



Diseases of the Aorta for  
USMLE Step One

Part 1: Aneurysm and Dissection

Part 2: Coarctation and Aortitis

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# Key Aortic Conditions

## Part I

- Aneurysm
- Dissection

## Part II

- Coarctation
- Aortic manifestations of systemic disease

# Key Aortic Conditions

- **Aneurysm**
  - Risk factors, pathology, physical exam description
- **Dissection**
  - Risk factors, presentation, pathology, complications
- Coarctation
- Aortic manifestations of systemic disease

# Key Aortic Conditions

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  - Risk factors, pathology, physical exam description
- **Dissection**
  - Risk factors, presentation, pathology, complications

Comparing and contrasting  
these two entities forms the basis of NBME inquiries

# Key Aortic Conditions

- Aneurysm
  - Risk factors, pathology, physical exam description
- Dissection
  - Risk factors, presentation, pathology, complications
- Coarctation
  - Severity of stenosis, disease associations
    - PDA (patent ductus arteriosus)
- Aortic manifestations of systemic disease

# Key Aortic Conditions

- Aneurysm
  - Risk factors, pathology, physical exam description
- Dissection
  - Risk factors, presentation, pathology, complications
- Coarctation
  - Severity of stenosis, disease associations
    - PDA
- Aortic manifestations of **systemic disease**
  - Aortitis: Takayasu syndrome and tertiary syphilis

# Key Aortic Conditions

Prototypic inflammatory and infectious disorders

- Aortic manifestations of **systemic disease**
  - Aortitis: Takayasu syndrome and tertiary syphilis

# (Abdominal) Aortic Aneurysm

- Background
  - Risk factors (**atherosclerosis**)
    - **Tobacco**, HTN, HLD
  - Demographics:
    - Advanced age: **male >65**





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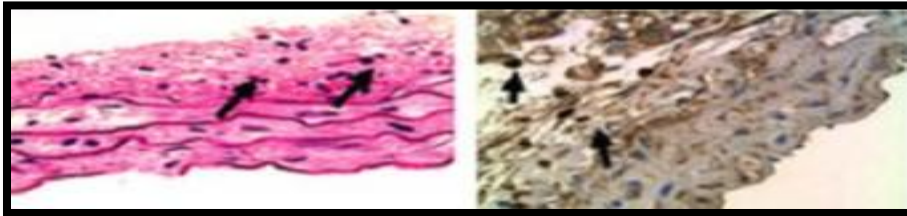
Sachs didn't forget DM.  
DM is a negative RF.



# (Abdominal) Aortic Aneurysm

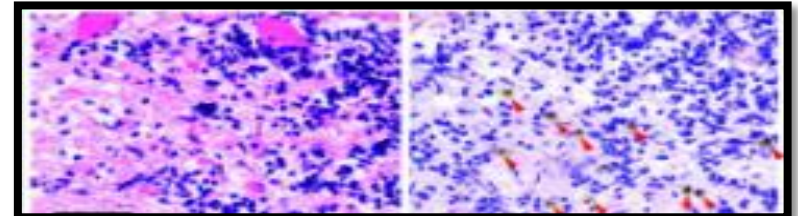
- Pathology

- **Transmural inflammation** with predominance of lymphocytes and ( $M\Phi$ )  
→ release of **metalloproteinase**/elastase
- Result: **degradation of the extracellular matrix** → weakening and progressive expansion of the aortic wall
  - Tenuous perfusion of vaso vasorum creates relative ischemia of the media



Transmural  
Inflammation

$M\Phi$  (+) stain



Transmural  
Inflammation

MMP (+) stain

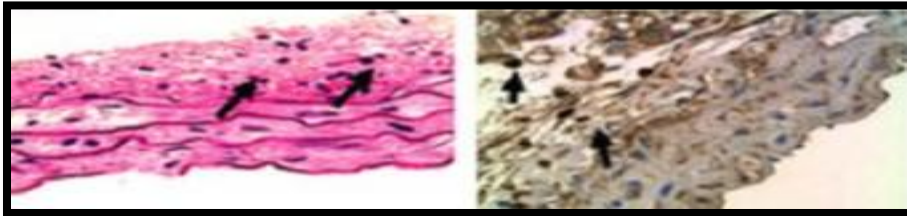
# (Abdominal) Aortic Aneurysm

- Pathology

Recurrent theme

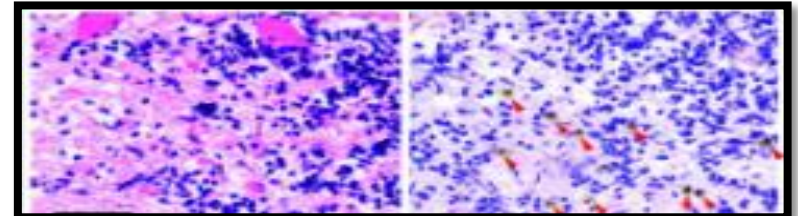


- Tenuous perfusion of vaso vasorum creates relative ischemia of the media



Transmural  
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Transmural  
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# (Abdominal) Aortic Aneurysm

- Clinical Presentation
  - Pulsatile mass, rupture
- Diagnostics
  - U/S, Angiography (CT/MR)
- Management
  - Serial assessment until 5.5 - 6.0 cm
    - >6.0 cm: 25% rupture
  - Surgery: open or endovascular repair



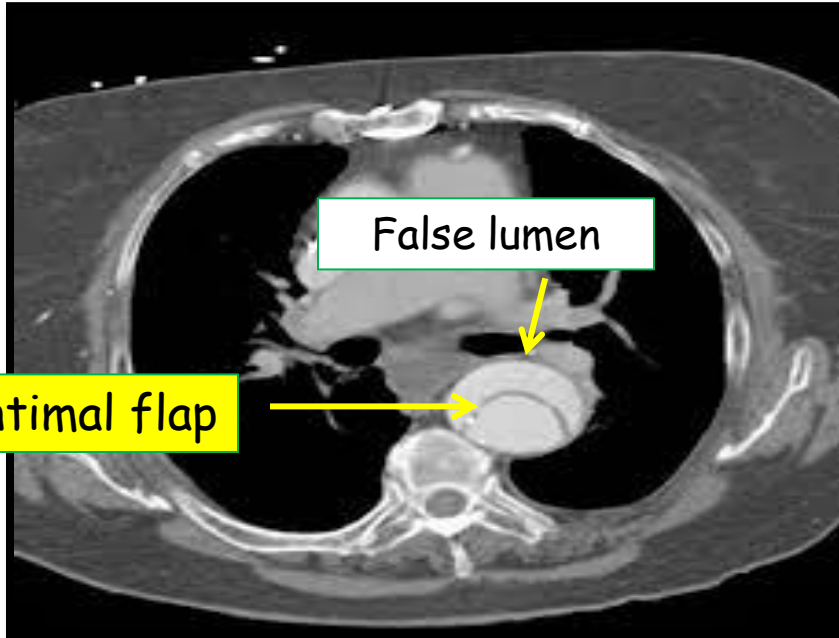
# (Abdominal) Aortic Aneurysm

- Clinical Presentation
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Auscultation: renal artery bruits (or high pitched bowel sounds).

# Aortic Dissection: Key Points



Intimal tear → false lumen

Vocabulary:

Abrupt onset of pain with  
ripping or tearing

HTN

Marfan's (or Ehlers-Danlos)

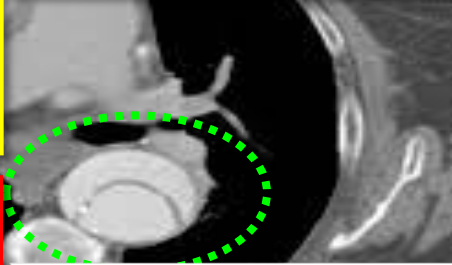


# Aortic Dissection: Key Points

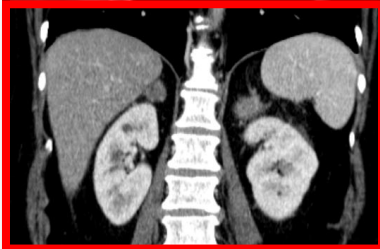


Hemopericardium  
(tamponade)

Aortic regurg, acute



Flank pain  
Ischemic renal injury  
(gross hematuria)



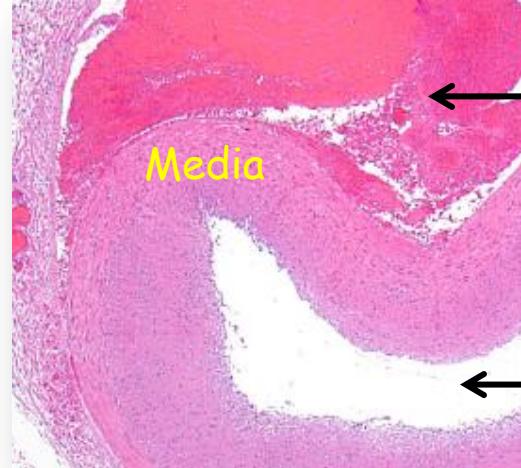
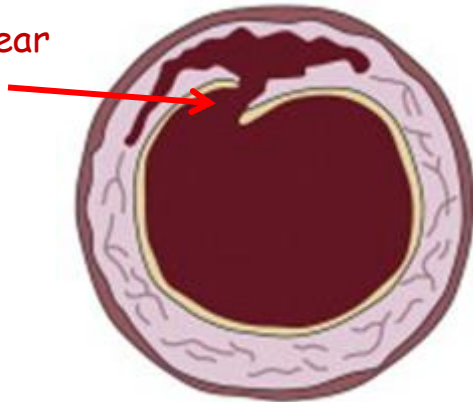
Where does that little tear in  
the intima travel?



# Aortic Dissection

- Background:
  - Risk factors: HTN and cystic medial necrosis (e.g. Marfan's)
- Pathogenesis
  - HTN → shear forces → intima tear → **dissects media** (false lumen)

Intimal tear

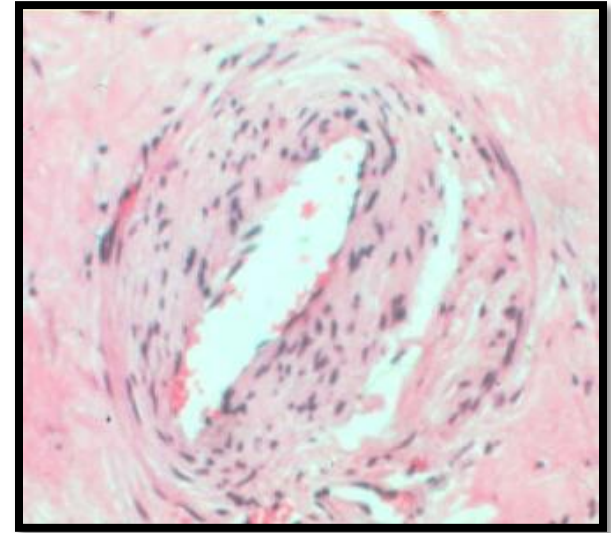
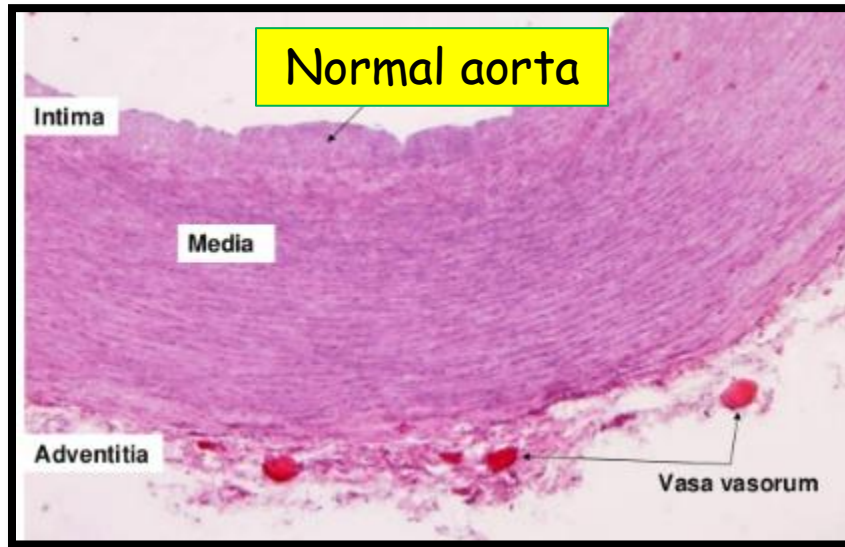


Clot in vessel wall  
(false lumen)

Lumen



# Aortic Dissection: Pathology



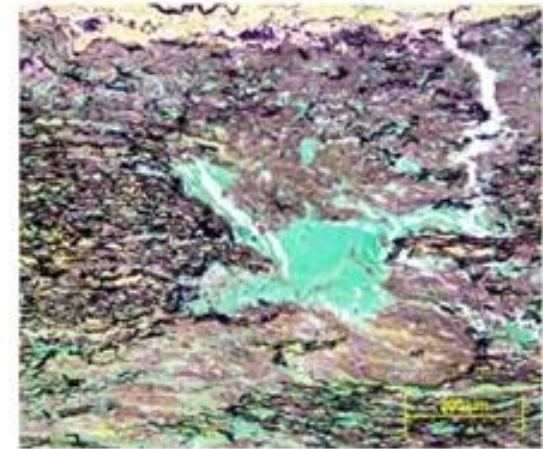
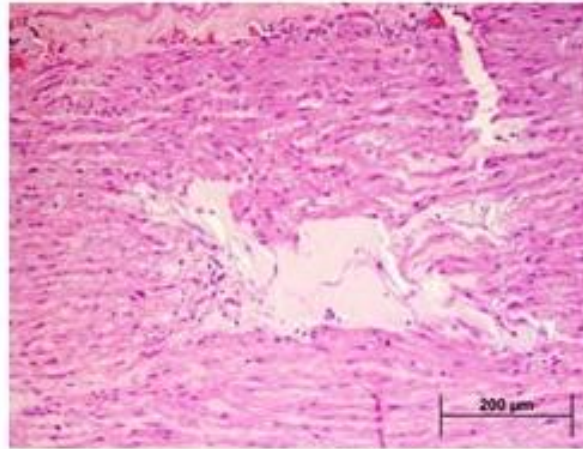
Majority have normal histology

Arteriolar hyalinosis of vasa vasorum →  
ischemia/degeneration of ECM of the media

# Aortic Dissection

- Background:
  - Risk factors: HTN and cystic medial necrosis (e.g. Marfan's)
- Pathogenesis
  - HTN → shear forces → intima tear → raises flap (false lumen)
- Pathology
  - Cystic medial necrosis

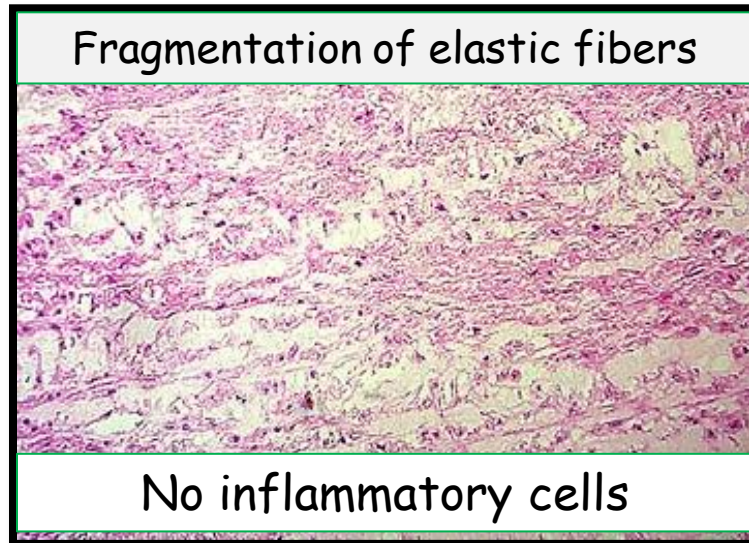
Fragmentation of elastic fibers with deposition of proteoglycans →  
cyst-like spaces



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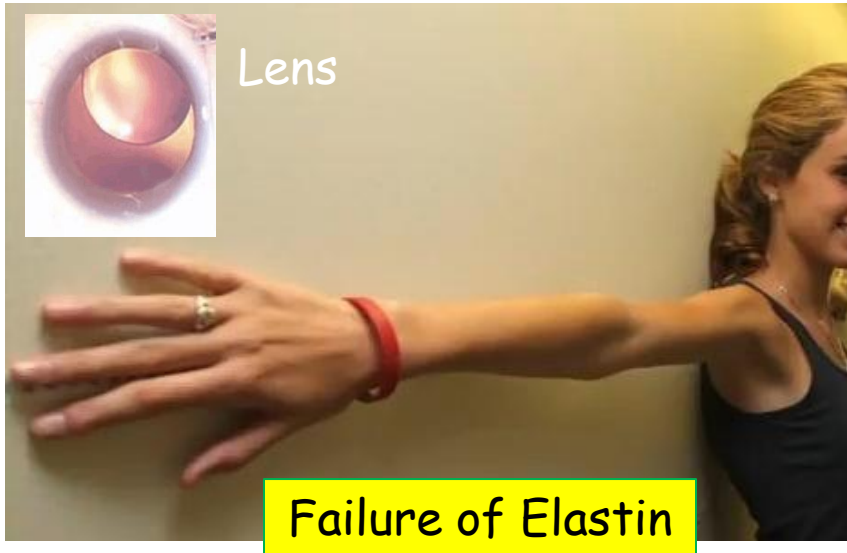
**Absence of  
(transmural) inflammation**



Marfan's: mutation of **Fibrillin-1** →  
functions as a scaffolding for the  
deposition of **Elastin**

Elastin failure:

Blood vessel - **dissection** (1° mortality)  
Periosteum - **MSK** manifestations  
Suspensory ligament, lens - **dislocation**



Cystic Medial  
Necrosis

Marfan's: mutation of **Fibrillin-1** →  
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Elastin failure:

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Ehlers-Danlos (family of disorders):  
Abnormal synthesis or processing of  
**Collagen**

**Normal elastin:** skin is hyperdistensible  
and 'snaps' back into place.

Collagen Failure:

Joint hypermobility  
**Tissue fragility** →  
Rupture of organs or blood vessels



**Snap's Back**  
(healthy elastin)

# Aortic Dissection

- Clinical Presentation
  - Abrupt onset of severe chest pain (**ripping, tearing, knife-like**) radiating to mid/upper back
  - Pulse asymmetry and/or deficit
- Clinical Manifestations
  - Organ Hypoperfusion
  - Damage → Aortic Root



# Aortic Dissection

- Clinical Manifestations
  - Organ Hypoperfusion
    - **Carotids**: stroke



# Aortic Dissection

- Clinical Manifestations
  - Organ Hypoperfusion
    - Carotids: stroke
    - Renal arteries
      - AKI
      - Symptoms
        - » Flank pain
        - » Hematuria



Renal hypoperfusion =  $\uparrow$  RAA



# Aortic Dissection

- Clinical Manifestations
  - Organ Hypoperfusion
    - Carotids: stroke
    - Renal arteries
    - Shock
      - Tamponade
      - Coronary ischemia
      - Exsanguination

# Aortic Dissection

- Clinical Manifestations
  - Organ Hypoperfusion
  - Damage → Aortic Root
    - Acute aortic insufficiency
    - Hemopericardium (tamponade)



# Aortic Dissection

- Clinical Manifestations
  - Organ Hypoperfusion
  - Damage → Aortic Root
    - Acute aortic insufficiency
      - Severe chest pain
      - SOB/CHF
      - Widened pulse pressure/↓ BP
      - Diastolic murmur



# Aortic Dissection

- Clinical Manifestations
  - Organ Hypoperfusion
  - Damage → Aortic Root
    - Acute aortic insufficiency
      - Severe chest pain
      - SOB/CHF
      - Widened pulse pressure/↓ BP
      - Diastolic murmur

Acute AI: diastolic murmur at RSB  
Chronic AI: diastolic murmur at LSB



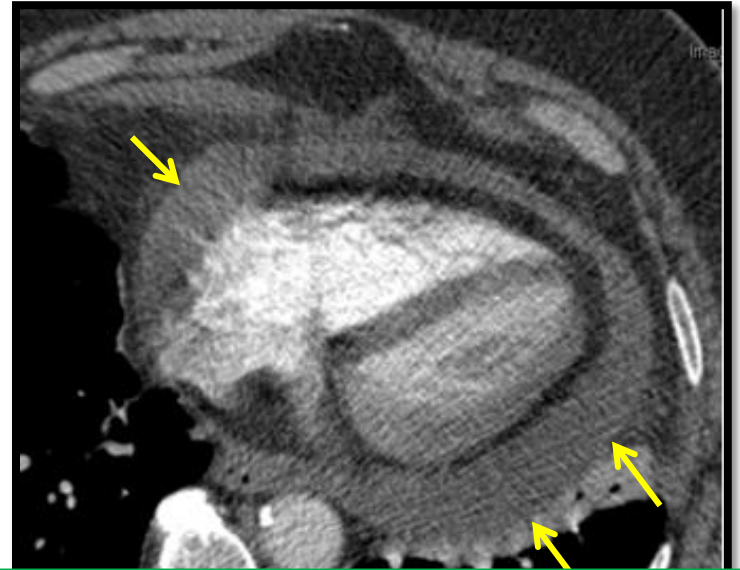
# Aortic Dissection

- Clinical Manifestations
  - Organ Hypoperfusion
  - Damage → Aortic Root
    - Acute aortic insufficiency
    - Hemopericardium (tamponade)
      - Cardiogenic Shock
      - Pulsus paradoxus
      - Autopsy



# Aortic Dissection

- Clinical Manifestations
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  - Damage → Aortic Root
    - Acute aortic insufficiency
    - Hemopericardium (tamponade)
      - Cardiogenic Shock
      - Pulsus paradoxus
      - Autopsy



Patient presents with midchest pain radiating to his back. Noted with a drop in systolic BP during inspiration (i.e. pulsus paradoxus). Which of following will be also be discovered at autopsy?  
Intimal tear, false lumen, hemopericardium

# Aortic Dissection

- Special Notes:
  - Aortic trauma
    - Tears in the arch occur at the ligamentum arteriosum



Ligamentum Arteriosum



# Key Features

## Aneurysm

- Atherosclerosis, Tobacco
- Palpable, Pulsatile Mass
- Pathology
  - Transmural inflammation
  - MΦ elaborate MMP

## Dissection

- HTN, Marfan's
- Chest Pain → upper back
  - Ripping, Tearing
- Pulse asymmetry
  - AI or pulsus paradoxus
- Pathology
  - Intimal tear → Media dissection
  - Cystic medial necrosis (elastin)
- Trauma
  - Ligamentum arteriosum (arch)





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