Objectives

• To review common CTA findings of acute aortic syndromes

• To review unusual manifestations and complications of these conditions

• To discuss important imaging findings that need to be urgently communicated to the surgeon/IR radiologist

Acute Aortic Syndromes

• Medical emergency

• Present with acute chest pain

• Characterized by high risk of aortic rupture and sudden death

Acute Aortic Syndromes

• Aortic dissection

• Intramural hematoma (IMH)

• Penetrating atherosclerotic ulcer

Acute Aortic Syndromes

• Causal relationship is proposed linking ulceration, IMH and aortic dissection

• Some patients exhibit some/all the above or may progress from one to the other – demonstrating a link
**Imaging Options**
- CXR
- Aortography
- TEE – hemodynamically unstable
- CTA – hemodynamically stable
- MRA – hemodynamically stable

**CTA**
- First line imaging test
- Readily available
- Rapid specific diagnosis of aortic pathology
  - Sensitivity: 100%
  - Specificity: 100%

**Technique:**
**Non-Contrast**

*Remy-Jardin et al, Radiology 2007; 245:315-329*

**High attenuation Acute IMH**

**Technique:**
**Contrast Enhanced CT Angiography**

*Remy-Jardin et al, Radiology 2007; 245:315-329*
CTA

- 70-120 ml Isovue 370
- Rate – 4-5 mL/sec
- Timing bolus or triggered delay
- Slice thickness: 1.25 mm
- Recon: 0.625/1.25
- Pitch: 1.375:1
- ECG-gating

MDCT Technique – MPR/3D

- Useful for communicating findings to surgeons/clinicians
- May be useful at branch points for deciding endovascular or surgical approach

Acute Aortic Syndromes

- Aortic dissection
- Intramural hematoma (IMH)
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Acute Aortic Syndromes

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Aortic Dissection

- Most common thoracic aortic emergency
- Males>Females
- Ascending aortic dissection:
  - Untreated: Mortality
    - 36-72% - 48 hours
    - 62-91% - 1 month
  - Treated: 75% 5-year survival

Aortic Dissection – Risk Factors

- Hypertension
- Aging
- Genetic
- Predisposing weakness of aortic wall
  - Cystic medial necrosis
- Pregnancy
- Bicuspid Aortic Valve
- Aortic surgery/catheterization
- Coarctation
- Loetz Dietz Syndrome

Aortic Dissection – Presentation

- Classic: Acute severe substernal tearing pain radiating to back (>70%)
- Aortic insufficiency
- Asymmetric pulses – upper limbs
- Absent femoral pulses (25%)

Atypical Presentation

- No chest pain – 15-20%
- Symptoms from branch vessel involvement
  - Chest pain and SOB - MI and CHF
  - Abdominal pain - Mesenteric ischemia
  - Stroke, confusion, coma, syncope

Aortic Dissection – Mechanism

- Tear in aortic intima
- Longitudinal split in media
- Creation of false channel in media
- Acute dissection is considered chronic at 2 weeks
**Typical Appearance**

- Typical double barreled dissection
- >75% of cases
- 2 or > opacified lumens
- Smooth spiraling flap
- ± differential enhancement of lumens
- Discontinuities in flap: intimal tears

**Atypical Appearance**

- Intramural hematoma
- Noncommunicating lumens
- Nonopacified crescentic or circumferential false lumen
- Non contrast images: high attenuation crescent or circumferential false lumen
- Displaced intimal calcification

**Acute Intramural Hematoma – Noncontrast Images**

**CT Review**

- Determine extent (Type A vs. B)
- Identify:
  - True and false lumens
  - “Entry” and “reentry” tears
  - Source of perfusion of major branches
    - True
    - False
    - Both/indeterminate
  - Complications
Aortic Dissections

- Classic AD begin at 3 distinct sites
  - Aortic root
  - 2 cm above aortic root
  - Just distal to the left subclavian takeoff

Dissection - Classification

DeBakey
- Type I: tear in ascending aorta, flap in ascending and descending aorta
- Type II: tear in ascending, flap in ascending aorta
- Type III: tear in descending, flap in descending aorta

Stanford
- Type A: flap in ascending aorta
- Type B: flap not in ascending aorta

Stanford Type A
- Surgical Emergency
- May result in death from
  - Wall rupture
  - Hemopericardium and tamponade
  - Occlusion of coronary ostia with MI
  - Severe aortic insufficiency

Common Adventitia with PA
Identify Lumens – True vs. False

False Lumen
- Beak sign
- Lumen size – Usually larger
- Differential flow
- Intraluminal thrombus
- Outer wall calcification
- Cobwebs

LePage MA et al, AJR 2001; 177:207

Differential Flow

True lumen central and small

False lumen

Beak Sign
Cobwebs

LePage MA et al, AJR 2001; 177:207

What happens to the false lumen?
- Thromboses
- Decreases in size over time
- Increases in size over time – aneurysmal
- Ruptures

Perfusion of major branches
- Arch
- Celiac
- SMA
- Renals
- IMA
Perfusion of major branches

- Arch vessels – innominate, left common carotid and left subclavian

Perfusion of major branches

- Celiac
- SMA
- IMA

Perfusion of major branches

- Right renal
- Left Renal
- Iliacs

Dissection – Acute Complications

- Branch vessel compromise – static or dynamic
- Mortality significantly increases with end organ ischemia
  - Brain
  - Heart
  - Bowel
  - Kidney
  - Spinal Cord

Static and Dynamic Obstruction

Williams DM et al; Radiology 1997; 203:37-44
Circumferential tear with Intimo-intimal Intussusception

Emergent Surgical Correction
- Stanford Type A
- Complicated Type B
  - Increasing aortic diameter/hematoma
  - Branch vessel compromise
  - Impending rupture
  - Persistent pain despite adequate analgesia
  - Bleeding into pleural cavity
  - Development of saccular aneurysm

Acute Aortic Syndromes
- Aortic dissection
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Intramural Hematoma (IMH)
- Spontaneous hematoma into aortic media from vasa vasorum infarction
- Variant of dissection
- Classic dissection – intimal flap present
- IMH – intimal flap absent
  - Absence of reentrance tear from media into lumen leads to development of IMH
- Elderly

IMH – Imaging Findings
- Relatively circumferential
- High attenuation on NC images
- High attenuation masked on CE images
- No entrance tear
- No direct communication between IHM and the aortic lumen
- No flow in hematoma

Acute Intramural Hematoma
**Aortic Branch Artery Pseudoaneurysms**
- Isolated pockets of contrast
- Sometimes seen in thrombosed FL
- Intercostal artery origin
- Dissection has sheared off arteries at their origins

**Intramural Blood Pools – Branch Artery Pseudoaneurysms**

**IMH Findings asso with ↑ Mortality**
- Stanford Type A
- Mural thickness >10 mm
- Aortic diameter >5 cm
- Presence of penetrating ulcer
- Rebleeding on serial imaging
- Extension of thrombus on serial imaging

**Acute Aortic Syndromes**
- Aortic dissection
- Intramural hematoma (IMH)
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**Penetrating Atherosclerotic Ulcer**
- Focal irregular outpouching of contrast from atherosclerotic plaque eroding the internal elastic lamina and penetrating the media
- Often in presence of extensive atheroma
- Location – descending thoracic aorta
Acute Aortic Syndromes

- Aortic dissection
- Intramural hematoma (IMH)
- Penetrating atherosclerotic ulcer
- Aneurysm rupture

Aortic Rupture

- Periaortic hematoma or contained rupture is more common with IMH than classic AD (IRAD Registry)

Aortic Rupture – CT Findings

- Hyperdense thickening of aortic wall (blood collects between partially disrupted aortic wall layers)
- Mediastinal hematoma
- Hemorrhagic pleural effusion
- Hemo-pericardium (less common)
- Impending hypovolemic shock:
  - Decrease in calibre of central vessels or excessive enhancement of aorta relative to injection

Contained Aortic Rupture

Acute Aortic Syndromes

- Cannot be distinguished from each other clinically

- Imaging is crucial for:
  - Determining the type of AAS
  - Identifying the location
  - Determining the extent of the pathology
  - Identifying anatomic complications

Take Home Points

Recognize and urgently communicate findings of AAS that may require emergent surgery/intervention:
References


Thank You

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