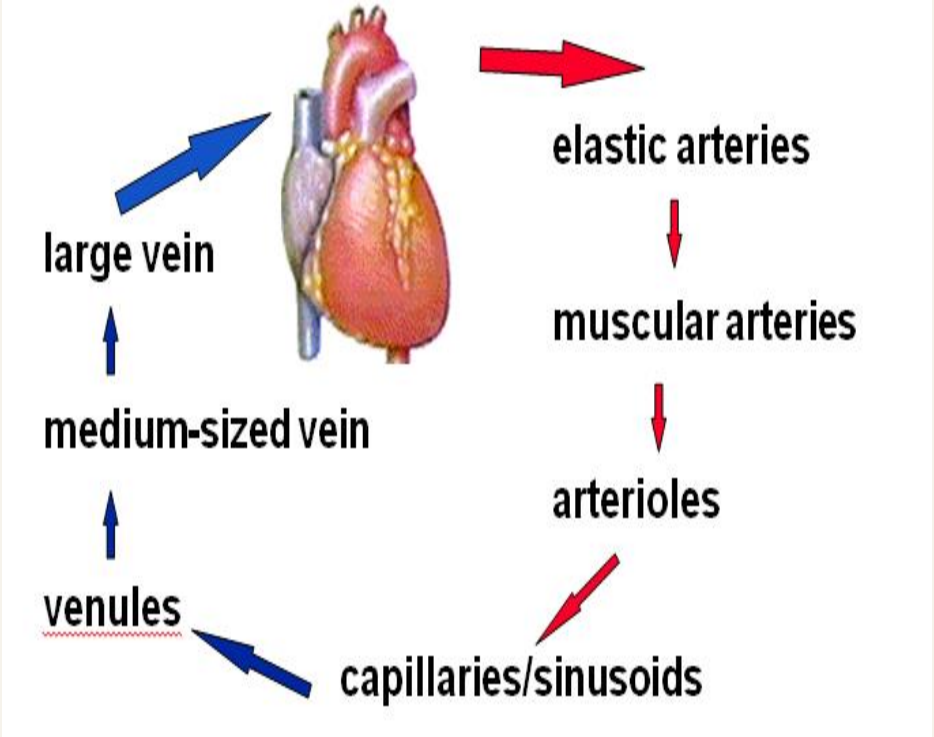

CIRCULATORY SYSTEM

- The circulatory system pumps and directs blood cells and substances carried in blood to all tissues of the body.
- It includes both the blood and lymphatic vascular systems.

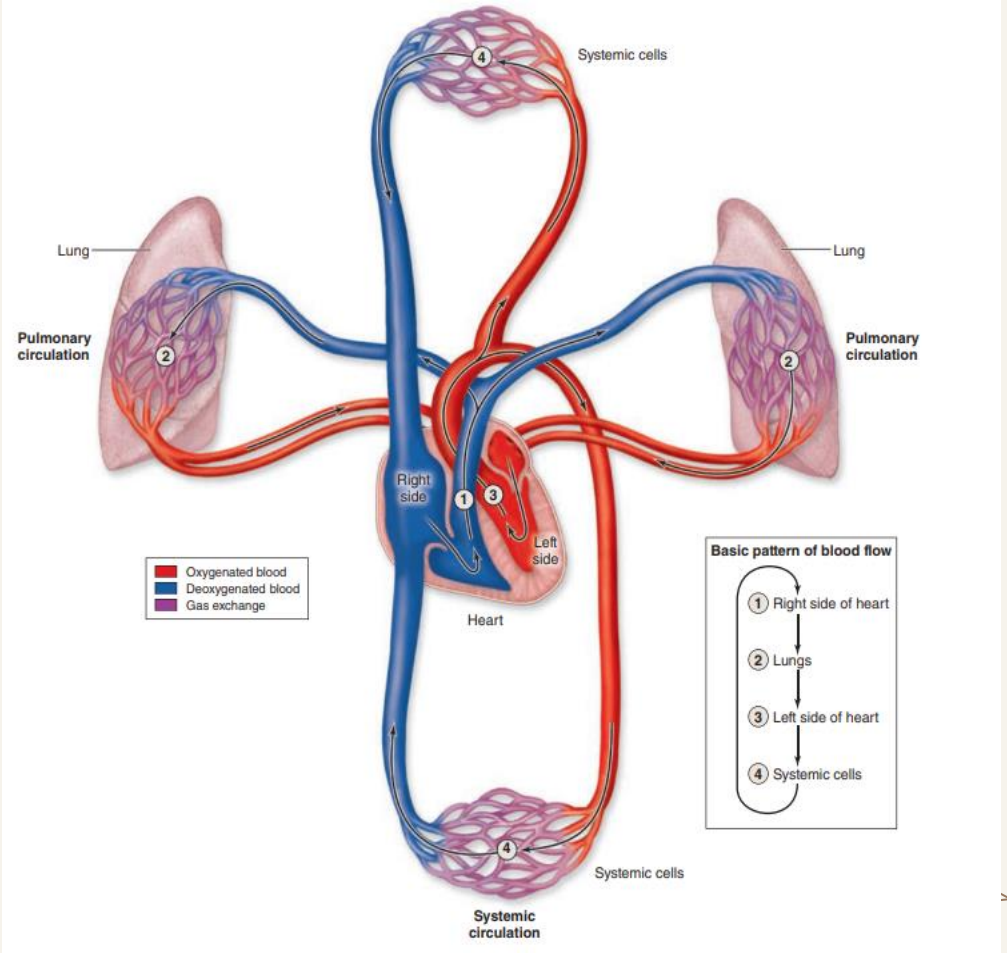
Cardiovascular system consists of the following structures:

- The heart propels blood through the system.
- Arteries, a series of vessels that carry blood to the tissues
- Capillaries, the smallest vessels, are the sites of O2 , CO2 , nutrient, and waste product exchange between blood and tissues.
- Veins which carry the blood from tissues to be pumped again.



The two major divisions of blood vessels:

- **Pulmonary circulation**: where blood is oxygenated in the lungs.
- **Systemic circulation**: where blood brings nutrients and removes wastes in tissues throughout the body.



HEART

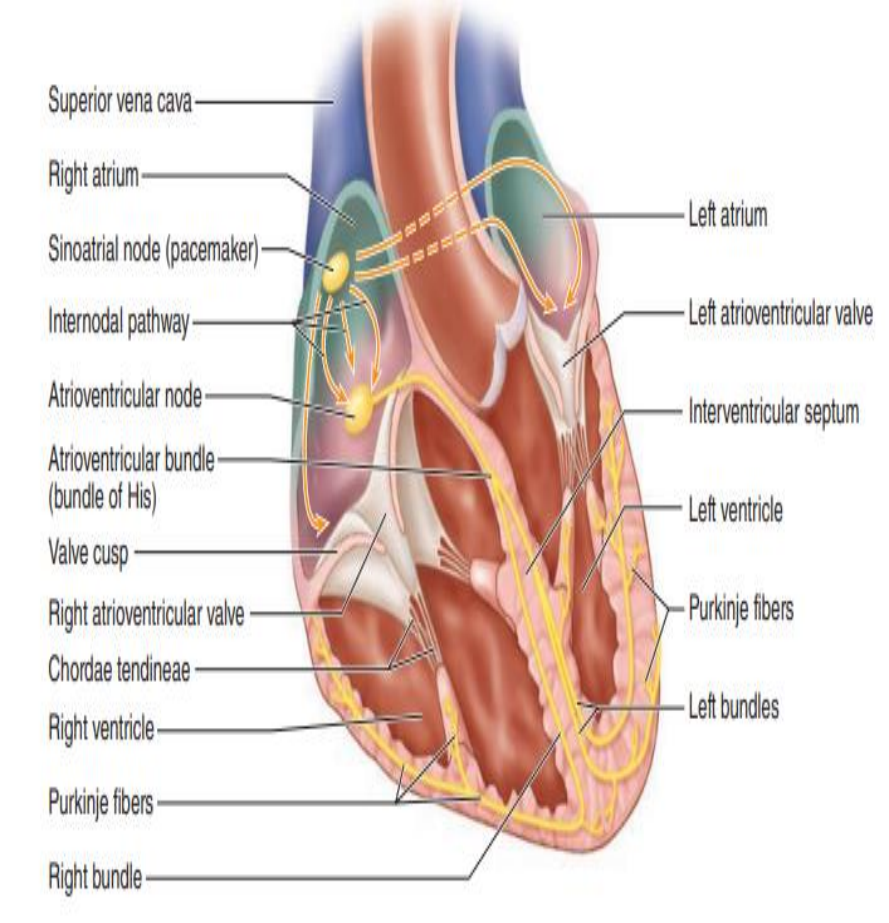
Function

- Contract rhythmically, pumping the blood through the circulatory system .

- Four chambers

➢ Right and left ventricles propel blood to the pulmonary and systemic circulations, respectively.

➢ Right and left atria receive blood from the body and the pulmonary veins, respectively.

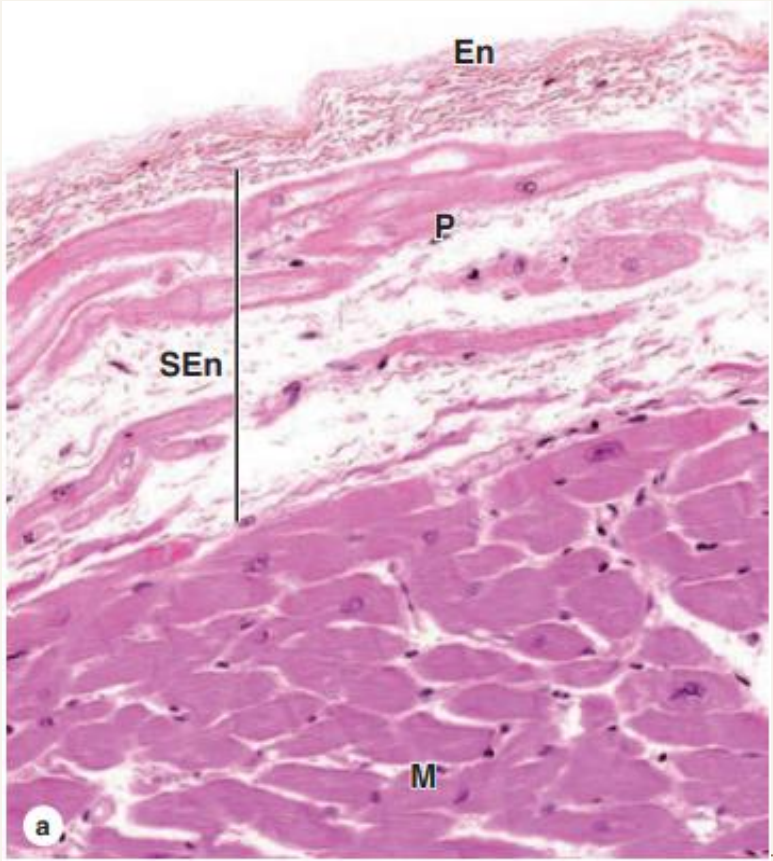


The wall of heart has three major layers:

(1) inner endocardium of endothelium and subendothelial connective tissue.

(2) myocardium consists mainly of contractile cardiac muscle fibers.

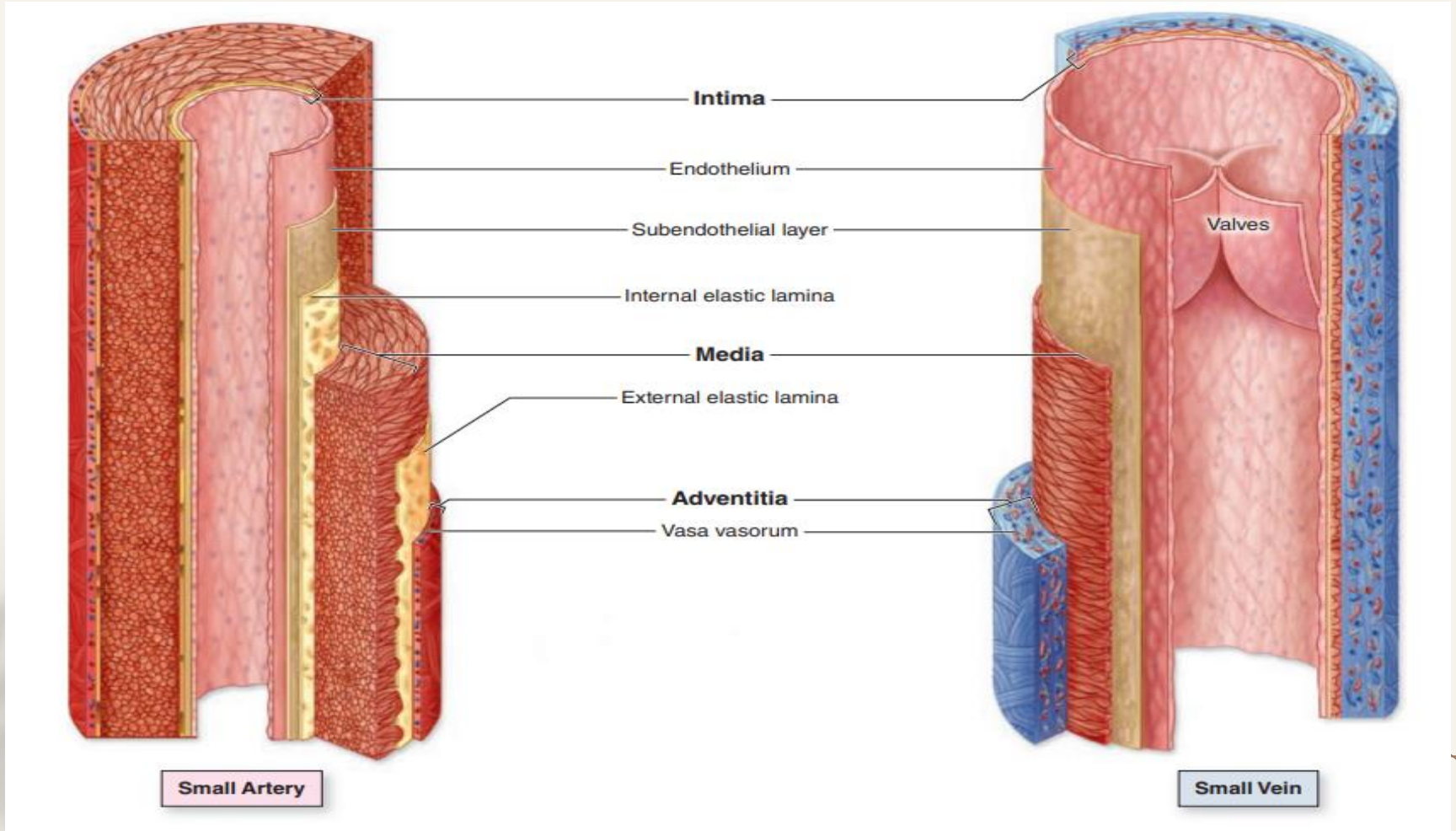
(3) epicardium is a simple squamous mesothelium supported by a layer of loose connective tissue containing blood vessels and nerves

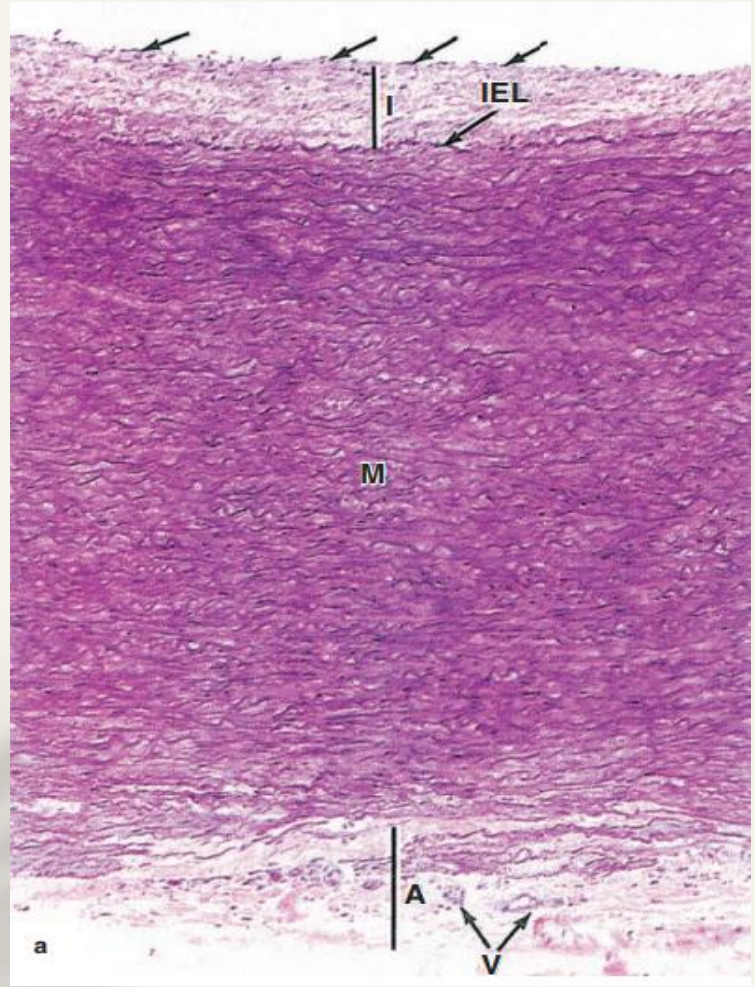


TISSUES OF THE VASCULAR WALL

The walls of all blood vessels consist of three concentric layers, or tunics:

- Tunica intima: Endothelium (simple squamous epithelium), subendothelial layer, internal elastic lamina
- Tunica media: Smooth muscle, elastic/collagen fibers, external elastic lamina
- Tunica adventitia: Loose connective tissue, vasa vasorum, nerves


Intima
Endothelium
Subendothelial layer
Internal elastic lamina
Media
External elastic lamina
Adventitia
Vasa vasorum
Valves
Small Artery
Small Vein



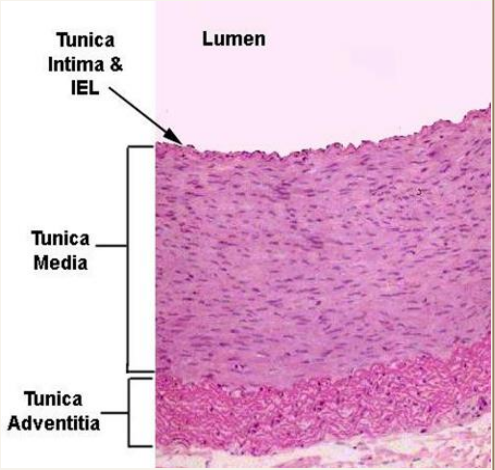
VASCULATURE

Elastic Arteries

- Aorta, Pulmonary artery.
- Carry blood to smaller arteries
- The most prominent feature of elastic arteries is the thick tunica media .
- Tunica intima is well developed.
- Between the intima and the media is the internal elastic lamina.
- The adventitia is much thinner than the media.

Muscular arteries

- Distribute blood to the organs .
- Intima has a thin subendothelial layer and a prominent internal elastic lamina
- Media : large smooth muscle cells with external elastic lamina
- Adventitia is thick.



Arterioles

- Smallest arteries ,less than 0.1 mm in diameter.
- Elastic laminae are absent,
- Media have only one or two smooth muscle layers.
- Adventitia is very thin.

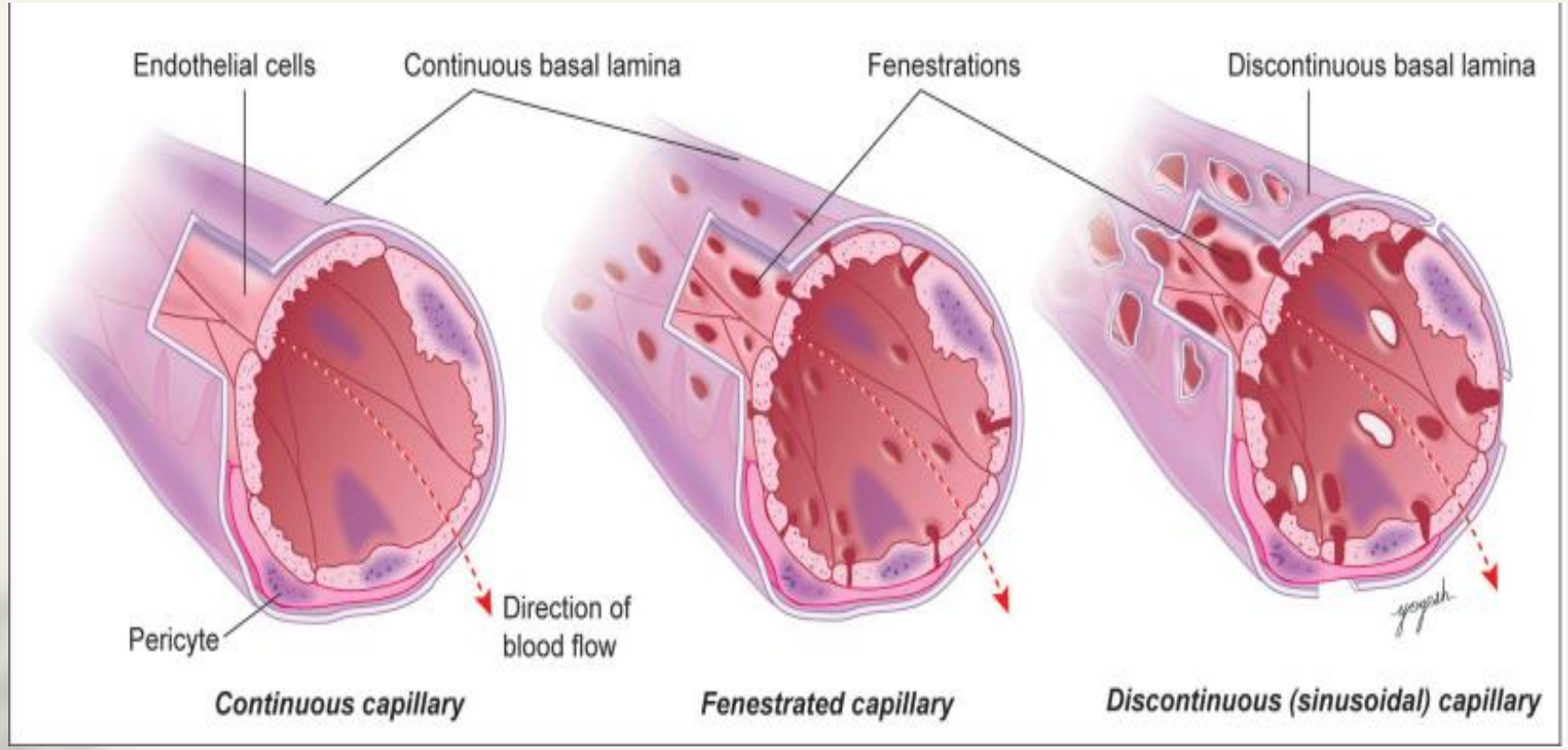
Capillaries

- Smallest blood vessels
- Function in networks called capillary beds (exchange metabolites by diffusion to and from cells).
- simple layer of endothelial cells surrounded by basement membrane .
- The average diameter of capillaries varies from 4 to 10 μm.

Capillary*

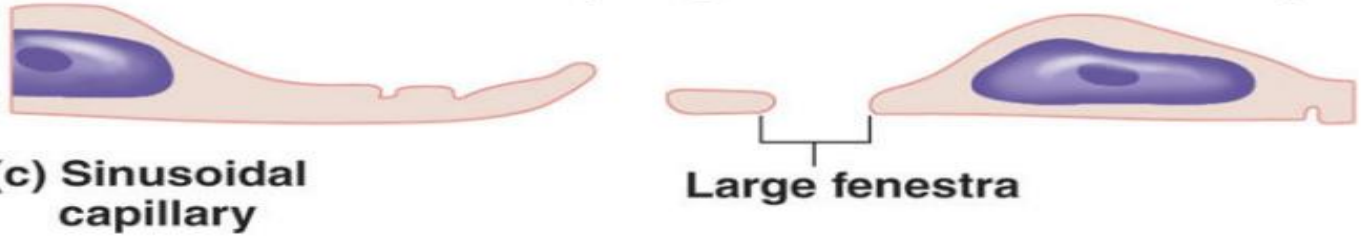
Capillaries are generally grouped into three histologic types, depending on the continuity of the endothelial cells and their basement membrane:

- 1. Continuous:
  - uninterrupted endothelium
  - most common type of capillary
  - in muscle, connective tissue, lungs, exocrine glands, and nervous tissues.
- 2. Fenestrated:
  - endothelial cells has numerous small fenestration,
  - in kidneys, intestine, and endocrine glands.
- 3. Sinusoidal:
  - discontinuous capillaries,
  - large irregular gaps
  - liver, bone marrow and spleen.


Endothelial cells
Continuous basal lamina
Fenestrations
Discontinuous basal lamina
Pericyte
Direction of blood flow
Continuous capillary
Fenestrated capillary
Discontinuous (sinusoidal) capillary

Structure of Capillary Walls

(a) Continuous capillary



Veins :Carry blood toward the heart.

- Thin tunica media compared to arteries.
- Based on diameter, veins are classified as: venules, small veins, medium-sized veins, and large veins.

Venules

- Post capillary venules are similar to capillaries but larger.
  - site of leukocyte exit from vasculature to sites of infection or tissue damage
- Muscular venules of larger size , surrounded by tunica media with two or three smooth muscle layers.
  - no valves
  - large diameter, thin walls

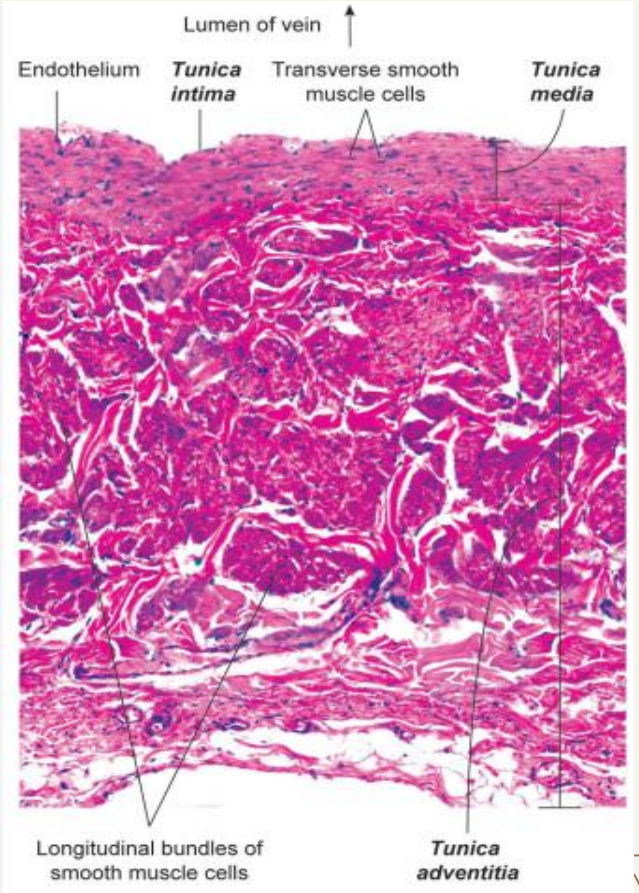
Small, Medium-sized viens

- tunica intima is thin
- media few layers of smooth muscle cells
- thick adventitial layer
- Ex: radial vein, tibial vein, popliteal vein.

Large veins

- well-developed intimal layers
- thin media with smooth muscle and connective tissue.
- tunica adventitia is the thickest layer with longitudinally arranged smooth muscle cells.
- Ex: Superior vena cava, inferior vena cava.

An important feature of large and medium veins is presence of valves in their lumen to prevent retrograde (backward) flow of blood.



large vien

LYMPHATIC VASCULAR SYSTEM

- Collect excess interstitial fluid from the tissue spaces as lymph and return it to the blood.
- Thin walls with endothelial cells
- Valves for unidirectional flow
- Lymph is rich in proteins, absent red blood cell.
- Lymphatic vascular system is a major distributor of lymphocytes, antibodies, and other immune components to many organs.

THANK YOU