

Cardiovascular Pathology

Aortic Aneurysm

Definition

Localized, pathologic dilation of the aorta 

 May present with:

- Abdominal pain
- Back pain

These symptoms can signal:

- Leak 
 - Dissection 
 - Imminent rupture 
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Core Pathogenesis

Pathophysiology Flowchart

Weakening of aortic wall → Progressive dilation of vessel
→ Turbulent blood flow → Further wall stress →
Expansion ± rupture

Important Association

Cystic Medial Degeneration

Degeneration of elastic tissue in tunica media →
Weakens vessel wall

Associated with:

- Hypertension
 - Marfan syndrome
 - Bicuspid aortic valve
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Major Types

Type	Key Association
Thoracic aortic aneurysm	HTN, connective tissue disease
Abdominal aortic aneurysm (AAA)	Atherosclerosis + smoking

1 Thoracic Aortic Aneurysm (TAA)



Risk Factors

Risk Factor	Notes
Hypertension	Most important
Bicuspid aortic valve	Congenital predisposition
Marfan syndrome 	Connective tissue weakness
Syphilis 	Vasa vasorum destruction



Syphilitic Aneurysm



Mechanism

Tertiary syphilis → Obliterative endarteritis of vasa vasorum → Ischemic damage to aortic media → Weakening + dilation of ascending aorta

⚠ Important Complication

Aortic root dilation → Aortic valve cannot close properly → Aortic regurgitation

🧠 Clinical Clues

- Chest pain
 - Back pain
 - Widened mediastinum (if severe)
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② Abdominal Aortic Aneurysm (AAA)

📌 Definition

Dilation of abdominal aorta, usually:




★ Infrarenal

Why infrarenal? → Fewer vasa vasorum in this region

 Pathophysiology Flowchart


Atherosclerosis + chronic inflammation → Extracellular matrix degradation → Weakening of vessel wall → Progressive dilation → AAA formation

! Major Risk Factors


Risk Factor	Importance
Smoking 	MOST important
Increasing age 	Vessel degeneration
Male sex	Higher prevalence
Family history 	Genetic predisposition

Clinical Features


May Present As:

- Pulsatile abdominal mass 
 - Abdominal pain
 - Back pain
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Ruptured AAA — Classic Triad


Feature	Explanation
Pulsatile abdominal mass	Enlarged aorta
Sudden abdominal/back pain 	Rupture/leak
Hypotension	Hemorrhagic shock

Exam Pearls


- AAA rupture = surgical emergency 
- Smoking is the strongest modifiable risk factor
- Most AAAs are infrarenal

Traumatic Aortic Rupture

Cause

Severe trauma or rapid deceleration injury 

Most Common Site

 Aortic isthmus

Located:

- Just distal to left subclavian artery
 - Proximal descending aorta
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Why This Site?

Aortic arch moves during deceleration

BUT descending aorta is relatively fixed → Shearing forces occur at isthmus

Classic Imaging Finding

- Widened mediastinum on chest X-ray
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Pathophysiology Flowchart

Rapid deceleration injury → Shearing stress at aortic isthmus → Partial/complete aortic tear → Massive internal hemorrhage → Shock/death if untreated

Quick Comparison Table

Feature	Thoracic Aneurysm	Abdominal Aneurysm
Main Cause	HTN/connective tissue disease	Atherosclerosis

Common Site	Ascending thoracic aorta	Infrarenal abdominal aorta
Major Risk Factor	Hypertension	Smoking
Major Complication	Aortic regurgitation	Rupture

High-Yield Associations


Disease/Condition	Association
Marfan syndrome	Thoracic aneurysm
Syphilis	Ascending aortic aneurysm
Smoking	AAA
Deceleration injury	Aortic rupture at isthmus


Exam Traps

- Tertiary syphilis → ascending thoracic aneurysm
- AAA = infrarenal
- Widened mediastinum after trauma = aortic rupture
- Pulsatile abdominal mass = AAA until proven otherwise

High-Yield Summary

Thoracic Aneurysm = Media degeneration problem 

Abdominal Aneurysm = Atherosclerotic + inflammatory weakening 

Traumatic Aortic Rupture = Deceleration injury at aortic isthmus 

Aortic Dissection

Definition


A tear in the aortic intima allows blood to enter the vessel wall → creating a false lumen

 This is a medical emergency


Pathophysiology Flowchart

Intimal tear develops → Blood enters tunica media → Dissects longitudinally through vessel wall → Formation of false lumen → Compromised branch vessel flow → Organ ischemia / rupture / death

Major Risk Factors

Risk Factor	Importance
Hypertension	★ MOST IMPORTANT
Marfan syndrome 	Connective tissue weakness
Bicuspid aortic valve	Structural abnormality
Other connective tissue disorders	Medial degeneration


Classic Presentation

 "Tearing" chest pain

- Sudden onset 

- Radiates to the back
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Other Findings

Feature	Explanation
Unequal BP in arms 	Different branch vessel involvement
Mediastinal widening on CXR	Enlarged dissected aorta
Pulse deficits	Reduced arterial flow
Organ ischemia	Branch vessel obstruction

Major Complications

Complication	Mechanism
Aortic rupture	Catastrophic hemorrhage
Organ ischemia	Vessel occlusion
Cardiac tamponade 	Blood enters pericardial sac
Acute aortic regurgitation	Aortic root involvement



Stanford Classification

● Stanford Type A (Proximal)

📌 Definition

Involves:

- Ascending aorta

May extend into:

- Arch
 - Descending aorta
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Dangerous Complications

Complication	Why It Happens
Acute aortic regurgitation	Aortic root dilation
Cardiac tamponade	Rupture into pericardium

 Treatment: SURGERY


 Stanford Type B (Distal)

 Definition

Involves only:

- Descending aorta
 - Distal to left subclavian artery
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 Treatment

1. β -blockers first  \rightarrow Reduce shear stress
 2. Then vasodilators
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 Easy Memory Trick

Type	Meaning	Treatment
A	Ascending	A = Act surgically 

B	Below subclavian	BP control 
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DeBakey Classification (Less Tested but Important)


Type	Involvement
Type I	Ascending + descending
Type II	Ascending only
Type III	Descending only

Why β -Blockers First?

Pathophysiology

β -blockers:

- \downarrow Heart rate
- \downarrow Contractility
- \downarrow Shear force on aortic wall

 Vasodilators alone can cause reflex tachycardia \rightarrow worsen dissection

Exam Pearls

- Tearing chest pain radiating to back = classic clue
 - HTN = strongest risk factor
 - Marfan + chest pain → suspect dissection
 - Mediastinal widening = important imaging clue
 - Type A = surgery
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Aortic Aneurysm vs Aortic Dissection

Feature	Aneurysm	Dissection
Pathology	Vessel dilation	Intimal tear
Pain	Often asymptomatic	Sudden severe tearing pain
Major Risk	Rupture	Rupture + ischemia
Imaging	Dilated vessel	False lumen

Subclavian Steal Syndrome

Core Defect

Stenosis of subclavian artery before vertebral artery origin


Pathophysiology:

- ◆ Step 1: The setup (key anatomy)
 - Subclavian artery supplies the arm
 - Vertebral artery branches off the subclavian and goes to the brain

 Normally:

Subclavian → Vertebral → Brain (antegrade flow)

- ◆ Step 2: What goes wrong?

 Stenosis BEFORE the vertebral artery origin

So:

- Blood can't flow properly into distal subclavian → arm gets low perfusion
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◆ Step 3: Pressure gradient flips

- Distal subclavian pressure ↓ ↓ ↓ (because of stenosis)
- Vertebral artery (connected to brain circulation) has relatively higher pressure

👉 Blood flows from high → low pressure

🔥 Step 4: "Steal" phenomenon

👉 Blood now flows:

Brain → Vertebral artery → Subclavian → Arm

Reversal of vertebral artery flow

● Step 5: Consequence

👉 Blood is "stolen" from posterior brain circulation →

↓ supply to:

- Brainstem
- Cerebellum

👉 Leads to vertebrobasilar insufficiency

🧠 Symptoms

🦾 Arm Findings

- Arm ischemia
- Pain
- Paresthesias

🧠 Brain Findings

- Dizziness
- Vertigo
- Syncope

- Visual symptoms

Especially during:

⚡ Exertion of affected arm

👂 Important Clinical Clue

>15 mm Hg systolic BP difference between arms

⚠ Associations

Condition	Mechanism
Atherosclerosis	Most common
Takayasu arteritis	Large vessel inflammation
Heart surgery	Vascular injury

🧠 Exam Pattern Recognition

Classic Stem

Older patient:

- Arm fatigue during use
- Dizziness/vertigo
- Different arm BPs

→ Think subclavian steal syndrome

Final High-Yield Summary


Aortic Dissection =  Intimal tear creating false lumen

Type A

- Ascending involvement
- Surgery 

Type B

- Descending only
 - β -blockers first 
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Subclavian Steal Syndrome =  Vertebral artery flow reversal due to proximal subclavian stenosis

 Must-Know Exam Clues

- Tearing chest pain → aortic dissection
 - Unequal arm BPs → dissection or subclavian steal
 - Type A → surgery
 - Arm exercise causing vertigo → subclavian steal
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-> The End <-