

Cardiovascular Pathology




Hypertension






Definition

Persistent:

- Systolic BP \geq 130 mm Hg
AND/OR
 - Diastolic BP \geq 80 mm Hg
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Risk Factors

Risk Factor	Notes
↑ Age 	Vessel stiffness increases
Obesity 	↑ Cardiac workload
Diabetes 	Endothelial damage

Physical inactivity 	↑ Cardiovascular risk
High-sodium diet 	Water retention
Excess alcohol 	Sympathetic activation
Tobacco smoking 	Endothelial injury
Family history 	Genetic predisposition

Epidemiology

Incidence:

Black > White > Asian populations

Types of Hypertension

Primary (Essential) Hypertension —  90%

Mechanism

Usually due to:

- ↑ Cardiac output (CO)
- AND/OR
- ↑ Total peripheral resistance (TPR)

! Important

- No single identifiable cause
 - Multifactorial (genetics + environment)
-

2 Secondary Hypertension — ~10%

📌 Usually Due To:

Cause	Key Clue
Renal disease 🩺	Most common secondary cause
Renovascular disease	Renal artery stenosis
Primary hyperaldosteronism	Resistant HTN + hypokalemia
Obstructive sleep apnea 😴	Obesity + daytime sleepiness

🧬 Fibromuscular Dysplasia (High-Yield)

📌 Key Features

- Non-atherosclerotic renal artery stenosis
- Usually in young adult females

- Alternating stenosis + dilation

Classic Imaging

- "String of beads" appearance 

Pathophysiology

Renal artery narrowing → Kidney perceives low perfusion
→ ↑ Renin release → ↑ RAAS activation →
Vasoconstriction + Na⁺ retention → Hypertension

Hypertensive Crisis

Hypertensive Urgency

Definition

Severe hypertension:

- ≥ 180 systolic
OR

- ≥ 120 diastolic






WITHOUT acute end-organ damage

Hypertensive Emergency (Malignant HTN)

Definition

Severe hypertension + acute end-organ damage

Possible Organ Damage





Organ	Manifestation
Brain 	Encephalopathy, stroke
Eyes 	Retinal hemorrhages, papilledema
Heart 	MI, HF
Aorta	Dissection
Kidney 	Acute kidney injury
Blood	Microangiopathic hemolytic anemia
Pregnancy 	Eclampsia

Histology

- Fibrinoid necrosis of arterioles
-

Complications of Chronic Hypertension

"Target Organ Damage"

Organ System	Complication
Heart 	CAD, LVH, HF, atrial fibrillation
Brain 	Stroke
Aorta	Aneurysm, dissection
Kidney 	Hypertensive nephropathy
Eyes 	Retinopathy

Hyperlipidemia Signs

1] Xanthomas

Definition

Lipid-filled macrophage deposits in skin

Common Location

- Eyelids → xanthelasma
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2] Tendinous Xanthoma

Definition

Cholesterol deposits in tendons

Common Sites

- Achilles tendon
- Finger extensors

Association

Strongly associated with:

- Familial hypercholesterolemia
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3 Corneal Arcus

Definition

Lipid deposition in cornea 

Important

Age	Significance
Older adults	Usually benign (arcus senilis)
Young patients	Suggests hypercholesterolemia


Atherosclerosis

Definition

Most common form of arteriosclerosis → Cholesterol plaque buildup in tunica intima

Common Locations

Order of Frequency

1. Abdominal aorta
2. Coronary arteries 
3. Popliteal arteries
4. Carotid arteries
5. Circle of Willis 



Mnemonic

"A copy cat named Willis"

- Aorta
- Coronary
- Popliteal
- Carotid
- Willis

Risk Factors

Modifiable



Factor	Mechanism
Hypertension	Endothelial damage
Smoking 	Oxidative injury
↑ LDL	Plaque formation
↓ HDL	Reduced cholesterol removal
Diabetes 	Glycation injury

Nonmodifiable

- Age
- Male sex
- Postmenopausal status
- Family history

Pathogenesis of Atherosclerosis



Stepwise Flowchart


Endothelial dysfunction → LDL enters vessel wall →
Monocyte adhesion + migration → Macrophages ingest
LDL → Foam cell formation  → Fatty streak develops
→ Smooth muscle migration/proliferation (mediated by
PDGF + FGF) → Extracellular matrix deposition →
Fibrous plaque formation → Complex atheroma ±
calcification 

Key Concepts

Feature	Importance
Foam cells	Earliest visible lesion
Fatty streaks	First grossly visible lesion
Calcification	↑ Risk of complications

Symptoms

Symptom	Cause
Angina 	Coronary ischemia
Claudication 	Peripheral artery disease

 May also be asymptomatic

Complications of Atherosclerosis

Complication	Mechanism
Ischemia	Reduced blood flow
Infarction	Plaque rupture/thrombosis
Aneurysm	Wall weakening
Peripheral vascular disease	Limb ischemia
Embolism	Plaque fragments travel

Exam Pearls

Hypertension

- Primary HTN = most common
- Fibromuscular dysplasia = string of beads
- Malignant HTN → fibrinoid necrosis

Atherosclerosis

- Foam cells = lipid-laden macrophages
- Fatty streak = earliest lesion
- Abdominal aorta = most common site

Hyperlipidemia

- Tendinous xanthomas → familial hypercholesterolemia
- Young patient + corneal arcus → suspect hypercholesterolemia

Final High-Yield Summary


Hypertension → Endothelial injury → Accelerates atherosclerosis → Leads to CAD, stroke, CKD, aneurysm, HF

Atherosclerosis is fundamentally: A chronic inflammatory disease of arteries

Cholesterol Emboli Syndrome


Definition

Microembolization of cholesterol crystals from unstable atherosclerotic plaques (usually the aorta) into small arteries.






 Often occurs after vascular procedures:

- Angiography
 - Angioplasty
 - Endovascular grafting
-


Pathophysiology Flowchart

Atherosclerotic plaque ruptures → Cholesterol crystals released  → Embolization to small arteries → Vessel obstruction + inflammatory reaction → End-organ ischemia/injury

Key Clinical Features

Feature	Explanation
Livedo reticularis 	Net-like skin discoloration
Blue toe syndrome 	Digital ischemia with intact pulses
Acute kidney injury 	Renal arteriole emboli
Stroke/CVA 	Cerebral embolization
Gut ischemia 	Mesenteric vessel involvement

 VERY HIGH-YIELD CLUE

 Pulses remain palpable!

Why? → Small arteries affected → Large arteries remain patent

This helps distinguish cholesterol emboli from:

- Large arterial thrombosis
 - Acute limb ischemia
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Exam Pattern Recognition

Classic Scenario

Older patient with:

- Severe atherosclerosis
- Recent angiography/vascular procedure

Then develops:

- AKI
- Blue toes
- Livedo reticularis

→ Think cholesterol emboli syndrome



Arteriolosclerosis

Definition

A form of arteriosclerosis affecting:

- Small arteries
 - Arterioles
-



Two Major Types

Hyaline Arteriolosclerosis

Mechanism


Leakage of plasma proteins into vessel wall

- smooth muscle extracellular matrix deposition

Pathophysiology Flowchart

Chronic hypertension or diabetes → Endothelial injury → Plasma proteins leak into vessel wall → Pink hyaline thickening develops → Narrowed lumen → Chronic ischemia

Associations

Disease	Mechanism
Hypertension	Pressure-induced injury
Diabetes mellitus 	Glycosylation damage

Histology

- Homogeneous pink (“hyaline”) wall thickening
-

2 Hyperplastic Arteriolosclerosis


Mechanism

Severe hypertension causes smooth muscle proliferation

Pathophysiology Flowchart

Severe hypertension → Repeated vascular injury →
Smooth muscle hyperplasia → Basement membrane
duplication → Concentric thickening → Severe luminal
narrowing

Histology

- "Onion-skin" appearance 
-

Association

- Malignant/severe hypertension
-



Hyaline vs Hyperplastic Arteriolosclerosis

Feature	Hyaline	Hyperplastic
Vessel Type	Small arteries/arterioles	Small arteries/arterioles
Main Causes	HTN, diabetes	Severe/malignant HTN
Histology	Pink hyaline thickening	Onion-skin appearance
Mechanism	Plasma protein leakage	Smooth muscle proliferation



High-Yield Connections

Chronic Hypertension Can Cause:

- Hyaline arteriolosclerosis
 - Hyperplastic arteriolosclerosis
 - Atherosclerosis
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Exam Pearls


- Blue toe syndrome + palpable pulses = cholesterol emboli

- Recent angiography = major clue
 - Onion-skinning = hyperplastic arteriolosclerosis
 - Diabetes → hyaline arteriolosclerosis
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Final Takeaway

Cholesterol Emboli Syndrome = Cholesterol crystal shower from plaques 

Hyaline Arteriolosclerosis = Protein leakage into vessel walls 

Hyperplastic Arteriolosclerosis = Onion-skin thickening from severe HTN 

-> The End <-