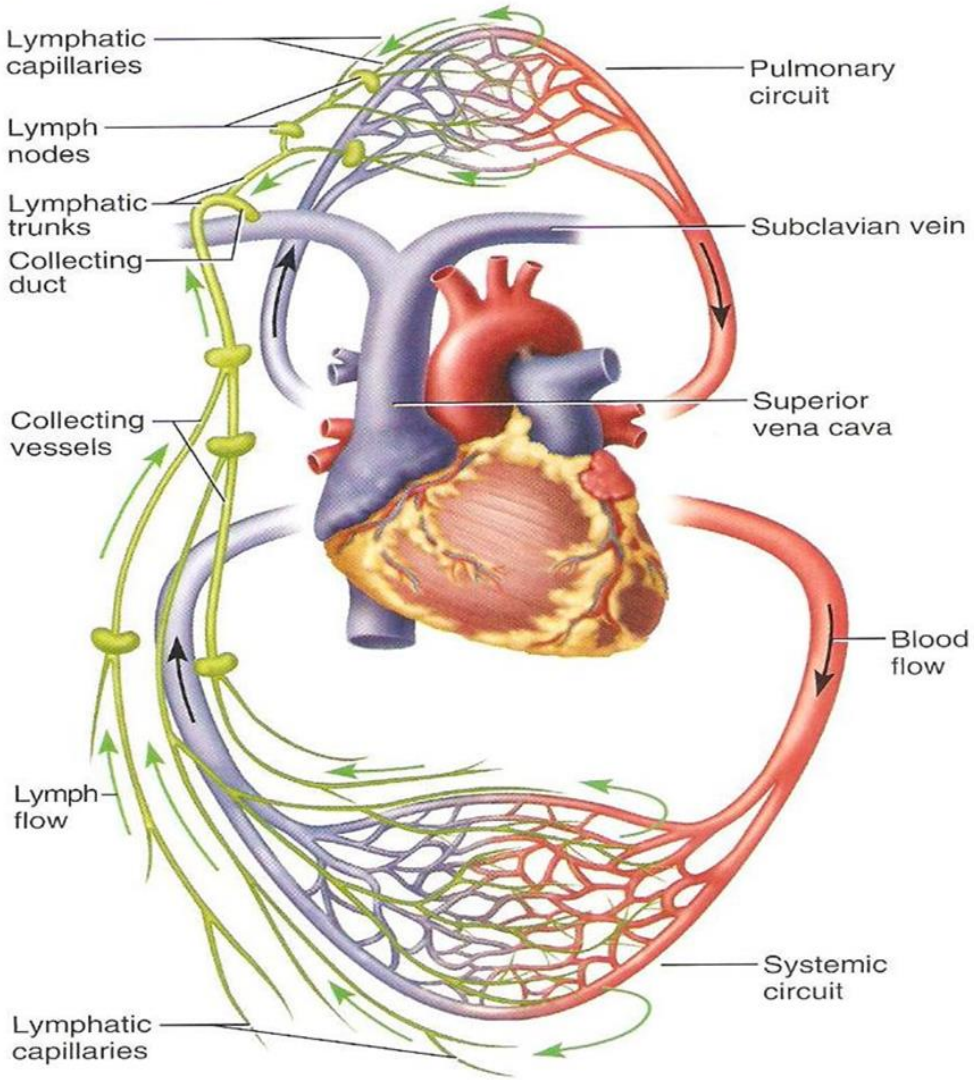
Circulatory system

Histology : First stage 2019

Dr. Kawther tuama khalf

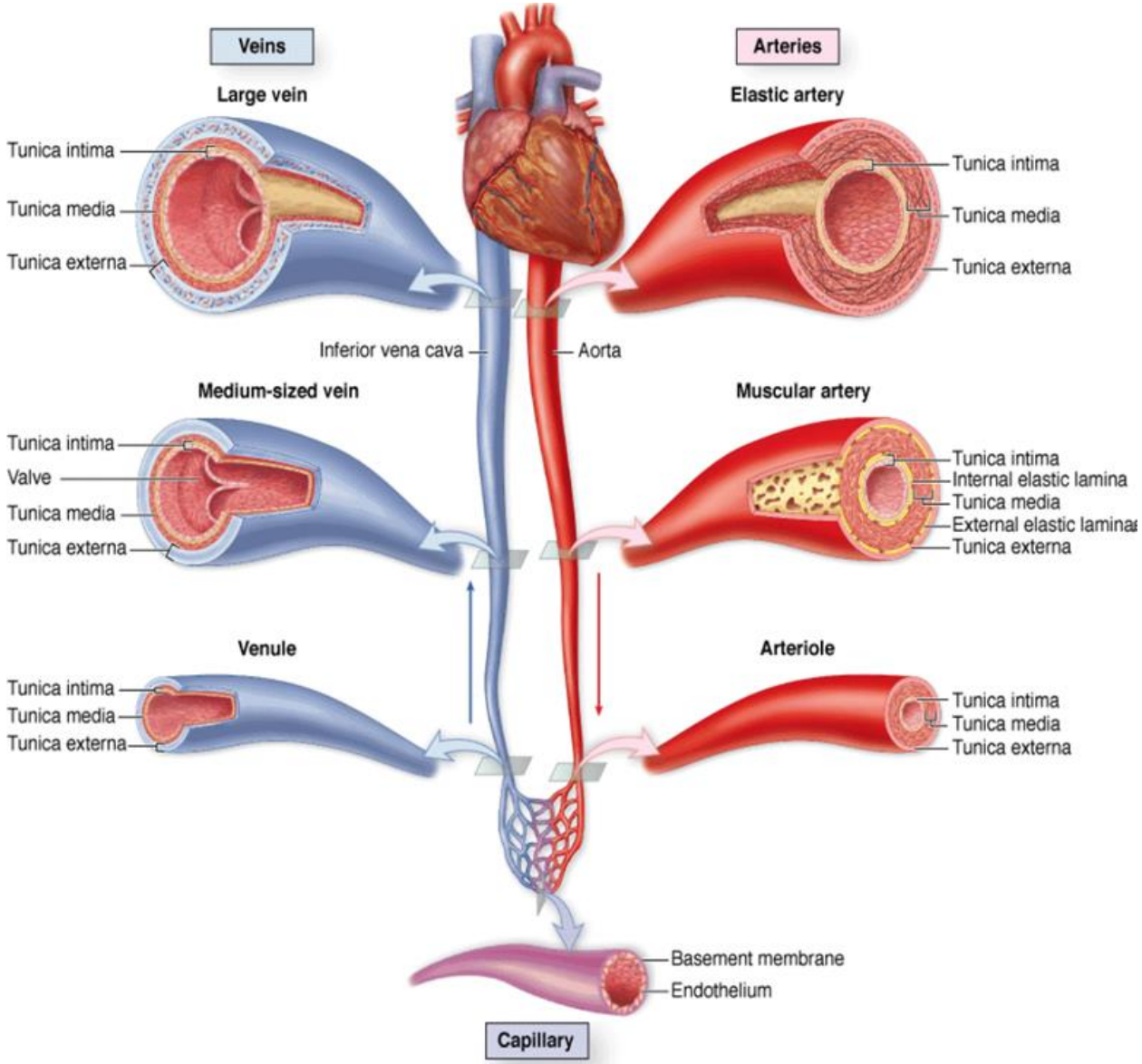
- The circulatory system include the

Cardiovascular system and Lymphatic system.



- Cardiovascular system

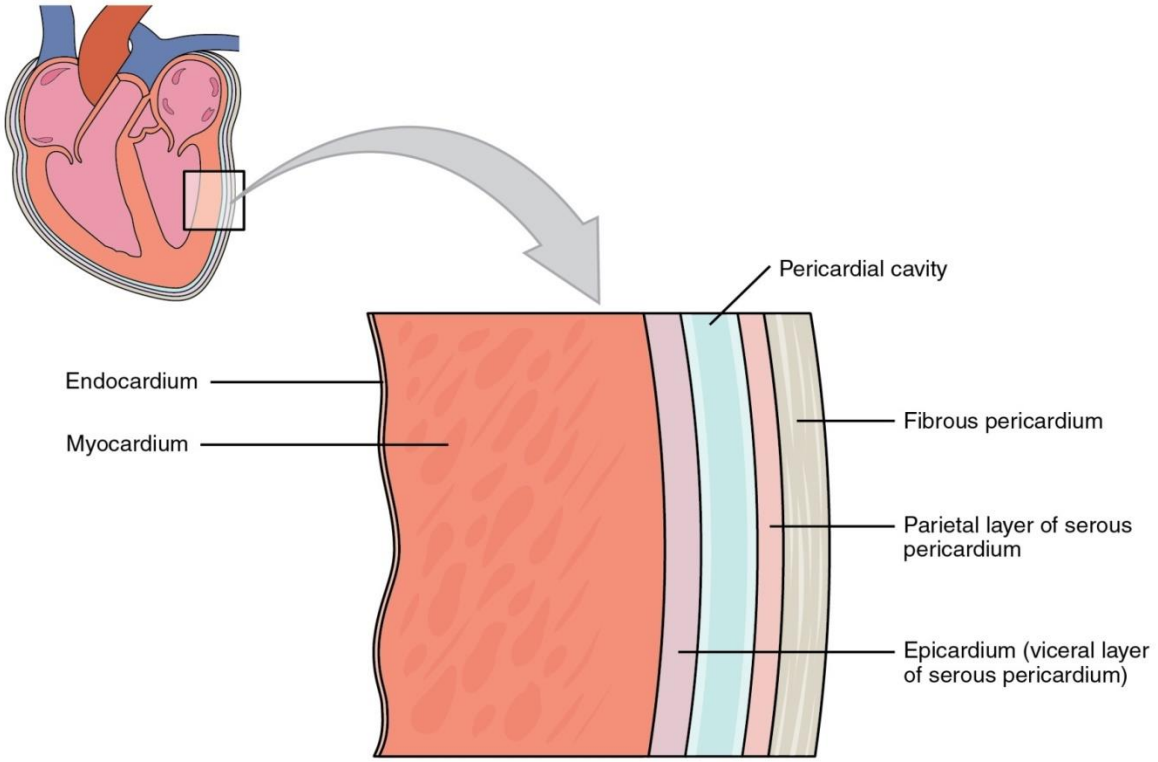
  Heart , arteries , capillary and veins.



HEART

Cardiac muscle in the four chambers of the heart wall contracts rhythmically. The walls of all four heart chambers consist of three major layers:

the internal endocardium; the middle myocardium; and the external epicardium.



- The endocardium

Inner layer of the heart lines the atria and ventricles and covers the heart valves vessels, has three sublayers:

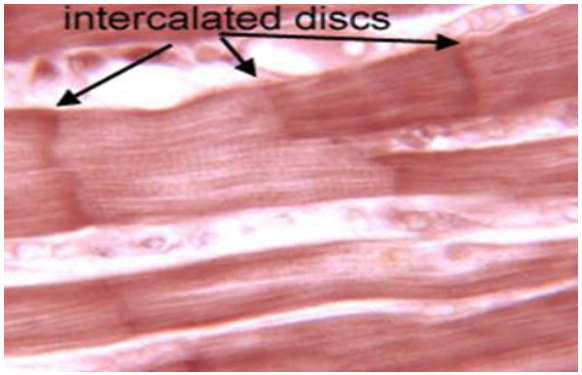
- Endothelium - innermost portion a simple squamous epithelium.
- Middle layer of the endocardium is mix of connective tissue and smooth muscle.
- Subendocardial Layer - outer layer of the endocardium is loose connective tissue joining the endocardium and myocardium.

-The myocardium

Is the middle layer (thickest layer) of the heart wall and contains the cardiac muscle with its fibers arranged spirally around each heart chamber.

- Cardiac muscle cells in the myocardium are arranged in strands whose ends attach to the dense connective tissue.

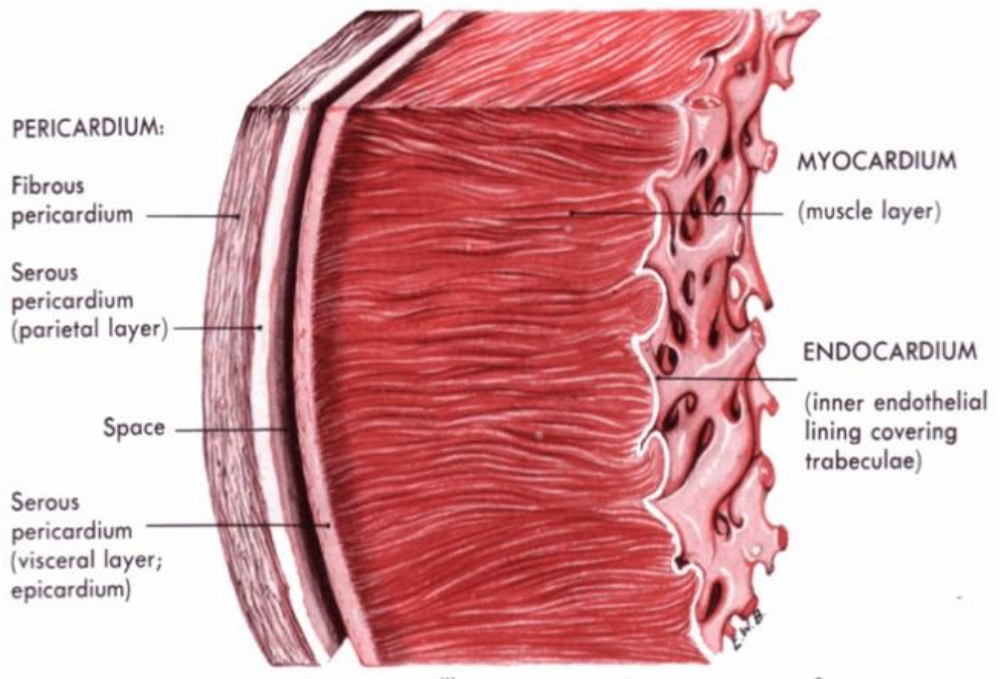
- Loose FECT holds bundles of cardiac muscle cells, fibers together and contains numerous blood vessels.



-The epicardium

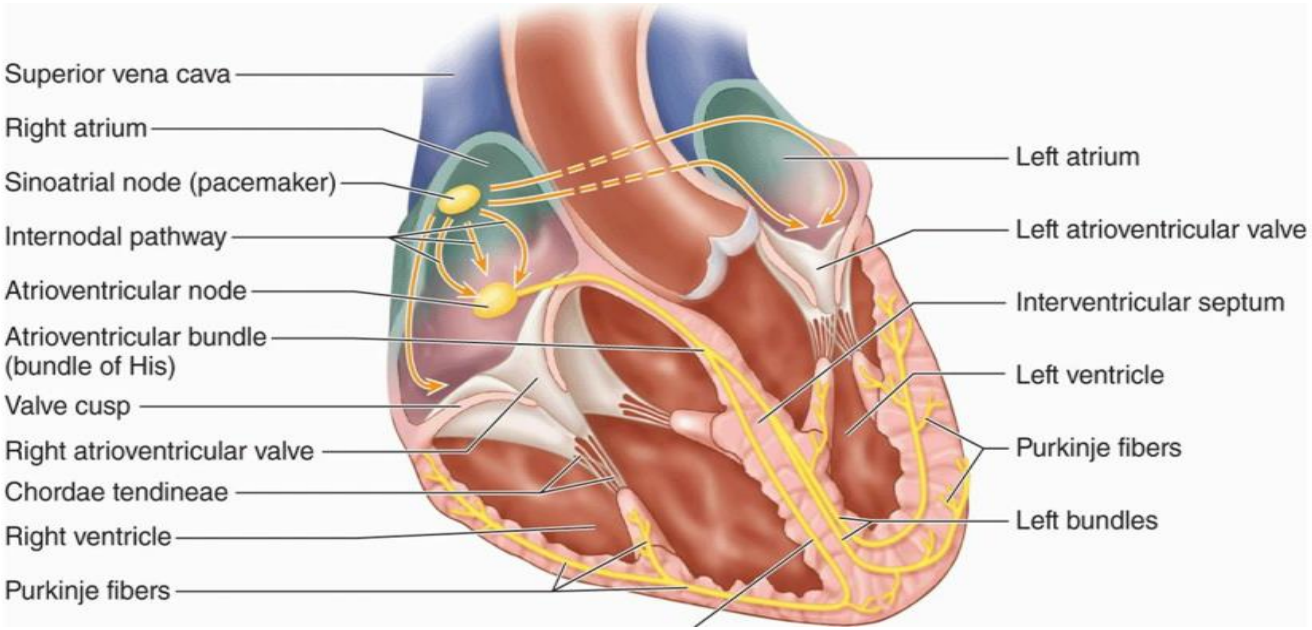
- Is the outer layer of the heart wall (simple squamous mesothelium) supported by a layer of loose connective tissue containing blood vessels and nerves.
- The epicardium corresponds to the visceral layer of the **pericardium** (the membrane surrounding the heart).

The **pericardium** is a two-layered connective tissue sac that encloses the heart. The **fibrous** pericardium is the **outer layer**, and the **serous** pericardium is the **inner layer**. The space between the two layers is the **pericardial cavity**, that contains serous fluid, this facilitates the pumping action of the heart.



Within the subendocardial layer and adjacent myocardium, modified cardiac muscle cells make up the impulse conducting system of the heart. This system consists of two nodes of specialized myocardial tissue in the right atrium: the sinoatrial (SA) node and the atrioventricular (AV) node, followed by the AV bundle (of His).

At the apex of the heart, the bundles branch further into a subendocardial conducting network of myofibers called **Purkinje fibers**. These are pale-staining fibers, larger than the adjacent contractile muscle fibers, with sparse, peripheral myofibrils and much glycogen.



TISSUES OF THE VASCULAR WALL

Walls of all blood vessels except capillaries contain smooth muscle and connective tissue in addition to the endothelial lining. The amount and arrangement of these tissues in vessels are influenced by mechanical factors, blood pressure, and metabolic factors reflecting the local needs of tissues.

1- The endothelium is a specialized epithelium that acts as a semipermeable barrier between two internal compartments: the blood plasma and the interstitial tissue fluid. Besides their key role in metabolite exchanges between blood and tissues, endothelial cells have several other functions:

-The endothelium presents a nonthrombogenic surface on which blood will not clot and actively secretes agents that control local clot formation.

-The cells regulate local vascular tone and blood flow by secreting various factors that stimulate smooth muscle contraction or relaxation.

- Endothelium has several roles in inflammation and local immune responses. Endothelial cells also secrete various factors called interleukins that affect the activity of local white blood cells during inflammation.

- Under various conditions endothelial cells secrete various growth factors, as vascular endothelial growth factor (VEGF).

2- Smooth muscle fibers occur in the walls of all vessels larger than capillaries and are arranged helically in layers. In arterioles and small arteries, the smooth muscle cells are connected by many more gap junctions and permit vasoconstriction and vasodilation which are of key importance in regulating the blood pressure.

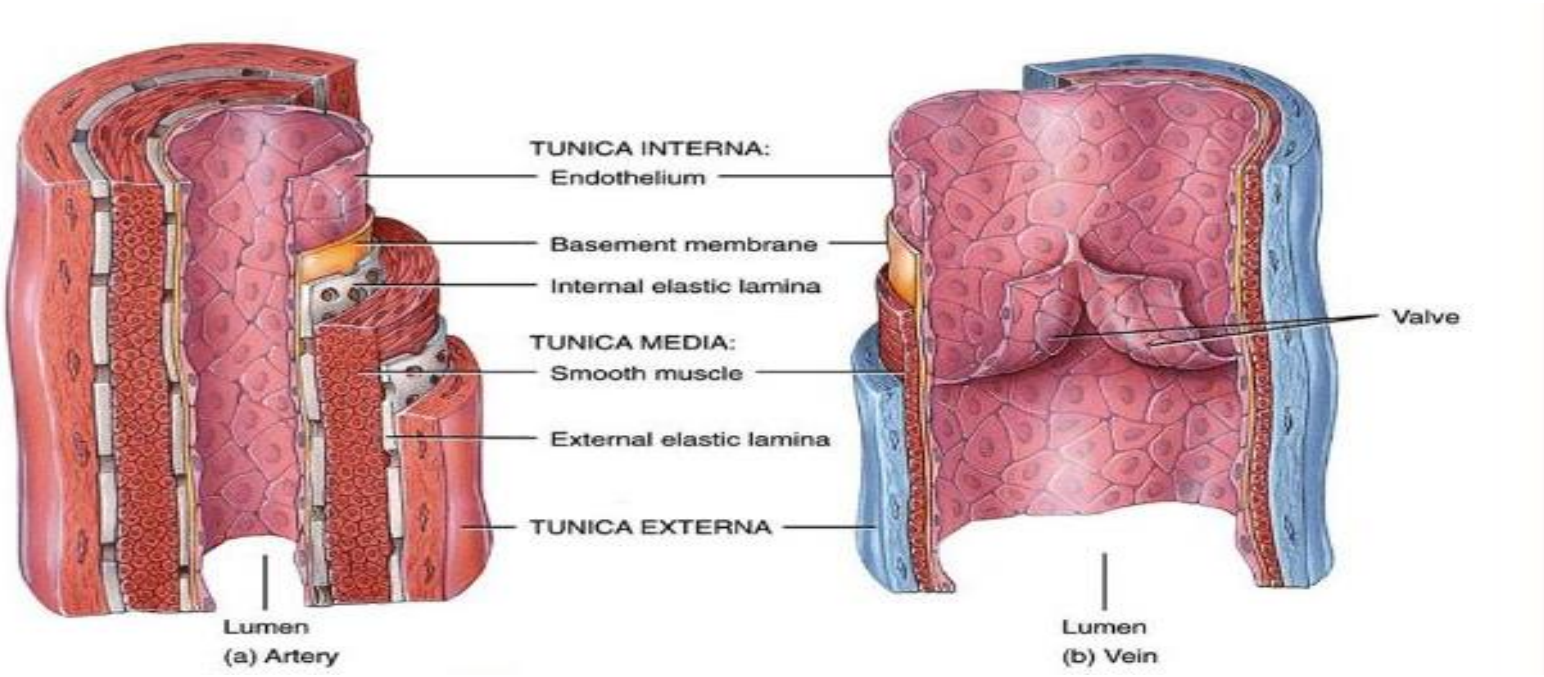
3- Connective tissue components are present in vascular walls in variable amounts and proportions based on local functional requirements.

- Collagen fibers are found in the subendothelial layer, between the smooth muscle layers, and in the outer covering.

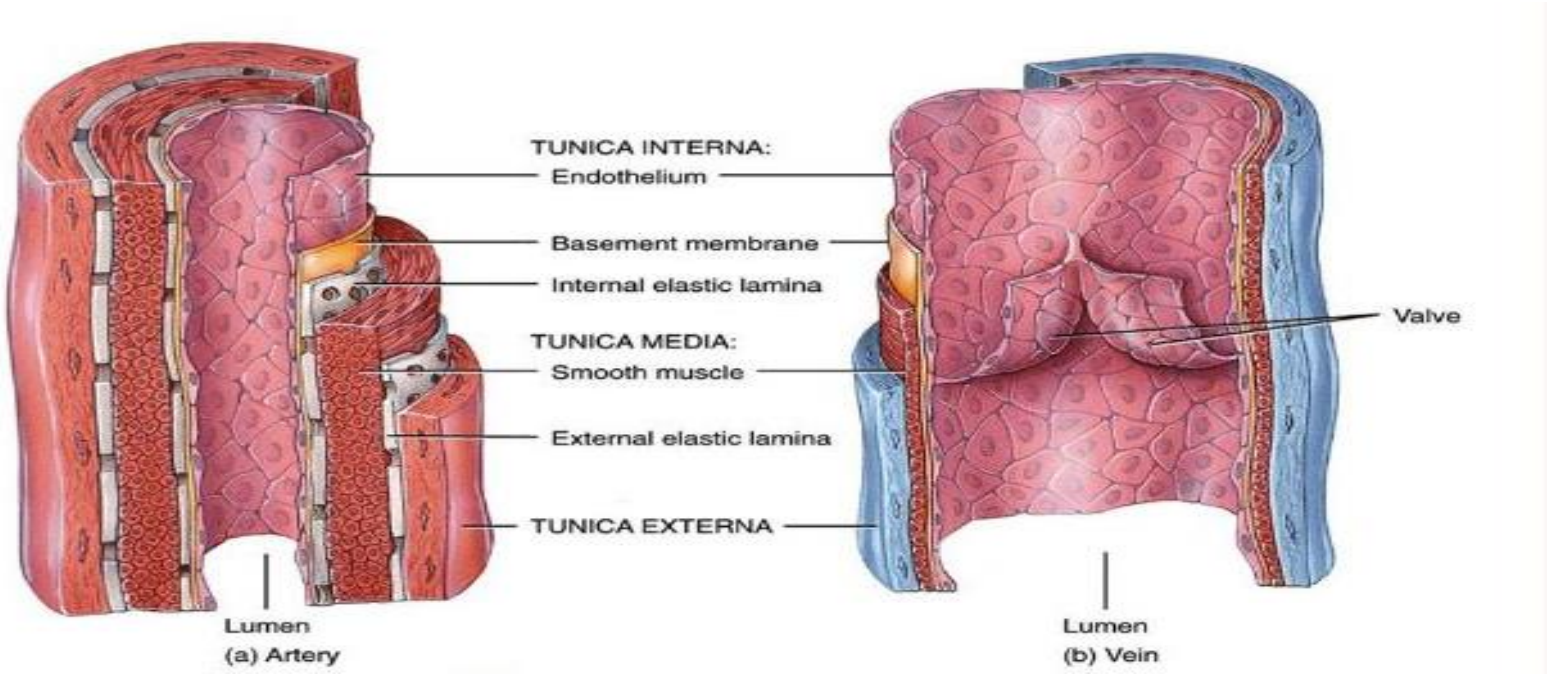
- Elastic fibers provide the resiliency required for the vascular wall to expand under pressure.

All walls of larger vessels have **three concentric layers, or tunics :**

1- Tunica Intima : consists of one layer of endothelial cells supported by a subendothelial layer of loose connective tissue containing smooth muscle cells. In arteries, the intima is separated from the media by an **internal elastic lamina,** This lamina, composed of elastin, has gaps (fenestrae) that allow the diffusion of substances to nourish cells deep in the vessel wall.



2- Tunica Media : consists of concentric layers of helically arranged smooth muscle cells . Interposed among these cells are variable amounts of elastic fibers and lamellae, reticular fibers (collagen type III) and glycoproteins. In arteries, the media has a thinner **external elastica lamina,** which separates it from the tunica adventitia.



3- Tunica Adventitia

The adventitia consists of collagen and elastic fibers . Collagen in the adventitia is type I.

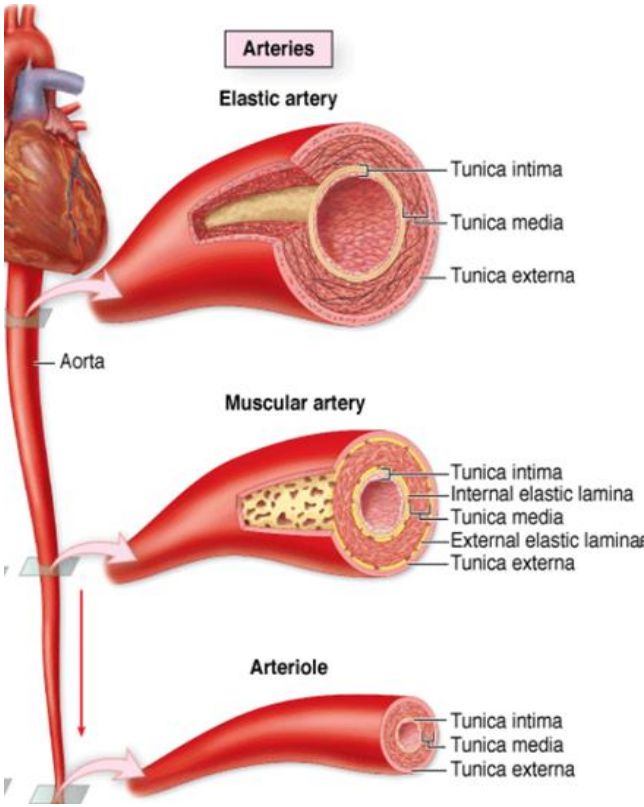
The arterial blood vessels are classified, based on their diameter, into arterioles, arteries of medium diameter (muscular arteries), and larger (elastic) arteries.

Elastic Arteries

Are the aorta, the pulmonary artery, and their largest branches; these large vessels are also called conducting arteries because their major role is to carry blood to smaller arteries. the most prominent feature of elastic arteries is:

- **The intima** is well developed, with many smooth muscle cells in the subendothelial connective tissue.

The internal elastic lamina is not easily discerned because it is similar to the elastic laminae of the next layer.



- **The thick media** in which elastic lamellae, alternate with Layers of smooth muscle fibers.

-**The adventitia** is much thinner than the media.

The numerous elastic laminae of these arteries contribute to their important function of making blood flow more uniform.

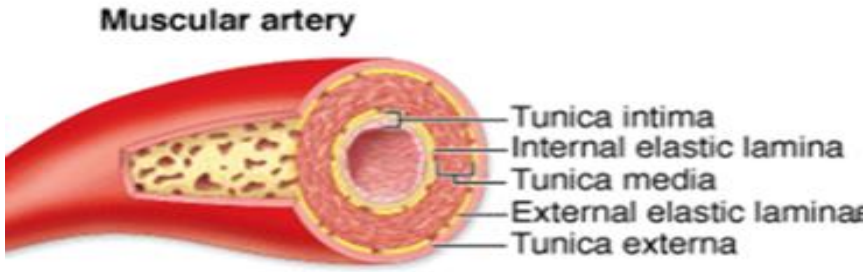
Muscular Arteries

The muscular arteries distribute blood to the organs and help regulate blood pressure by contracting or relaxing the smooth muscle in the media.

-**The intima** has a very thin subendothelial layer and a prominent internal elastic lamina.

-**The media** may contain up to 40 layers of large smooth muscle cells interspersed with a variable number of elastic lamellae (depending on the size of the vessel). An **external elastic lamina**, the last component of the media, is present only in the larger muscular arteries.

-**The adventitia** consists of connective tissue. Lymphatic capillaries, vasa vasorum, and nerves are also found in the adventitia.



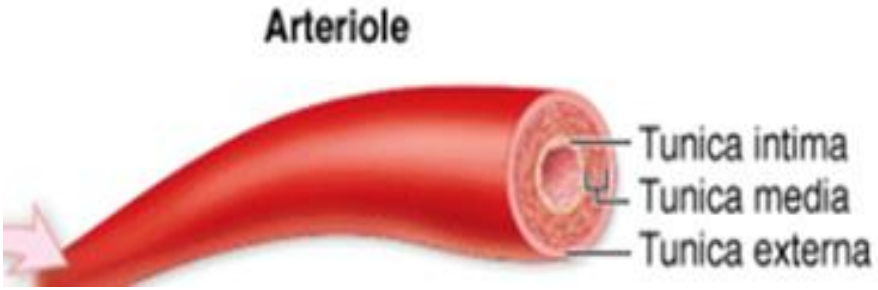
Arterioles

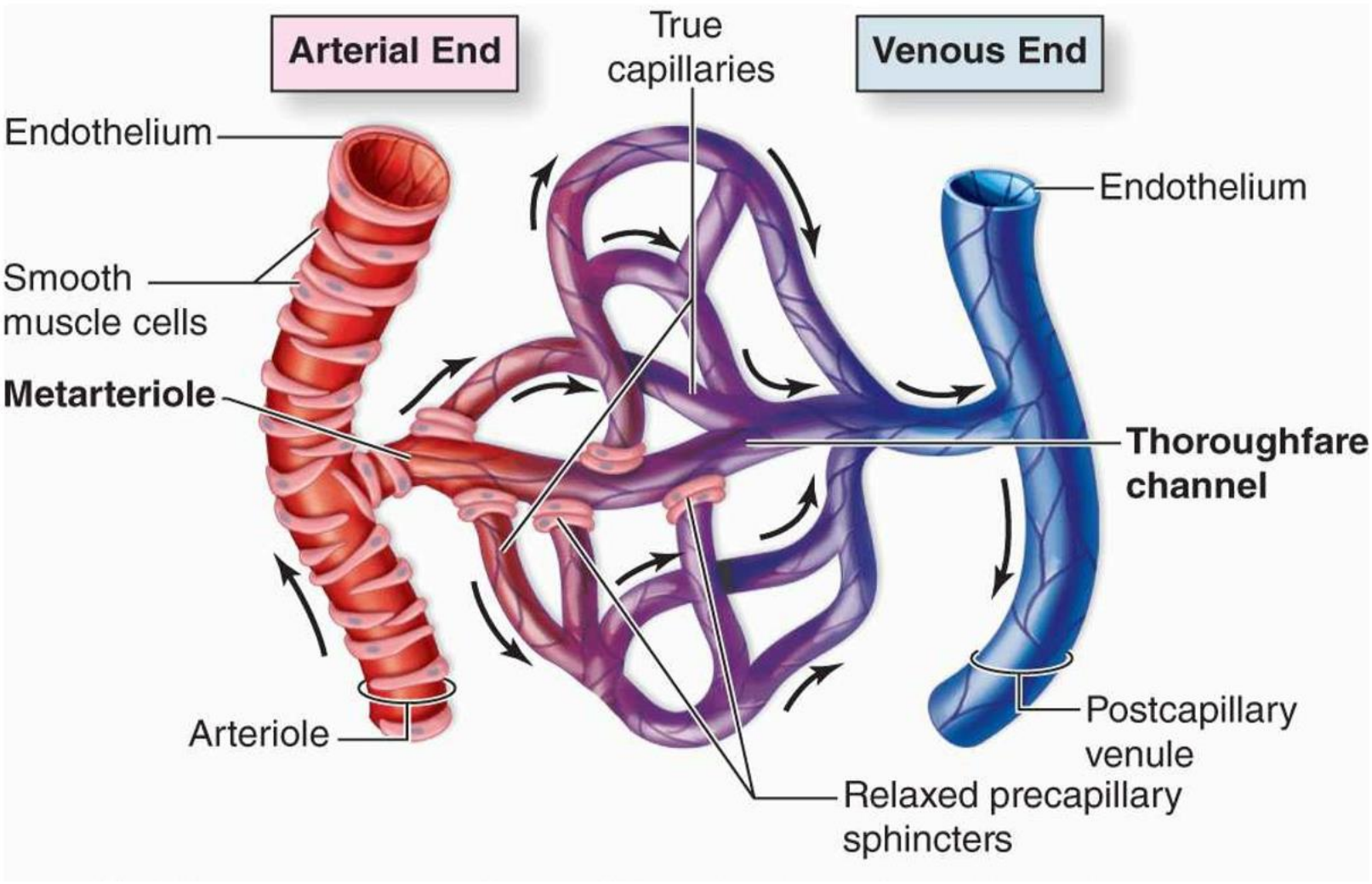
The smallest arteries branch as arterioles:

-The subendothelial layer is very thin, elastic laminae are absent,

-The media consists of the circularly arranged smooth muscle cells (only one or two smooth muscle layers). it shows no external elastic lamina.

- In both small arteries and arterioles, **the adventitia** is very thin and inconspicuous.

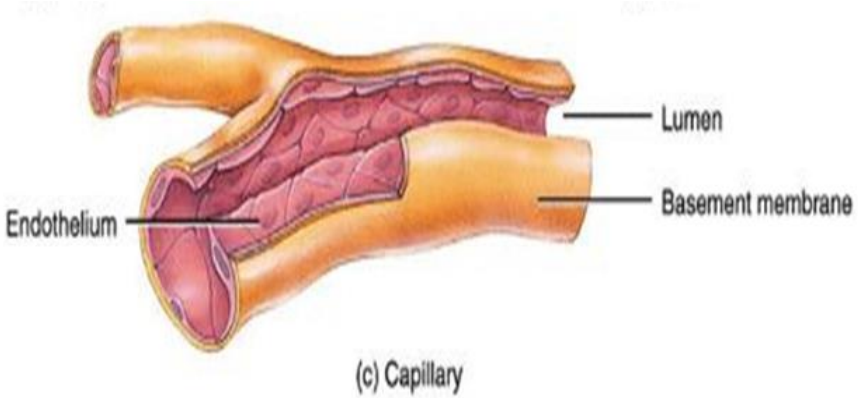



Arterial End
True capillaries
Venous End
Endothelium
Smooth muscle cells
Metarteriole
Arteriole
Endothelium
Thoroughfare channel
Postcapillary venule
Relaxed precapillary sphincters

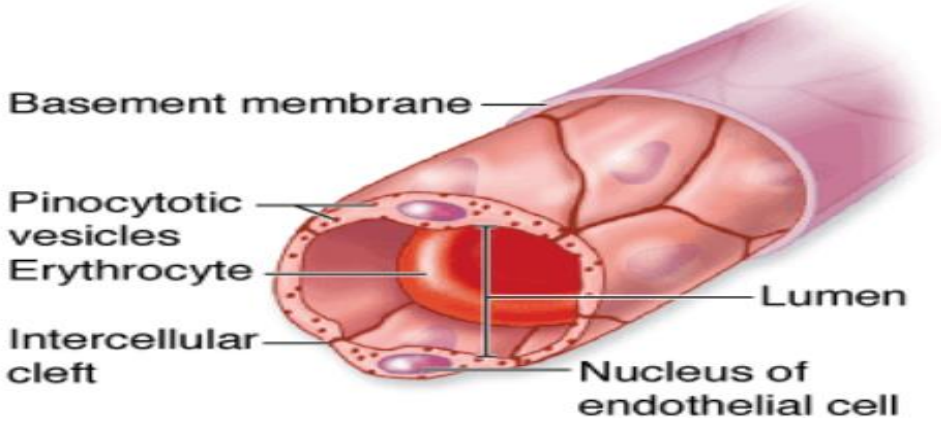
Capillaries

Are composed of a single layer of endothelial cells rolled up as a tube . Capillaries permit and regulate metabolic exchange between blood and surrounding tissues.

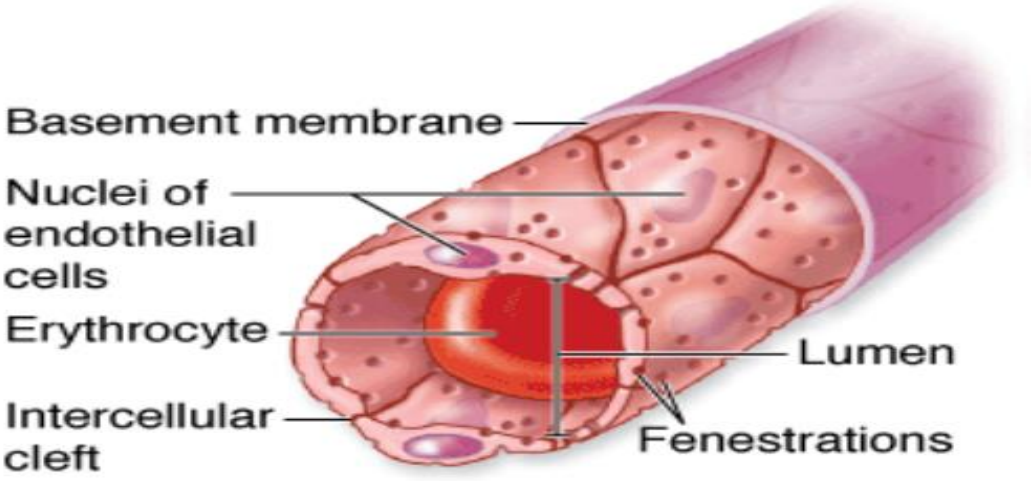
Capillaries are generally grouped into three histologic types, depending on the continuity of the endothelial cells and the external lamina.



1. **The continuous or somatic capillaries** are characterized by the absence of fenestrae in their wall. They are found in all types of muscle tissue, connective tissue, exocrine glands, and nervous tissue.



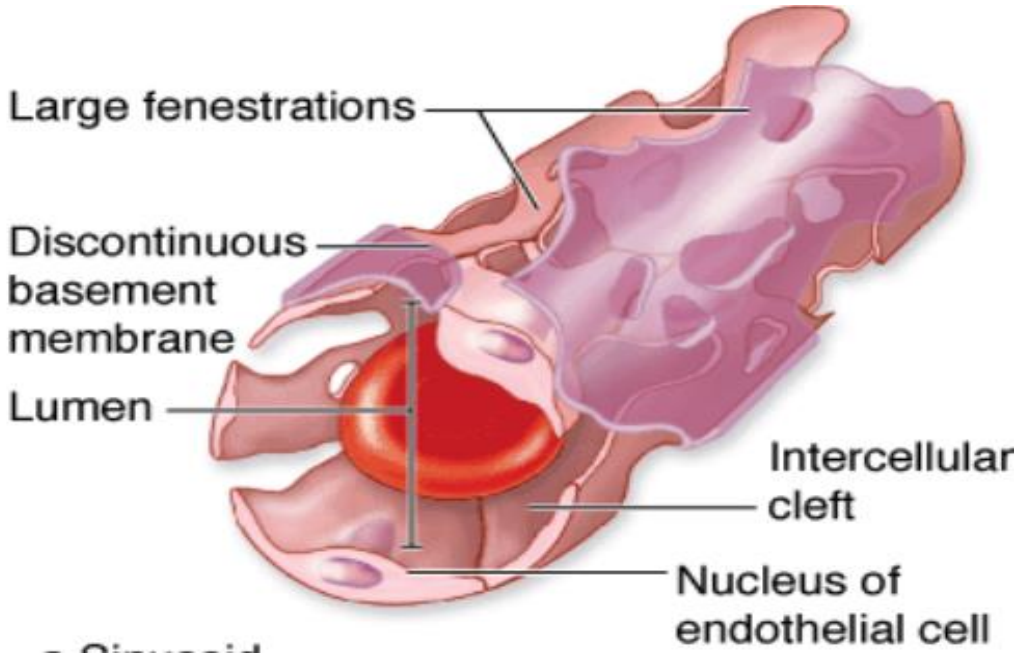
2- The fenestrated or visceral capillaries are characterized by the presence of several circular transcellular openings in the endothelium membrane called **fenestrae.** Fenestrae are limited by the cell membrane. The basal lamina of the fenestrated capillaries is continuous.



3- The discontinuous sinusoidal capillaries:

The endothelial cells form a discontinuous layer and are separated from one another by wide spaces.

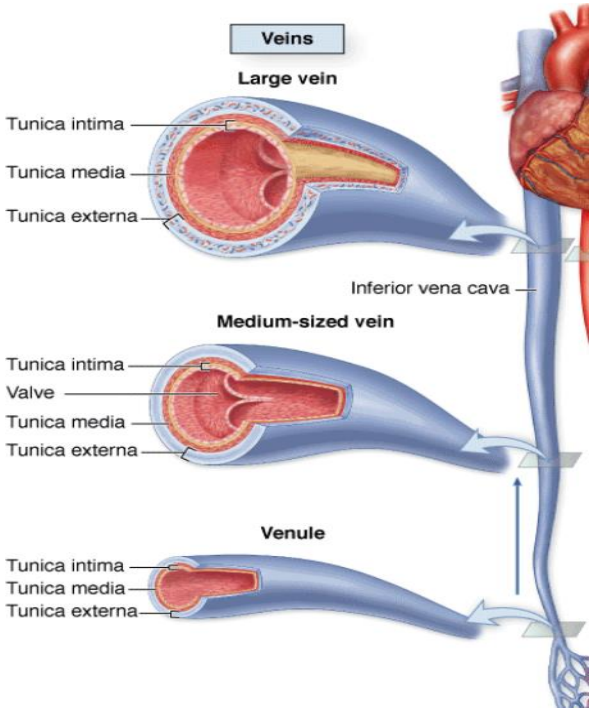
The basal lamina is discontinuous. Sinusoidal capillaries are found mainly in the liver , bone marrow and spleen.



postcapillary venules the transition from capillaries to venules occurs gradually. postcapillary venules (pericytic venules) are characterized by the presence of **pericytes.** The tunica intima of these vessels is composed of endothelium and a very thin subendothelial layer. The media of these venules may contain only contractile pericytes

Muscular Veins

Most venules are muscular, with at least a few smooth muscle cells in their walls . The **intima** usually has a thin **subendothelial** layer, which may be absent at times. The **media** consists of small bundles of **smooth muscle cells** intermixed with reticular fibers and a delicate network of elastic fibers. The collagenous adventitial layer is well developed.



The big venous trunks close to the heart, are large veins. Large veins have a well-developed **tunica intima**, but the **media** is much thinner, with few layers of smooth muscle cells and abundant connective tissue. The **adventitial layer** is the thickest and best-developed tunic in veins; it frequently contains longitudinal bundles of smooth muscle. These veins, particularly the largest ones, have valves in their interior. The valves consist of 2 semilunar folds of the tunica intima that