is the largest and thinnest.

  Always a surgical emergency.

- Type B dissection involves the distal aorta.

  Medically managed.

Aortic Dissection



Signs/Symptoms

- Sudden onset of sharp, tearing pain radiating to the back.
- Any neurologic complaints associated with pain.
- Syncope.
- Acute CHF.
- Other vague non-specific symptoms.

Physical Exam Findings

- Hypoxia
- Altered mental status
- Tachycardia
- Pulse deficits
- BP discrepancies
- Shock

Aortic Dissection

- However, landmark study (*International Registry of Aortic Dissection)* found:
  - pulse deficit: 15 %
  - aortic murmur: 31.6 %
  - normal chest x-ray: 12 %
  - absence of mediastinal widening: 34 %
  - syncope: 12 %
  - painless: 2.2%

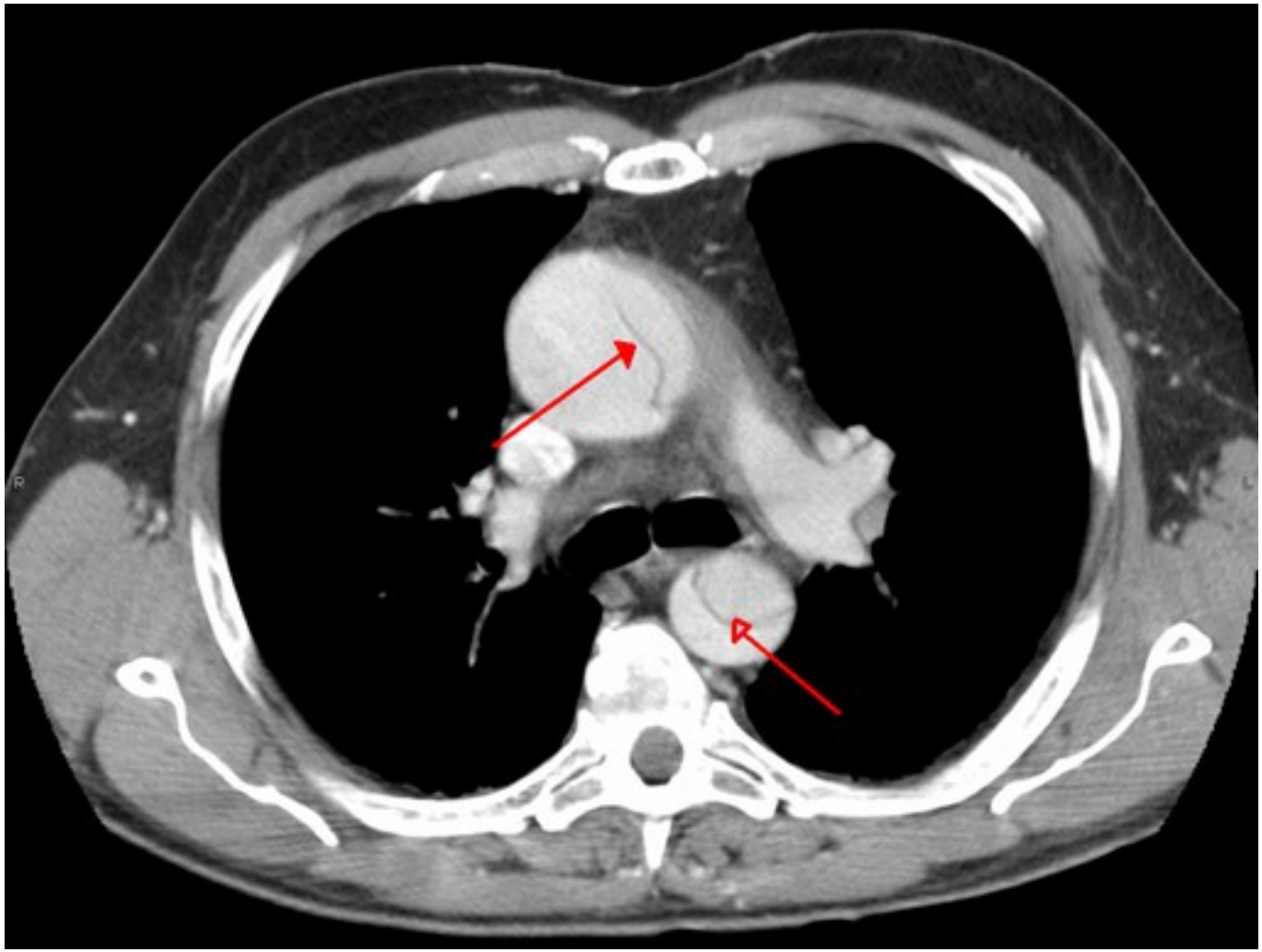
Imaging Studies

- CXR
- CT
- MRI/MRA
- TEE
- TTE (low sensitivity: 55-75%)
- Angiography (former “gold standard”)

Imaging Studies

- Classic teaching of CXR findings:
  - Widened aortic knob or mediastinum.
  - Displaced intimal calcification.
  - Pleural effusion (left >> right).
  - Opacification of the “AP window.”
  - Left apical pleural cap.
  - Indistinct or irregular aortic contour.
  - Tracheal or esophageal deviation.

Aortic Dissection



I heard you can use the d-dimer…

- The d-dimer is almost 100% sensitive for acute dissection. HOWEVER, specificity is low.
- Useful in the high negative predictive value
- A false positive d-dimer would require CT scanning of approximately 40% of the patients

Aortic Dissection

- Mortality 1-2% per HOUR for type A dissections.

  75% within 2 weeks, 90% mortality at 30 days.

- With successful initial therapy:

  5-year survival rate is 75%

  10-year survival rate (if surgically repaired) is 40%-60%.

Aortic Dissection

- Treatment strategies are similar to aortic aneurysm:
  - Medical:
    - Morphine
    - Anxiolytics
    - Afterload reduction and β-blockade
      - Goal SBP 100-110mmHg
      - Goal HR 50-60bpm
  - Surgical

Aortic Dissection

- Surgery is indicated for all type A dissections.
- Indicated for type B dissections only if :
  - Persistent symptoms.
  - Rapidly expanding false lumen.
  - Impending or frank aortic rupture.
  - Major organ malperfusion that cannot be resolved by percutaneous therapy.

Aortic Dissection

- Increased risk of death:
  - Older age.
  - Signs and symptoms of organ malperfusion.
  - Clinical instability (pulse deficits, renal failure, hypotension, and/or shock).

Aortic Dissection

- Despite advances in medical/surgical treatment, 15-30% of patients will require further surgical intervention for complications:
  - aortic dilatation and rupture (most common cause of death)
  - progressive aortic regurgitation
  - organ malperfusion
  - irreversible ischemia

Case Presentation

- 24 year old man, restrained driver involved in a high-speed MVC vs. tree.
- Airbags deployed.
- Complaining of chest pain and shortness of breath
- VITALS:

  BP 98/52 HR 132 RR 26 SaO2 90% RA

Case Presentation

What is your differential diagnosis?

Blunt Aortic Injury

Author unknown, trauma.org

Signs/Symptoms

- Inter-scapular pain
- Dyspnea
- Dysphagia
- Relative upper extremity hypertension ("pseudo-coarctation")
- ** Often do not make it into the ED**

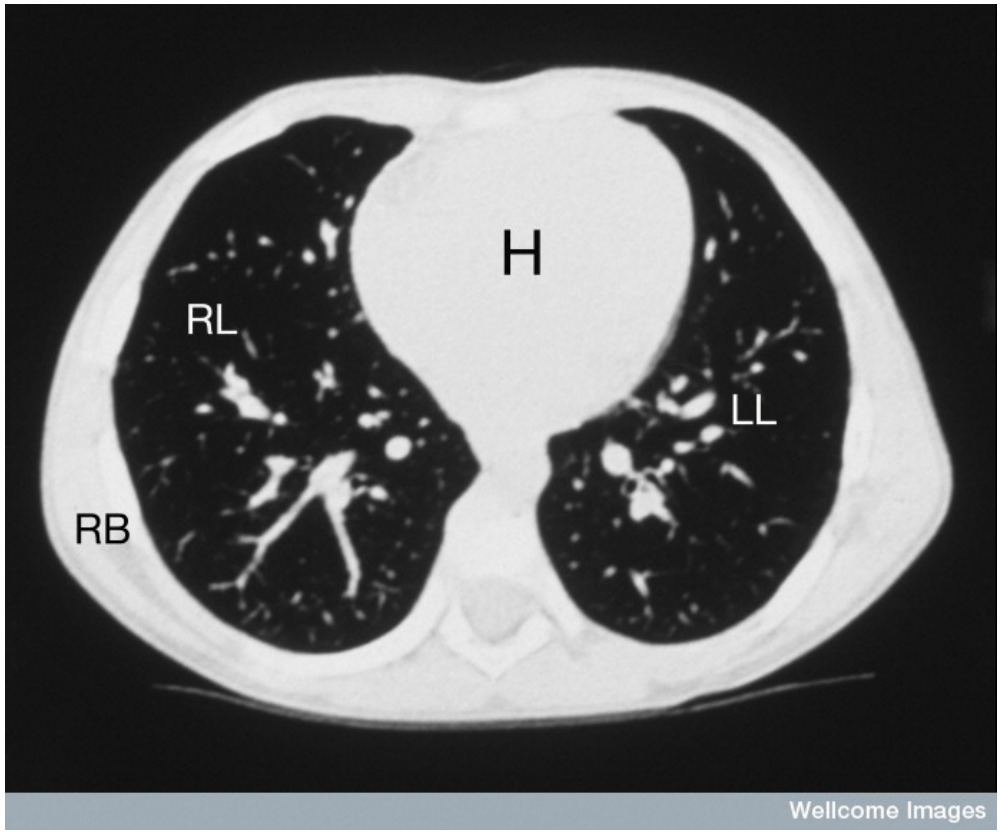
Physical Exam Findings

- Seat-belt or steering wheel imprint.
- May find evidence of rib fractures.
- Left supraclavicular hematoma.
- New murmur.
- In-hospital death between 50-100%, exsanguinating hemorrhage being the most important cause of early death.

Imaging Studies

- CXR
- Spiral CT (97-99.3% sens, 87.1-99.8% spec)
- CTA
- MRI
- TEE
- Intravascular ultrasonography
- Bi-planar angiography

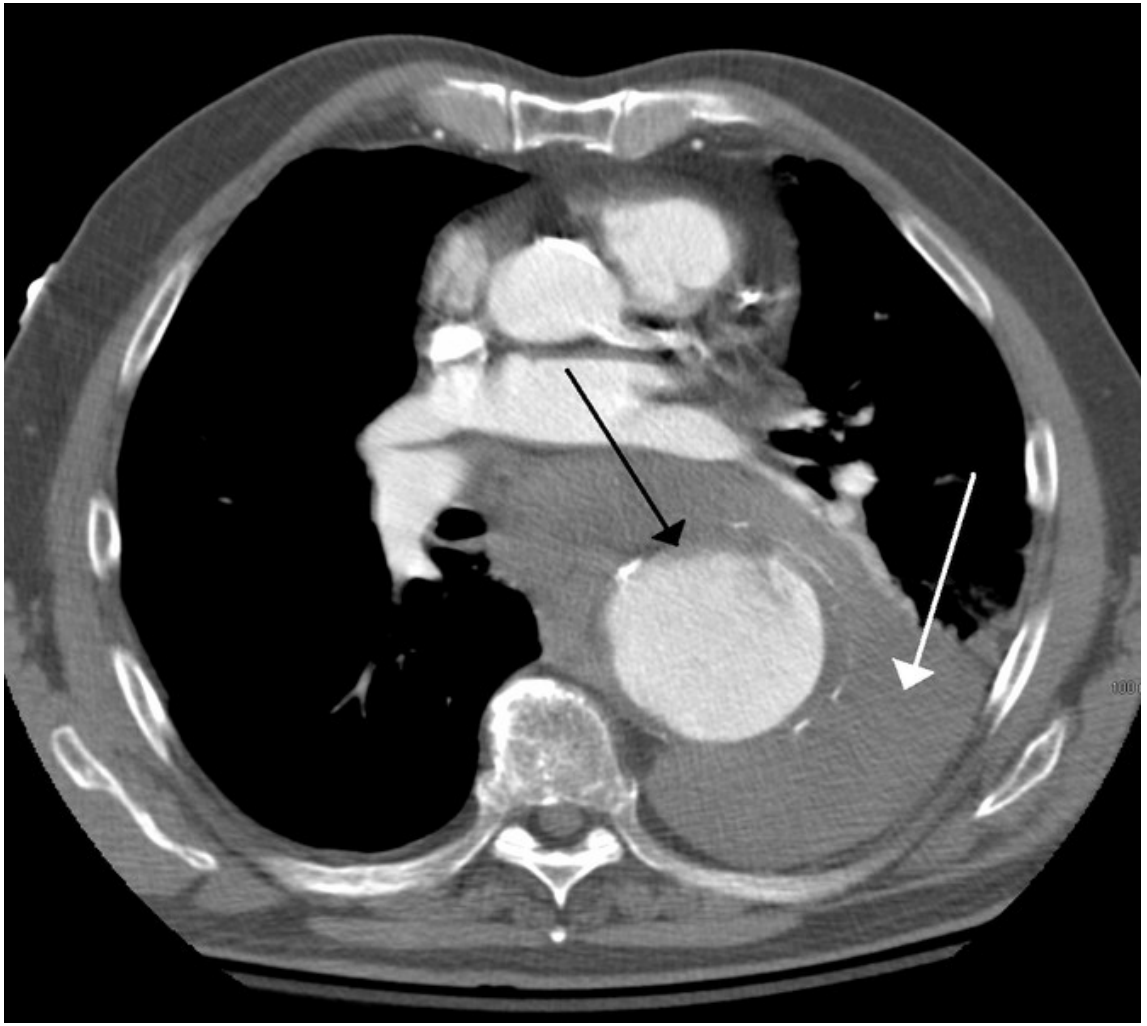
Imaging Studies



Blunt Aortic Injury

- Most commonly thoracic, rarely abdominal.
- Various gradations of injury:
  - Intimal tear.
  - Intramural hematoma.
  - Pseudoaneurysm.
  - Free rupture.

Blunt Aortic Injury



James Heilman, MD, Wikimedia Commons

Blunt Aortic Injury

- Estimated 7,500 - 8,000 cases per year in the United States.
- Blunt thoracic trauma is second most common cause of trauma-related death after head injury.
- Thoracic aortic rupture accounts for nearly 18% of all deaths in motor vehicle collisions.

Blunt Aortic Injury

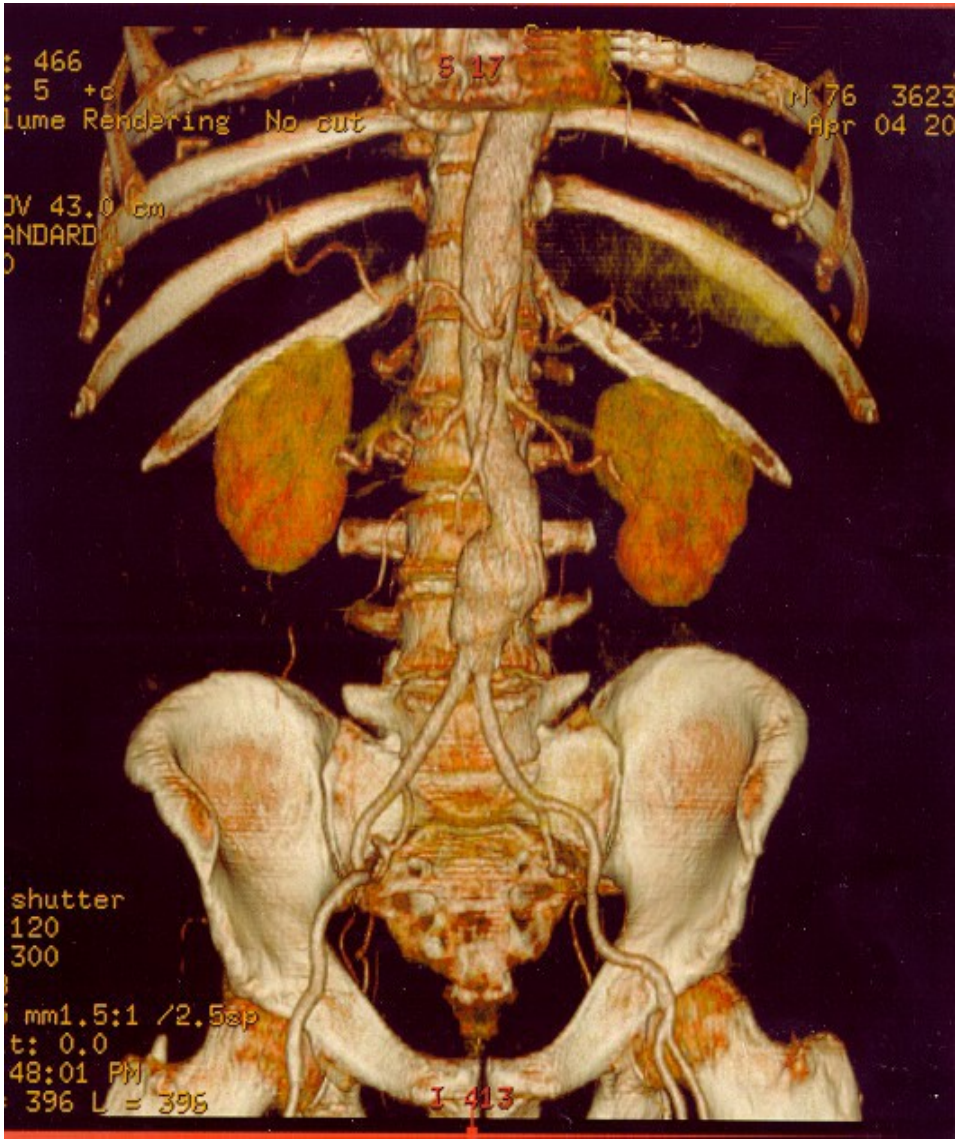
- For those who initially survive, the prognosis remains poor:
  - ~30% die within first 6 hours.
  - 50% will not live beyond the first 24 hours.

TRAINS Score

- Predictors of aortic injury include:
  - Widened mediastinum.
  - BP <90 mmHg.
  - Long bone fracture.
  - Pulmonary contusion.
  - Left scapula fracture.
  - Hemothorax.
  - Pelvic fracture.

Blunt Aortic Injury

- The isthmus is area of greatest strain.
- Tensile strength at the isthmus was found to be only 63% of that of the proximal aorta.
- Aortic ruptures occur at this site in 80% of the pathological series and in 90-95% of the clinical series.



Blunt Aortic Injury

- Rupture (descending order):
  - Isthmus
  - Ascending aorta
  - Aortic arch
  - Distal descending aorta
  - Abdominal aorta

Blunt Aortic Injury

- Theory on mechanism of blunt aortic injury:

  shearing stress during rapid deceleration.

  compression of the aorta between sternum and thoracic spine (osseous pinch).

  direct load causing aortic wall strain and medial tears.

Image removed of blunt aortic trauma

Blunt aortic injury. *N. Engl. J. Med.* 2008;359(16):1708–17
http://www.nejm.org/doi/full/10.1056/nejmra0706159

Blunt Aortic Injury

- Associated extra-thoracic injures are common, particularly abdominal and intracranial.
- Morbidity (amputation and brachial plexus injury) is frequent.

Treatment

- Initially thought to be fatal (Parmley).
- Traditional treatment: early open surgical repair with graft interposition.
- Hemodynamic instability upon presentation remains the main mortality risk factor.

Treatment

- Small pseudoaneurysms and intimal injuries can generally be managed expectantly.
- Delayed repair is safe in certain patient populations.

Treatment

- For hemodynamically stable patients, may start β-blockers to lower MAP and to decrease aortic shear force.

  The target mean arterial pressure is between 60 and 70 mmHg.

- HOWEVER, if there is a significant associated cerebral injury, even mild hypotension may worsen the neurologic outcome and normal blood pressure should be maintained.

Advantage of

- Avoidance of:
  - thoracotomy
  - single-lung ventilation
  - aortic cross clamping
  - left heart or cardiopulmonary bypass.
- Expeditious

Disadvantage of

- Endograft size tends to be large
- Still uncertain complications
  - Migration of graft
  - Erosion of graft
- Unknown long-term outcomes

Possible Complications

- 2 peaks for complications:
  - During the first week: those with major or borderline aortic radiologic injury
  - Between the first and third months

Diagnosis of Aortic Disease

- Maintain a high level of suspicion!
- No one test is perfect.
- CT scan if possible, otherwise TTE/TEE if available.

Bibliography

1. Rooke TW, Hirsch AT, Misra S, et al. 2011 ACCF/AHA Focused Update of the Guideline for the Management of Patients With Peripheral Artery Disease (Updating the 2005 Guideline). *Journal of the American College of Cardiology.* 2011;58(19):2020–2045.

2. Sakalihasan N, Limet R, Defawe O. Abdominal aortic aneurysm. *The Lancet.* 2005;365(9470):1577–1589.

3. Sule A, Ojo E, Ardil B. Abdominal aortic aneurysm and the challenges of management in a developing country: A review of three cases. *Annals of African Medicine.* 2012;11(3):176.

4. Desjardins B, Dill KE, Flamm SD, et al. ACR Appropriateness Criteria(®) pulsatile abdominal mass, suspected abdominal aortic aneurysm. *The international journal of cardiovascular imaging.* 2012. Available at: http://www.ncbi.nlm.nih.gov/pubmed/22644671. Accessed July 4, 2012.

5. Ranasinghe AM, Strong D, Boland B, Bonser RS. Acute aortic dissection. *BMJ.* 2011;343(jul29 2):d4487–d4487.

6. Upadhye S, Schiff K. Acute Aortic Dissection in the Emergency Department: Diagnostic Challenges and Evidence-Based Management. *Emergency Medicine Clinics of North America.* 2012;30(2):307–327.

7. De León Ayala IA, Chen Y-F. Acute aortic dissection: An update. *The Kaohsiung Journal of Medical Sciences.* 2012;28(6):299–305.

8. Booher AM, Eagle KA, Bossone E. Acute aortic syndromes. *Herz.* 2011;36(6):480–487.

9. Steenburg SD, Ravenel JG, Ikonomidis JS, Schönholz C, Reeves S. Acute traumatic aortic injury: imaging evaluation and management. *Radiology.* 2008;248(3):748–762.

10. Lavall D, Schäfers H-J, Böhm M, Laufs U. Aneurysms of the ascending aorta. *Dtsch Arztebl Int.* 2012;109(13):227–233.

11. Rogers R. Aortic Disasters: Are You Missing Them? 2011.

12. Reed and Curtis. Aortic Emergencies: Part I -Thoracic Dissections And Aneurysms. EB Medicine. 2006;8(2). Available at: http://www.ebmedicine.net/topics.php?paction=showTopic&topic_id=24.

13. Reed and Curtis. Aortic Emergencies: Part II - Abdominal Aneurysms And Aortic Trauma. EB Medicine. 2006;8(3). Available at: http://www.ebmedicine.net/topics.php?paction=showTopic&topic_id=27.

14. Neschis DG, Scalea TM, Flinn WR, Griffith BP. Blunt aortic injury. *N. Engl. J. Med.* 2008;359(16):1708–1716.

15. Demetriades D. Blunt Thoracic Aortic Injuries: Crossing the Rubicon. *Journal of the American College of Surgeons.* 2012;214(3):247–259.

16. Jayaraj A, Starnes BW. Contemporary Management of Blunt Aortic Injury. *Perspectives in Vascular Surgery and Endovascular Therapy.* 2011;23(1):49–55.

17. Moysidis T, Lohmann M, Lutkewitz S, Kemmeries G, Kröger K. Cost associated with D-Dimer screening for acute aortic dissection. *Advances in Therapy.* 2011;28(11):1038–1044.

Bibliography

18. Booher AM, Eagle KA. Diagnosis and management issues in thoracic aortic aneurysm. *Am. Heart J*. 2011;162(1):38–46.e1.

19. Fattori R, Russo V, Lovato L, Di Bartolomeo R. Optimal Management of Traumatic Aortic Injury. *European Journal of Vascular and Endovascular Surgery*. 2009;37(1):8–14.

20. Bossone E, Evangelista A, Isselbacher E, et al. Prognostic role of transesophageal echocardiography in acute type A aortic dissection. *American Heart Journal*. 2007;153(6):1013–1020.

21. Filardo G, Powell JT, Martinez MA-M, Ballard DJ. Surgery for small asymptomatic abdominal aortic aneurysms. In: The Cochrane Collaboration, Filardo G, eds. Cochrane Database of Systematic Reviews. Chichester, UK: John Wiley & Sons, Ltd; 2012. Available at: http://doi.wiley.com/10.1002/14651858.CD001835.pub3. Accessed July 4, 2012.

22. Badger SA, Jones C, McClements J, et al. Surveillance strategies according to the rate of growth of small abdominal aortic aneurysms. *Vascular Medicine*. 2011;16(6):415–421.

23. Thrumurthy SG, Karthikesalingam A, Patterson BO, Holt PJE, Thompson MM. The diagnosis and management of aortic dissection. *BMJ.* 2012;344(jan11 1):d8290–d8290.

24. Flanagan L, Bancroft R, Rittoo D. The value of d-dimer in the diagnosis of acute aortic dissection. *International Journal of Cardiology*. 2007;118(3):e70–e71.

25. Elefteriades JA. Thoracic Aortic Aneurysm: Reading the Enemy's Playbook. *Current Problems in Cardiology.* 2008;33(5):203–277.

26. Mosquera VX, Marini M, Muñiz J, et al. Traumatic aortic injury score (TRAINS): an easy and simple score for early detection of traumatic aortic injuries in major trauma patients with associated blunt chest trauma. Intensive Care Medicine. 2012. Available at: http://www.springerlink.com/index/10.1007/s00134-012-2596-y. Accessed July 5, 2012.

27. Anon. Volume 1/PART III/Section Four/Chapter ... from Rosen.

Questions?