

# Cardiovascular system (CVS)

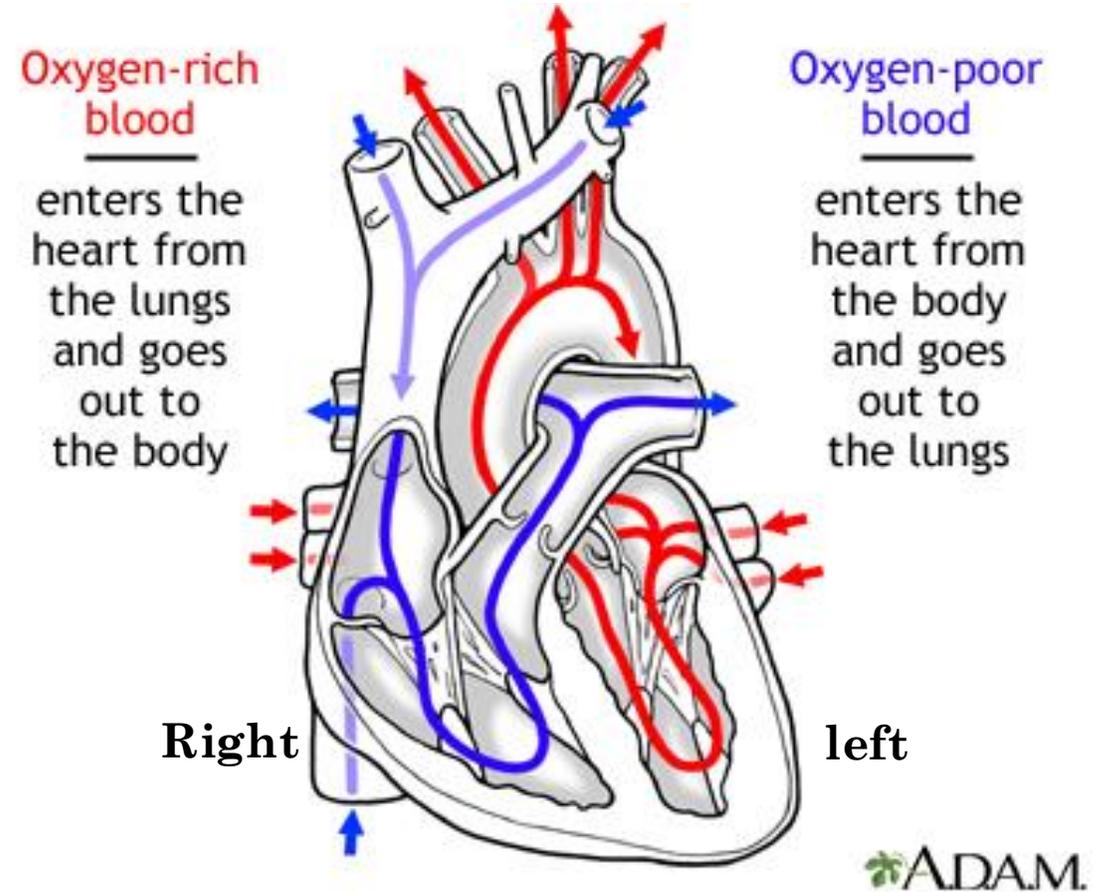
3.12.2025

Dr. Hind sarayrah

Histopathology specialist

- Main diseases of heart and blood vessels discussed in this lecture:

- 1) Heart failure
- 2) Infective endocarditis
- 3) Rheumatic heart disease
- 3) Ischemic heart disease
- 5) Cardiac tumors
- 6) Aortic aneurysm and dissection
- 7) Vasculitis
- 8) Atherosclerosis
- 9) vascular tumors



# Heart failure

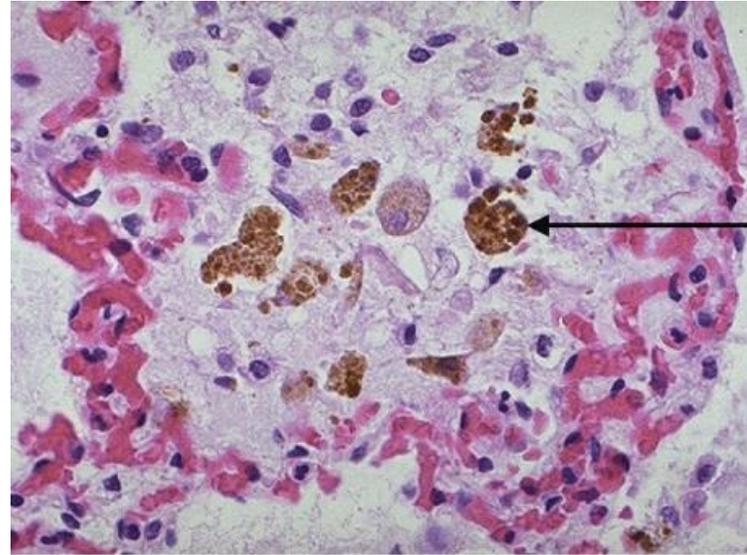
Normal ejection fraction 65%

- Heart failure is defined as the condition in which a heart cannot pump blood to adequately meet the metabolic demands of peripheral tissues
- The cardiovascular system is a closed circuit. Thus, although left-sided and right-sided failure can occur independently, failure of one side (particularly the left) often produces excessive strain on the other, terminating in global heart failure
- **1) Left sided heart failure:**
- Caused by: IHD (ischemic heart disease)/ Hypertension / Aortic and mitral valvular diseases / Primary myocardial diseases.
- The clinical and morphologic effects of left-sided CHF are a consequence of passive congestion (blood backing up in the pulmonary circulation), stasis of blood in the left-sided chambers, and inadequate perfusion of downstream tissues leading to organ dysfunction.

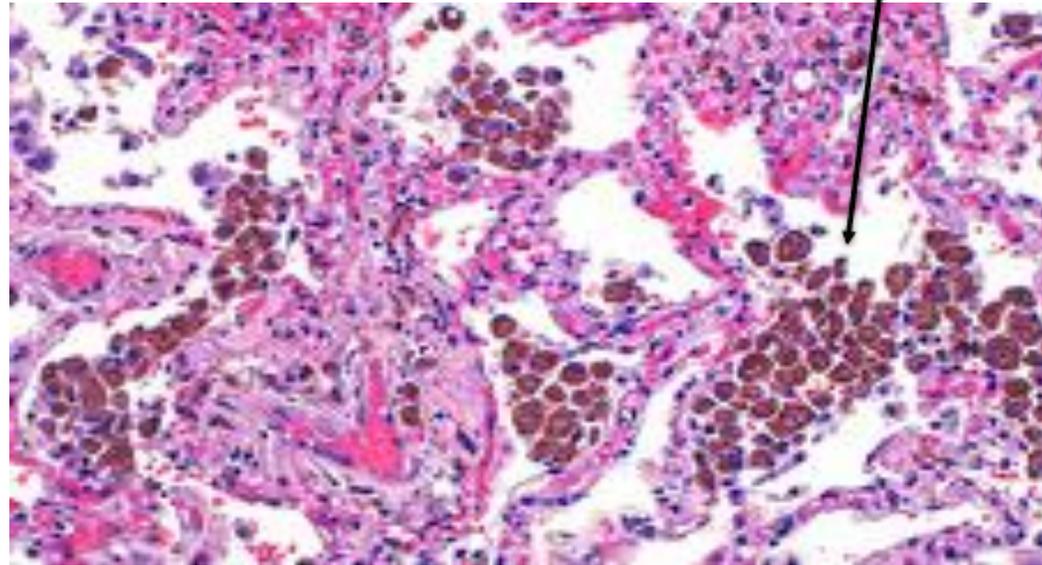
- Morphology:
- The most commonly affected organ in LVF is the lung
- Lung findings: heart failure cells (hemosiderin containing macrophages)
  - Mechanism of forming heart failure cells: Extravasated red cells and plasma proteins in the alveoli are phagocytosed and digested by macrophages; the accumulated iron is stored as hemosiderin.
- **2) Right sided heart failure:**
  - most commonly caused by left-sided heart failure.
  - The clinical and morphologic effects of right-sided CHF are a consequence of Engorgement of the systemic and portal venous systems.
  - The hallmark of RVF is peripheral edema of the dependent parts of the body particularly pedal and pretibial edema. , so called Pitting edema



leg swelling (edema) is a sign of right heart failure, especially if the edema is pitting edema. With pitting edema, a finger pressed on the swollen leg leaves an imprint.

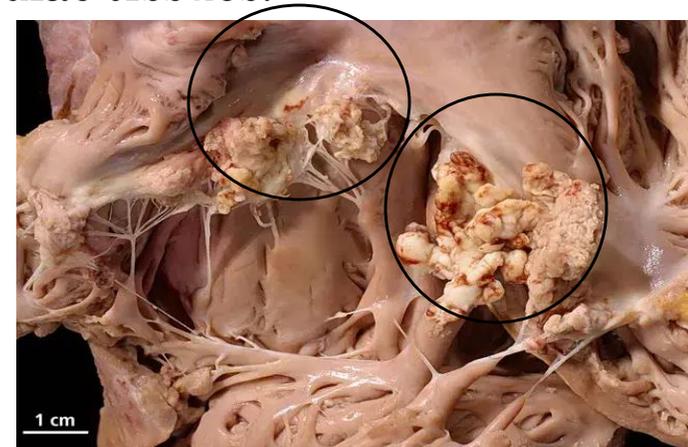


Hemosiderin-Laden  
macrophages



# Infective endocarditis

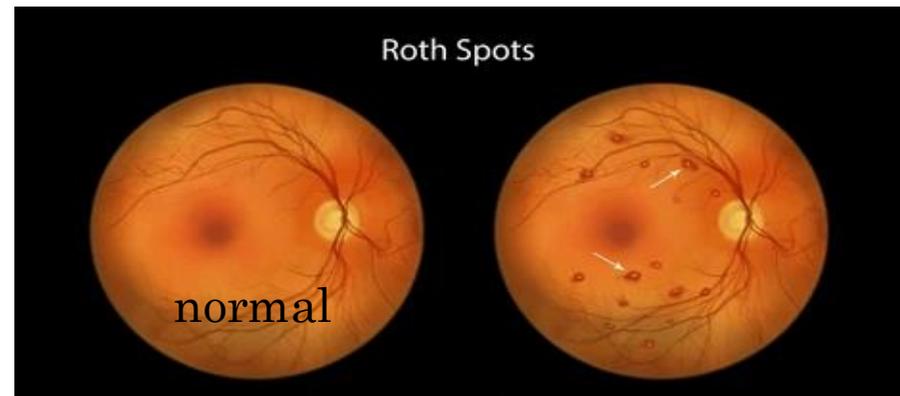
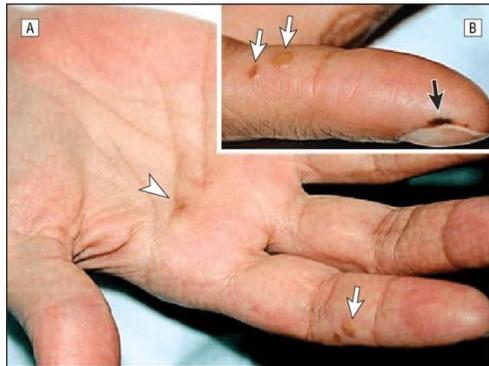
- ❖ Microbial infection on endothelial surfaces of heart which includes:
  - Mural endocardium
  - Valves and their apparatuses
  - Prosthetic or implanted components, including valves, homograft, pacemakers, intracardiac cardioverter defibrillators and their leads
  - Ventricular assist devices
- Morphology: Leads to the formation of vegetations composed of: thrombotic debris and organisms, often associated with destruction of the underlying cardiac tissues.
- The aortic valve and the mitral valve are most commonly infected
- Most infections are bacterial (bacterial endocarditis)
- Blood culture is the investigation of choice in IE



Acute infective endocarditis	Subacute infective endocarditis
<ul style="list-style-type: none"> <li>- Narcotizing, ulcerative</li> <li>- <b>Previously normal valve</b></li> </ul>	<ul style="list-style-type: none"> <li>- Less destructive</li> <li>- <b>Previously damaged valve</b></li> </ul>
<ul style="list-style-type: none"> <li>- Highly virulent organism</li> <li>- Most common cause is staph. aureus</li> </ul>	<ul style="list-style-type: none"> <li>- Low virulence organism</li> <li>- Most common cause is <math>\alpha</math>-hemolytic (viridans) streptococcus</li> </ul>
<ul style="list-style-type: none"> <li>- Death of patient within days to weeks</li> </ul>	<ul style="list-style-type: none"> <li>- Recover after antibiotic therapy</li> </ul>

• clinical features:

- **Fever is the most consistent feature of IE**
- **Cardiac murmur**
- **Roth spot (Retinal emboli)**
- **Osler nodes (painful subcutaneous nodules on fingers and toes)**
- **Janeway lesions (red, painless lesions on palms and soles)**
- **Splinter hemorrhage**



# Rheumatic heart disease

- An acute, immunologically mediated, multisystem inflammatory disease classically occurring a few weeks after group A streptococcal pharyngitis;
- The illness is so named because of its similarity in presentation to rheumatism.
- RF is the most common cause of heart disease in 5-30 age groups throughout the world.
- Rheumatic fever accounts for 99% of mitral stenosis
- Pathogenesis: the disease is type 2 hypersensitivity reaction, in which antibodies against M protein of some streptococcal strains cross react with the glycoprotein antigen in the heart, joints, and other tissues (molecular mimicry).
- a genetic susceptibility is likely to influence the development of the cross-reactive immune responses

- Morphology: calcification and fibrous bridging across the valvular commissures create “fish mouth” stenoses
- Clinical features:
  - Migratory polyarthritis of the large joints
  - Pancarditis (myocarditis, pericarditis, or endocarditis)
  - Subcutaneous nodules (typically on extensor surfaces of extremities)
  - Erythema marginatum, an irregular circinate skin rash
  - Sydenham chorea, a neurologic disorder with involuntary rapid movements

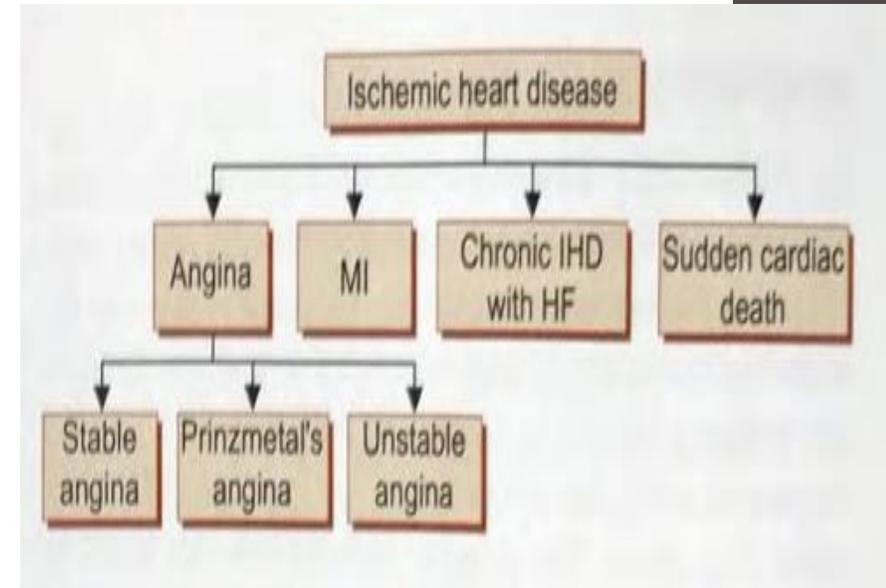


# Ischemic heart disease

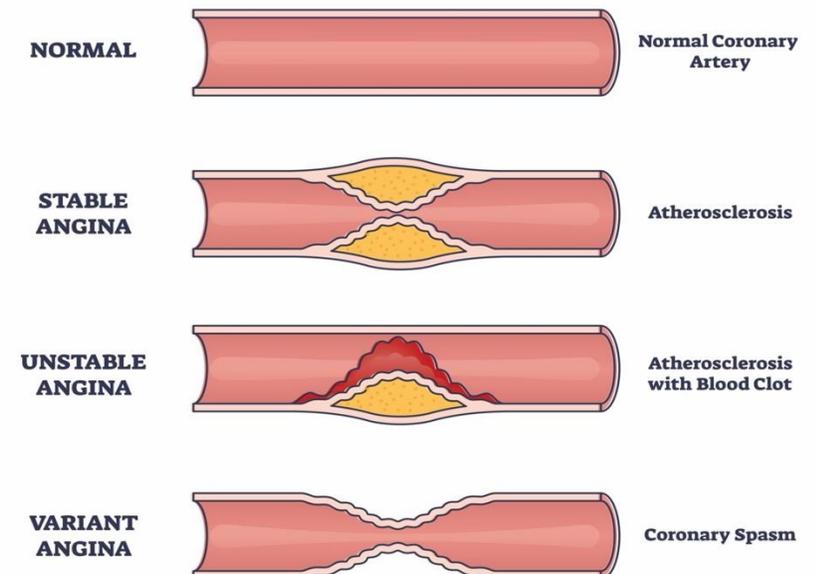
- Ischemia of the heart is a result of imbalance between the supply and demand of the heart for oxygenated blood.
- In more than 90% of cases, myocardial ischemia results from reduced blood flow due to obstructive atherosclerotic lesions in the epicardial coronary arteries; or vascular spasm.

**# Angina:** Often described as squeezing, pressure, heaviness, tightness or pain in the chest.

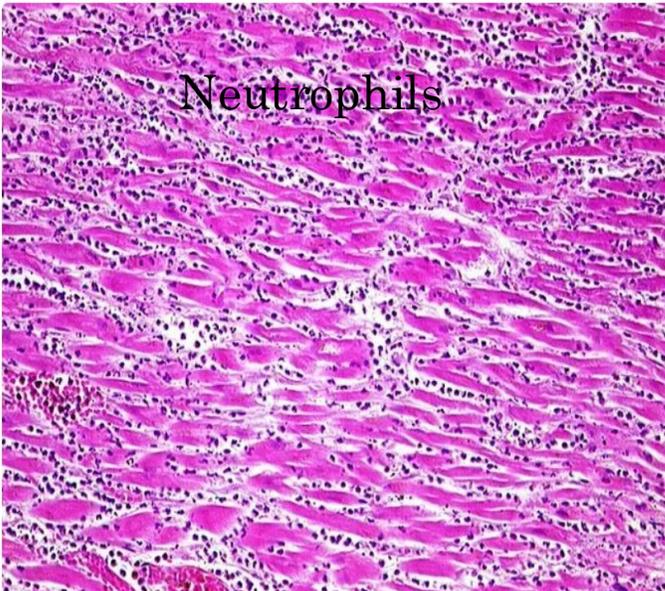
- **Stable:** Induced by activities that increase the energy requirements of the heart, including physical activity, emotional excitement, or psychological stress. The pain is usually relieved by rest (decreasing demand) or by administering vasodilators.
- **Unstable:** precipitated by progressively lower levels of physical activity or even occurring at rest.



## TYPES OF ANGINA

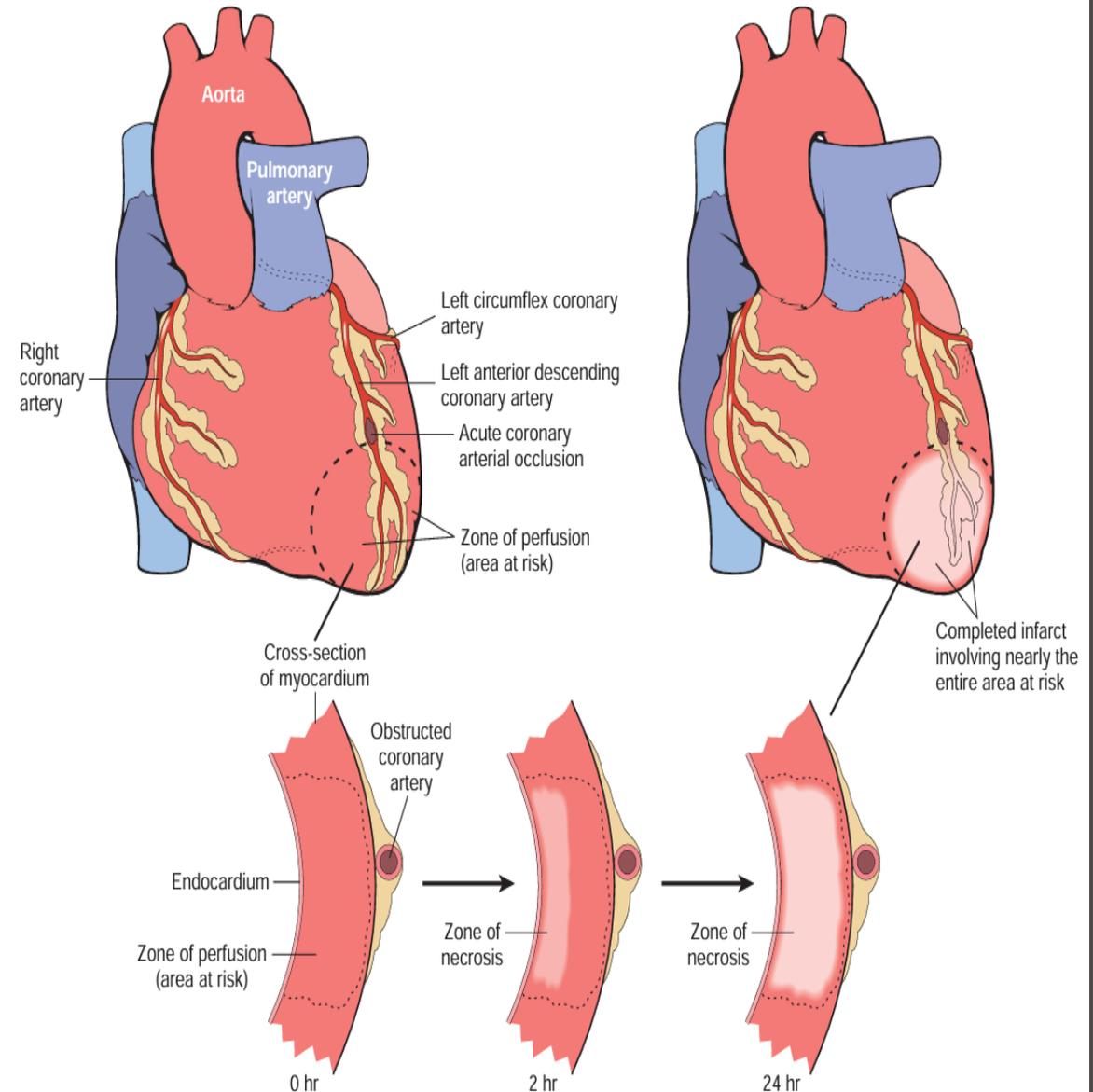
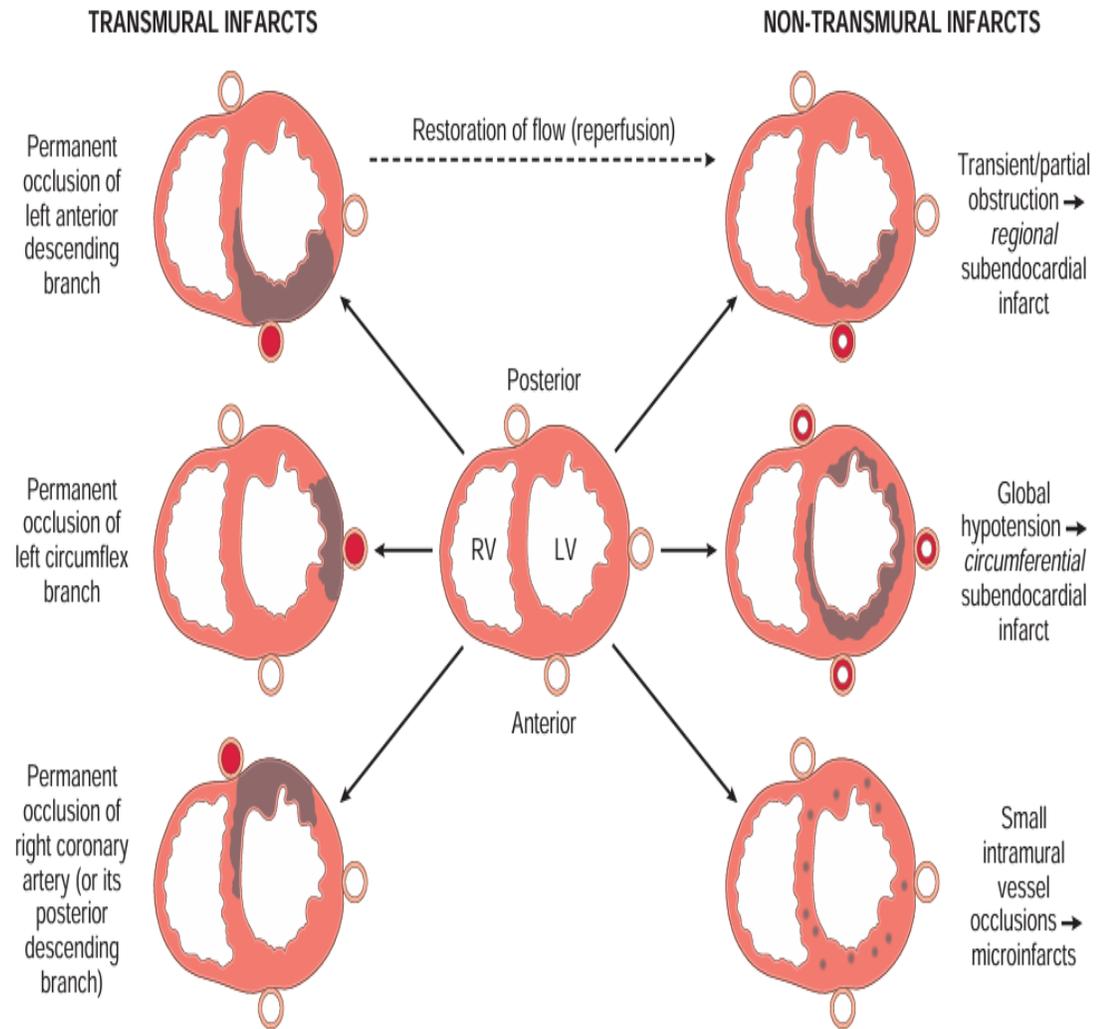


- **# Myocardial infarction:** Coronary arterial obstruction diminishes blood flow to a region of myocardium, causing ischemia, rapid myocardial dysfunction, and eventually— with prolonged vascular compromise—myocyte death.
- An infarct usually achieves its full extent within 3 to 6 hours; in the absence of intervention, an infarct caused by occlusion of an epicardial vessel can involve the entire wall thickness (transmural infarct). Clinical intervention within this critical window of time can lessen the size of the infarct within the territory at risk.
- The most important points:
  - Neutrophils predominate within 48-72 hours
  - Macrophages predominate after 72 hours



**Table 2: Evolution of Morphological Changes in MI**

Time	Gross	Light Microscopy
<b>Reversible injury</b>		
0-30 min.	None	None
<b>Irreversible injury</b>		
30 min to 4 hr.	None	<b>Waviness of fibers at border (earliest change)</b>
4-12 hr.	Occasional dark mottling	Beginning of coagulative necrosis, edema and hemorrhage
12-24 hr.	Dark mottling	Ongoing coagulative necrosis, marginal contraction band necrosis, beginning of neutrophilic infiltration
1-3 days	Mottling with yellow tan infarct center.	Coagulation necrosis, interstitial neutrophilic infiltrate
3-7 days	Hyperemic borders, central yellow tan softening	Beginning of disintegration with dying neutrophils, early phagocytosis by macrophages
7-10 days	Maximum yellow tan and soft depressed red-tan margin	Early formation of fibrovascular granulation tissue at margins
10-14 days	Red gray depressed infarct borders	Well established granulation tissue and collagen deposition
2-8 weeks	Gray-white scar progressive from border towards infarct core	Collagen deposition, ↓ Cellularity
> 2 months	Scarring complete	Dense collagenous scar



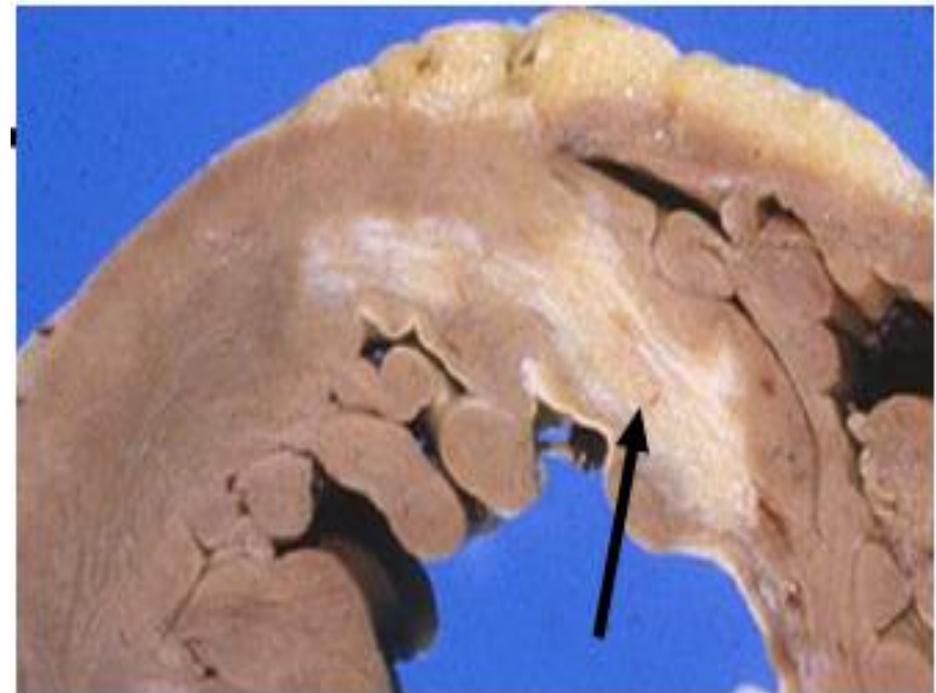
**Figure 12.11** Distribution of myocardial ischemic necrosis correlates with the location and nature of decreased perfusion. *Left*, the positions of transmural acute infarcts resulting from occlusions of the major coronary arteries; *top to bottom*, left anterior descending, left circumflex, and right coronary arteries. *Right*, the types of infarcts that result from a partial or transient occlusion, global hypotension, or intramural small vessel occlusions.

- Arteries are in epicardium, so first/ most impacted areas are subendocardial.
- **Most fatal MI's are transmural.**
- Potential complications: Death (most often from arrhythmia), Ventricular wall or papillary muscle rupture, Pericardial effusion, Heart failure

❖ Cardiac enzymes:

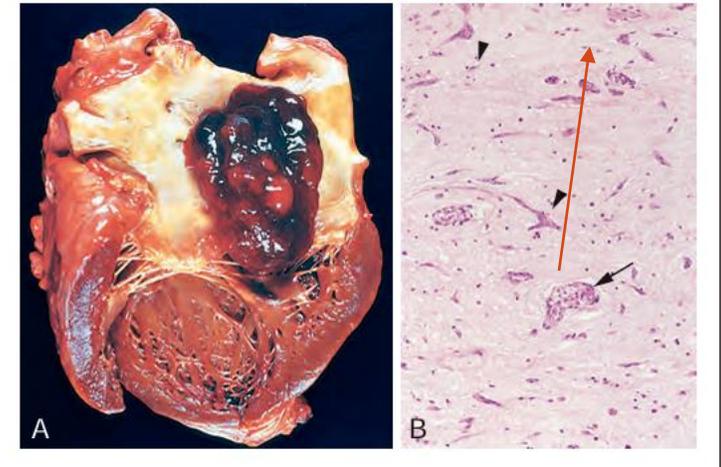
- **Myoglobin:** earliest enzyme to increase after MI
- **Troponin:** most sensitive and specific for MI

Enzyme	Initiation of rise	Peak	Return to baseline
CK-MB	2-4 hours	24 hours	48-72 hours
Troponin T and I (TnT, TnI)	2-4 hours	48 hours	7-10 days
AST/SGOT	In 12 hours	48 hours	4-5 days
LDH	24 hours	3-6 days	2 weeks



# Cardiac tumors

- **Myxomas** are the most common primary tumor of the adult heart.
- About 90% of myxomas arise in the atria, with a left-to-right ratio of approximately 4:1.
- Surgical removal is usually curative; rarely, presumably with incomplete excision, the neoplasm can recur months to years later.
- **Rhabdomyomas** are the most frequent primary tumor of the pediatric heart; regress spontaneously
- **Metastatic tumors to the heart :**
  - the most frequent are lung and breast carcinomas, melanomas, leukemias, and lymphomas
  - Metastases can reach the heart and pericardium by retrograde lymphatic extension from the mediastinum (mostly carcinomas), by hematogenous seeding (many tumors), by direct contiguous extension (of intrathoracic tumors), or by venous extension (tumors of the kidney or liver).



# Aortic aneurysm and dissection

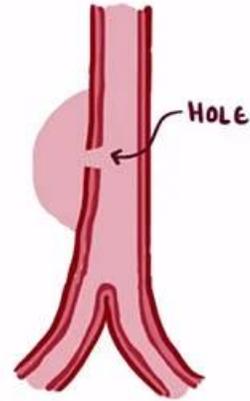
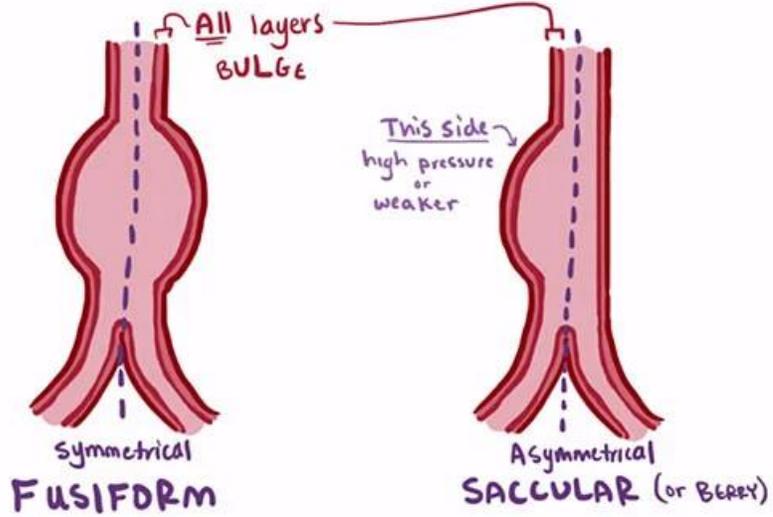
- **Aneurysm:** a localized abnormal dilation of aorta.
- Classified into two forms:
  - 1) **True aneurysm:** involves intact, attenuated arterial wall. Caused by Atherosclerosis.
  - 2) **False/pseudo-aneurysm:** breach in the vascular wall leading to extravascular hematoma communicating with intravascular space. Caused by Post-MI rupture and leakage at the site of vascular anastomosis.
- **Dissection:** it occurs when blood separates apart the laminar planes of the media with the formation of a blood-filled channel within the aortic wall.
- Most common seen in men (age 40-60) with hypertension, or young patient with Marfan syndrome.
- Most common cause of death: aortic rupture.

ANEURYSM ~ abnormal bulge in vessel

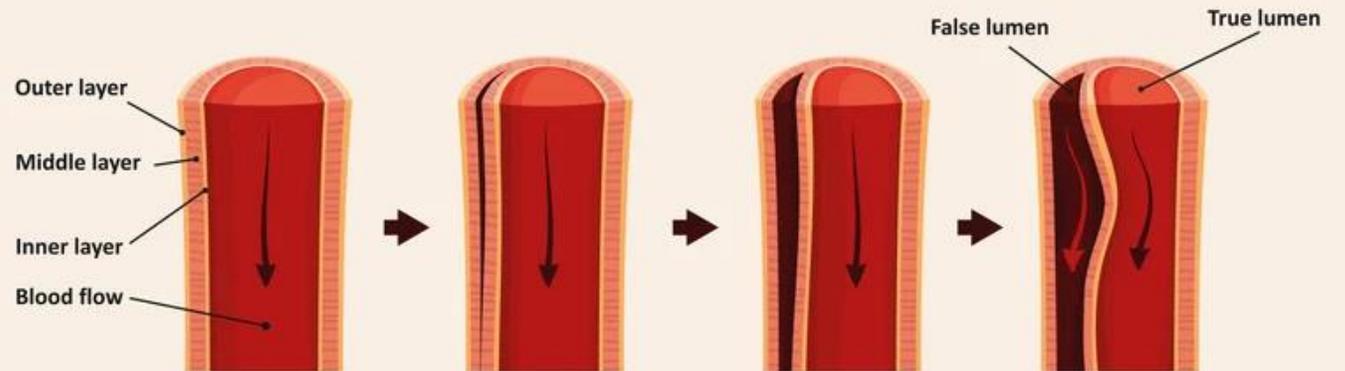
"FALSE"

TRUE ANEURYSM

PSEUDOANEURYSM



## AORTIC DISSECTION

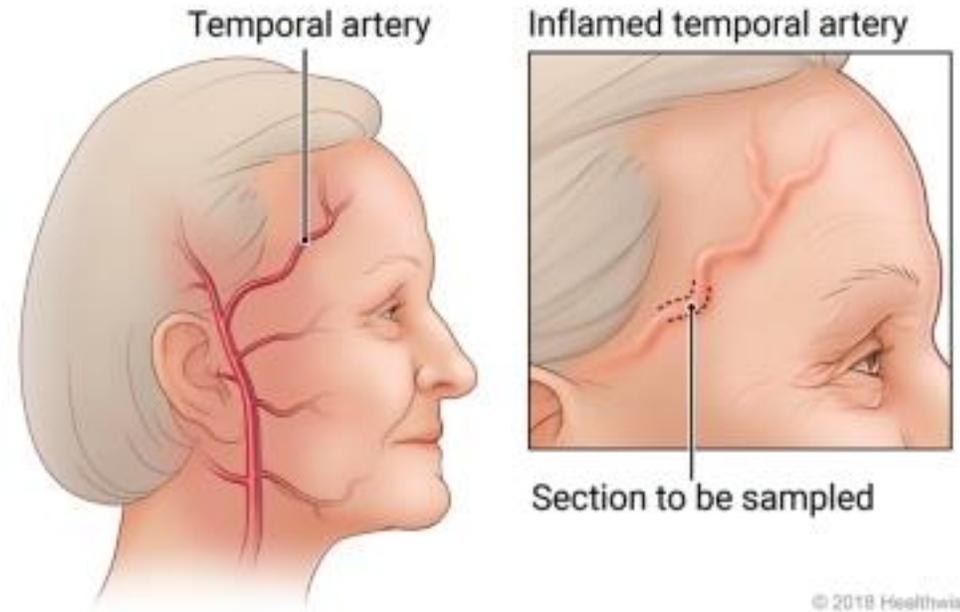


# Vasculitis

- Inflammation of the vessel wall
- The most important types:
- 1) Giant cell (temporal) arteritis:
  - Large vessel vasculitis.
  - the most common vasculitis in adult (usually > 50yrs)
  - the most common involved vessel: Superficial temporal artery.
  - Clinically: Jaw pain, Facial pain, localized headache sudden onset of blindness.
  - Investigation of choice: Biopsy of temporal artery (granulomatous inflammation)

Table 3: Classification based on vessel size.

Large vessel vasculitis	Medium vessel vasculitis	Small vessel vasculitis	
		Immune complex mediated	Paucity of immune complex
<ul style="list-style-type: none"><li>• Giant cell (temporal) arteritis</li><li>• Takayasu arteritis</li></ul>	<ul style="list-style-type: none"><li>• Classic PAN</li><li>• Kawasaki's disease</li><li>• Buerger's disease</li></ul>	<ul style="list-style-type: none"><li>• SLE</li><li>• Henoch-schonlein purpura</li><li>• Cryoglobulin vasculitis</li><li>• Goodpature syndrome</li></ul>	<ul style="list-style-type: none"><li>• Wegener's granulomatosis</li><li>• Microscopic polyangitis</li><li>• Churg-strauss syndrome</li></ul>



- 2) Kawasaki's disease:

- **Medium vessel vasculitis**

- **Vasculitis affecting children < 5yrs old.**

- ❖ Criteria for diagnosis of Kawasaki's disease there should be **fever** for  $\geq 5$  days , plus any 4 of the following:

- 1. Conjunctivitis (non-exudative)

- 2. Rash

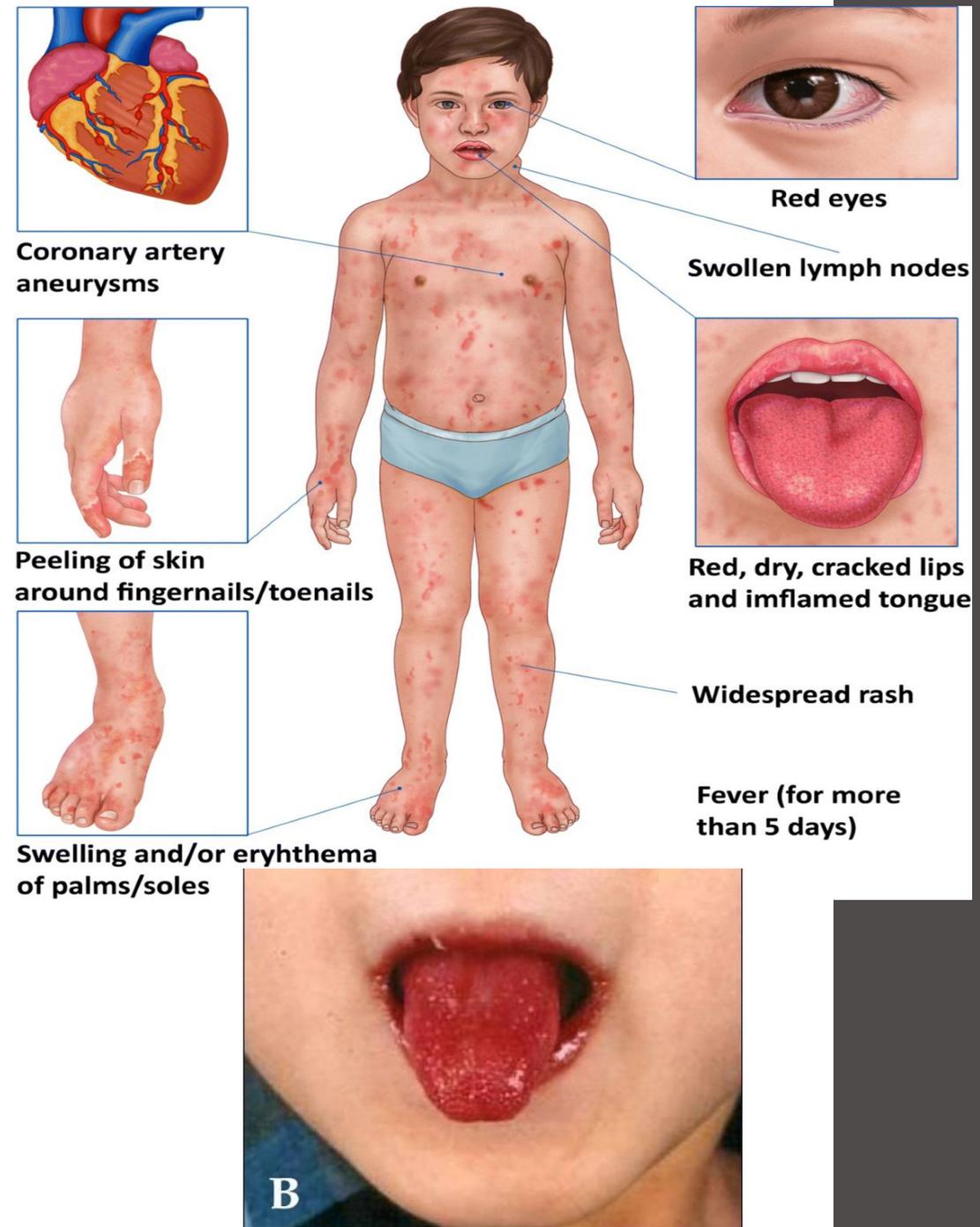
- 3. Edema or erythema of hands and feet

- 4. Adenopathy (mostly cervical)

- 5. Mucosal involvement (Strawberry tongue)

- The most important complication is formation of coronary artery aneurysm.

- **Long term complication is Myocardial infarction in children.**

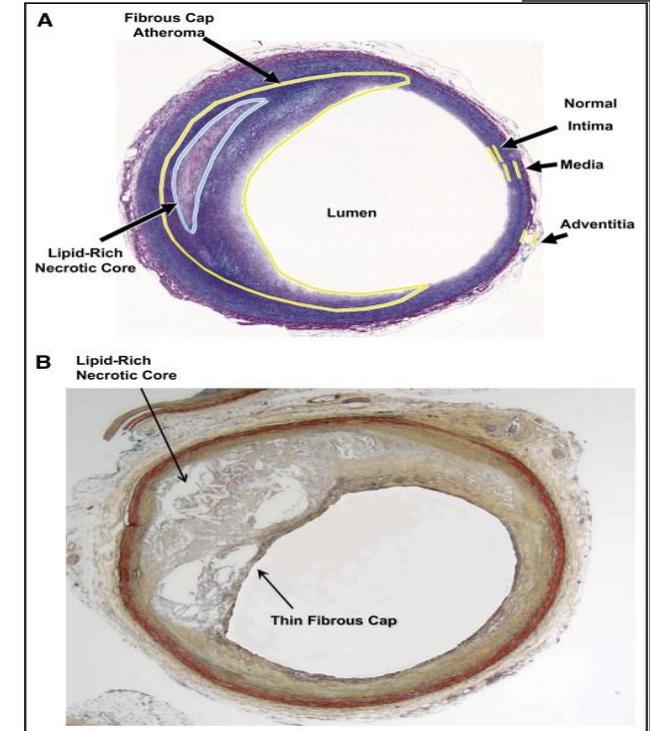
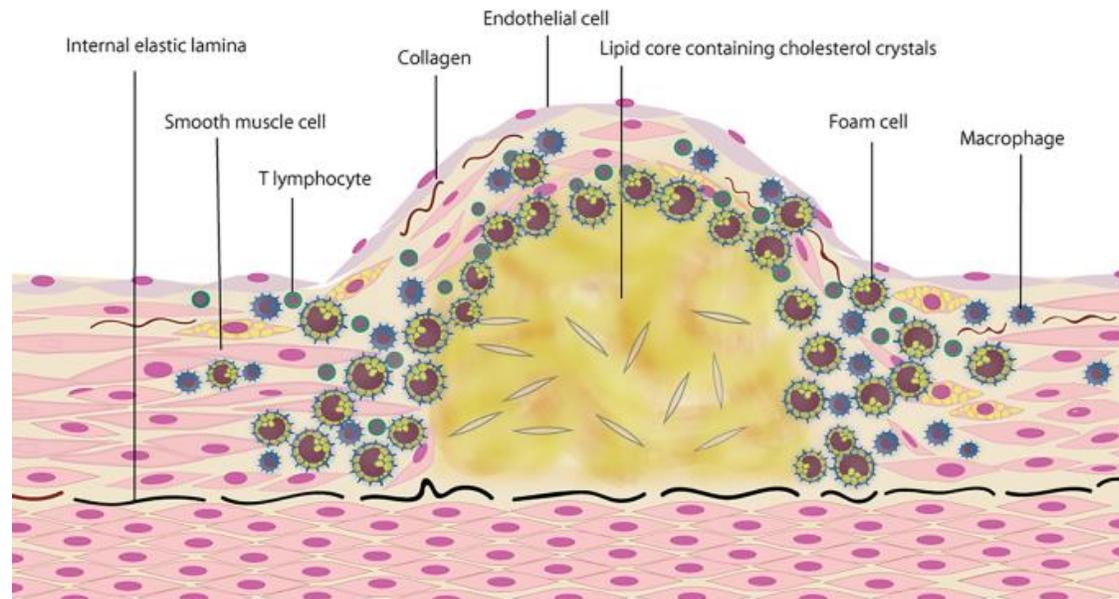


- 3) Henoch–Schönlein purpura (HSP):
- **The most common vasculitis in children**
- **Small vessel vasculitis** (arterioles, venules, and capillaries)
- Clinically: Palpable purpura and colicky abdominal pain.



# Atherosclerosis

- Characterized by deposition of atheroma/ fibrofatty plaque.
- Plaque is present within the intima.
- Consist of:
  - 1) Core of lipid: cholesterol, and could have debris of dead cells and foam macrophages.
  - 2) Covering of fibrous cap: smooth muscle cells, macrophages and foam macrophages.

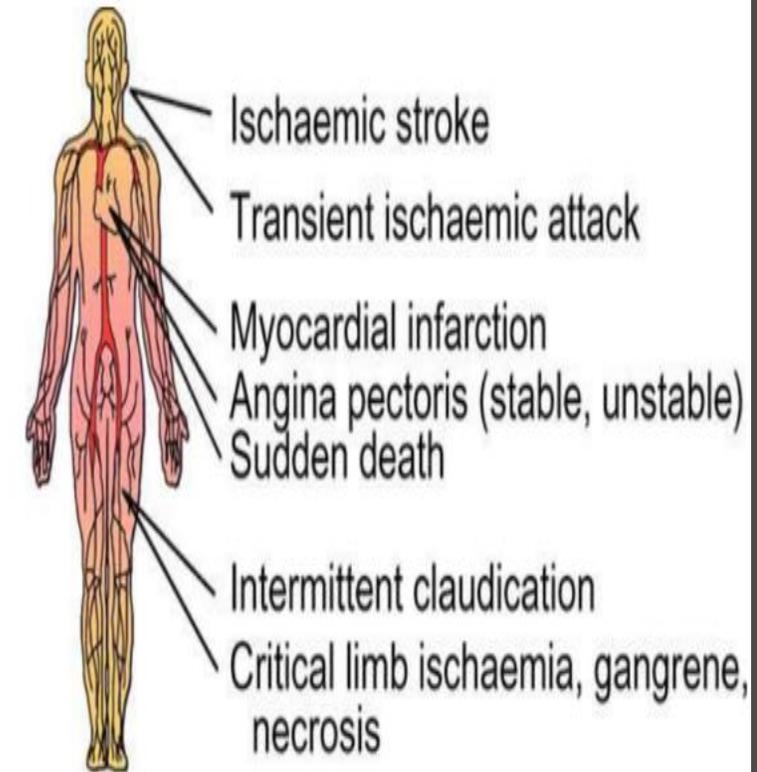


## ❖ Risk factors:

- Increase with age
- Type A personality: ambition, competitiveness, a sense of urgency, and high achievement drive
- Male > Female, But in postmenopausal women the risk increase.
- Obesity
- Hyperlipidemia, hypertension
- Cigarette smoking

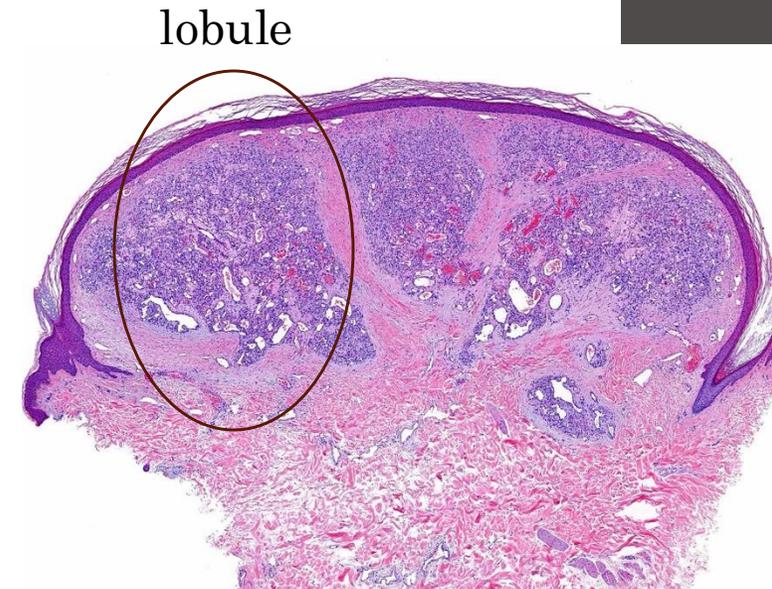
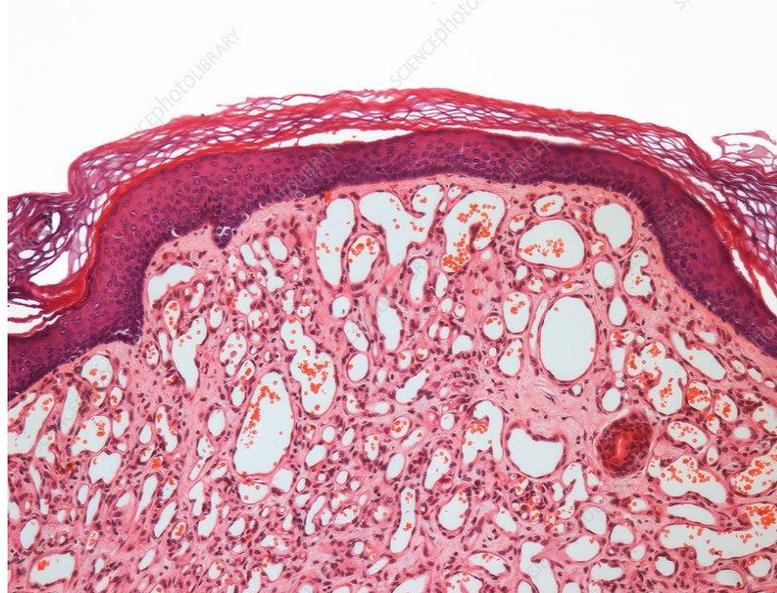
## ❖ Clinical consequences:

- Narrowing: Restricted blood flow can cause symptoms like angina (chest pain) and claudication (pain in the legs).
- Rupture: A plaque rupture leading to a blood clot can result in a heart attack if it occurs in a coronary artery or a stroke if it occurs in an artery supplying the brain.
- Aneurysm: Atherosclerosis can also weaken the artery wall, leading to a bulge known as an aneurysm.

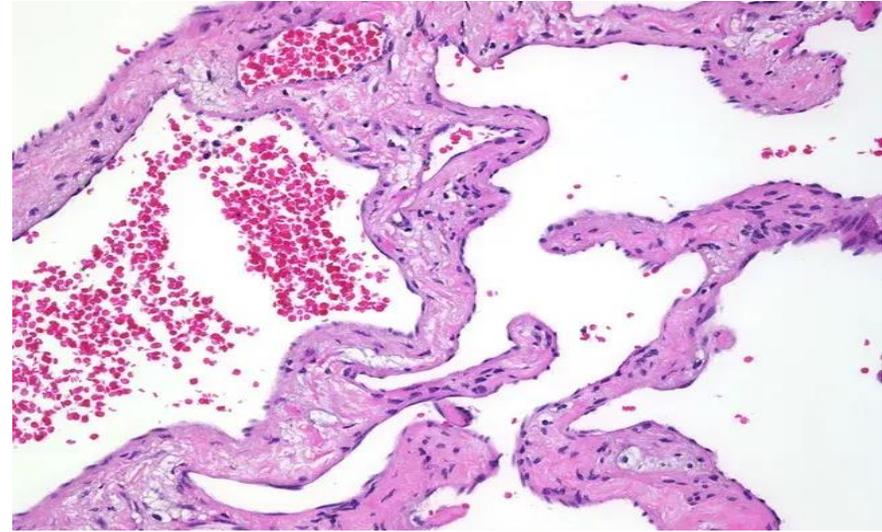


# Vascular tumors

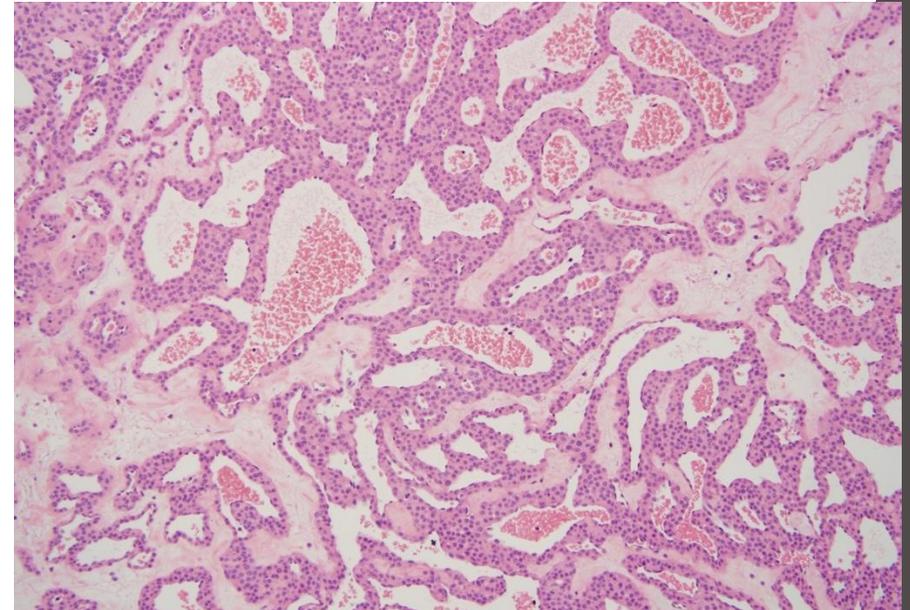
- **Benign tumors:**
  - 1) **Capillary hemangioma:** the most common type of vascular tumor
    - **Example: Strawberry hemangioma** (in newborns, growing rapidly in first few months then regress by age of 7).
    - Morphology: lobules of closely packed thin walled capillary sized blood vessels



- 2) Cavernous hemangioma:
- **Composed of large vascular spaces.**



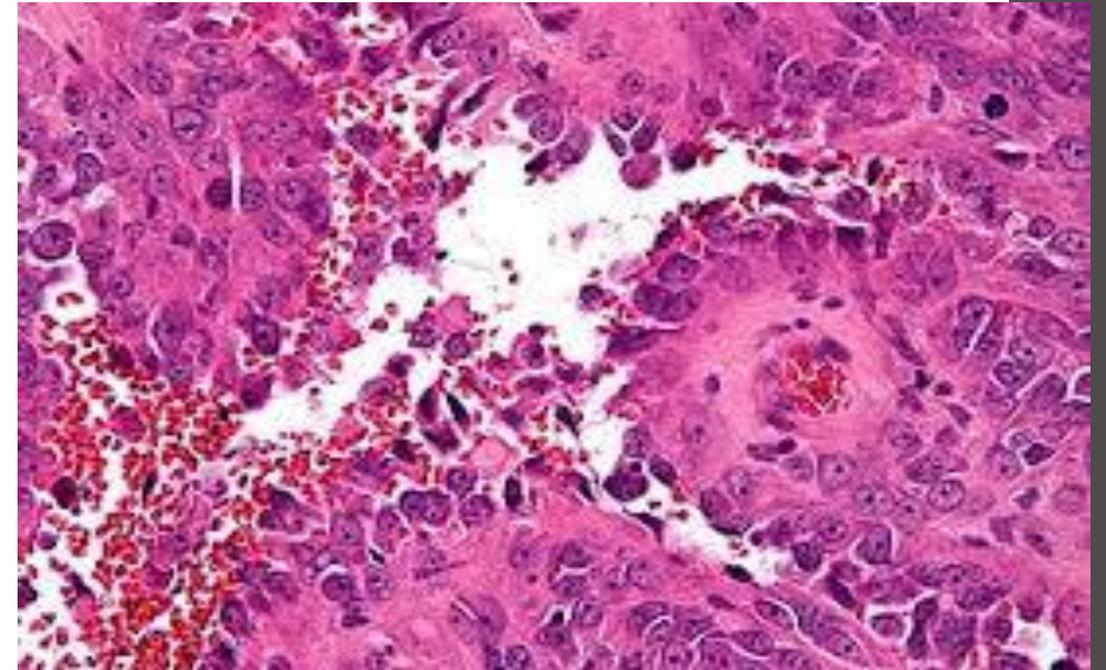
- 3) Glomus tumor:
- The most common site: distal portion of the digits (under finger nails)
- Morphology: clusters of glomus cells around blood vessels.



- **Malignant tumors:**
- Angiosarcoma:
- **Malignant endothelial cell neoplasm.**
- Most common site: skin, breast, liver
- Morphology: irregularly shaped anastomosing vascular channels or sheet-like growth/  
Multilayering of endothelial cells, nuclear atypia, increased mitoses, necrosis

**Prognosis:**

- Angiosarcoma is aggressive and can grow and spread quickly, and it has a tendency to return after treatment
- The prognosis is often poor, especially if the cancer has already metastasized (spread) to other parts of the body



thank you