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Make Your Own Assessment

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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

James Heilman, MD, Wikimedia Commons
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

<table>
<thead>
<tr>
<th>Radiologic procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>US aorta abdomen</td>
<td>9</td>
<td>Initial examination. May be limited by body habitus or acoustic window</td>
<td>O</td>
</tr>
</tbody>
</table>
| 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
Aortic Aneurysm

James Heilman, MD, Wikimedia Commons
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

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.
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
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.
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

- Associated extra-thoracic injuries 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.
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


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