

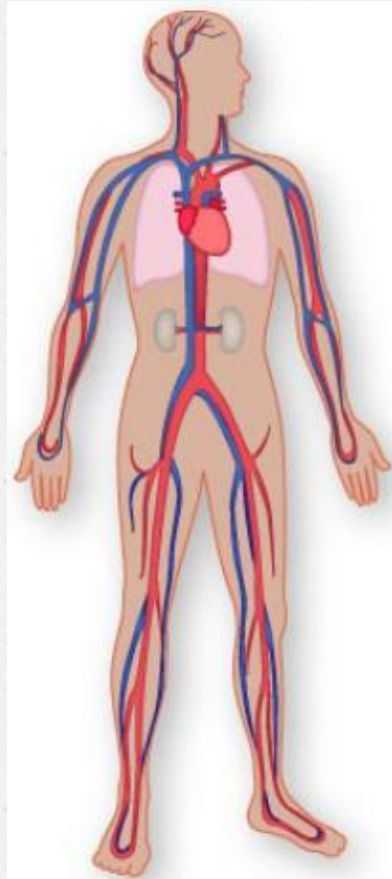


Organization of the vascular system

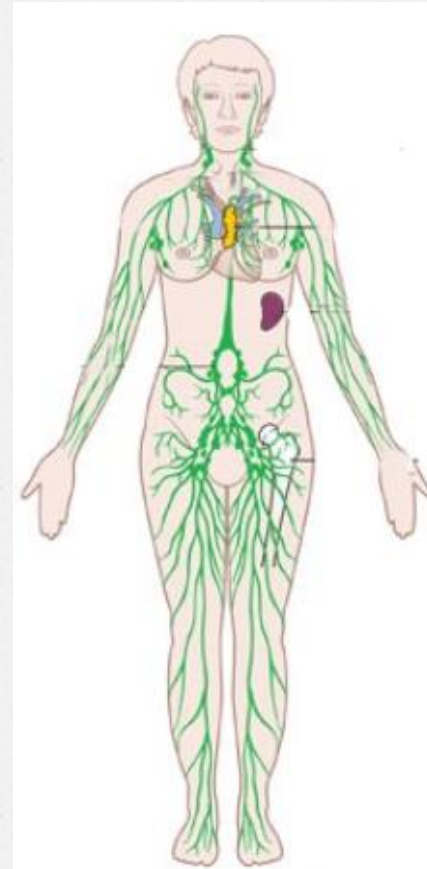
Objectives

- Describe the structural adaptations of the vessels to its function.
- Describe the differences between elastic and muscular arteries.
- State the main criteria that the structure of vein differ from that of arteries.

Vascular system



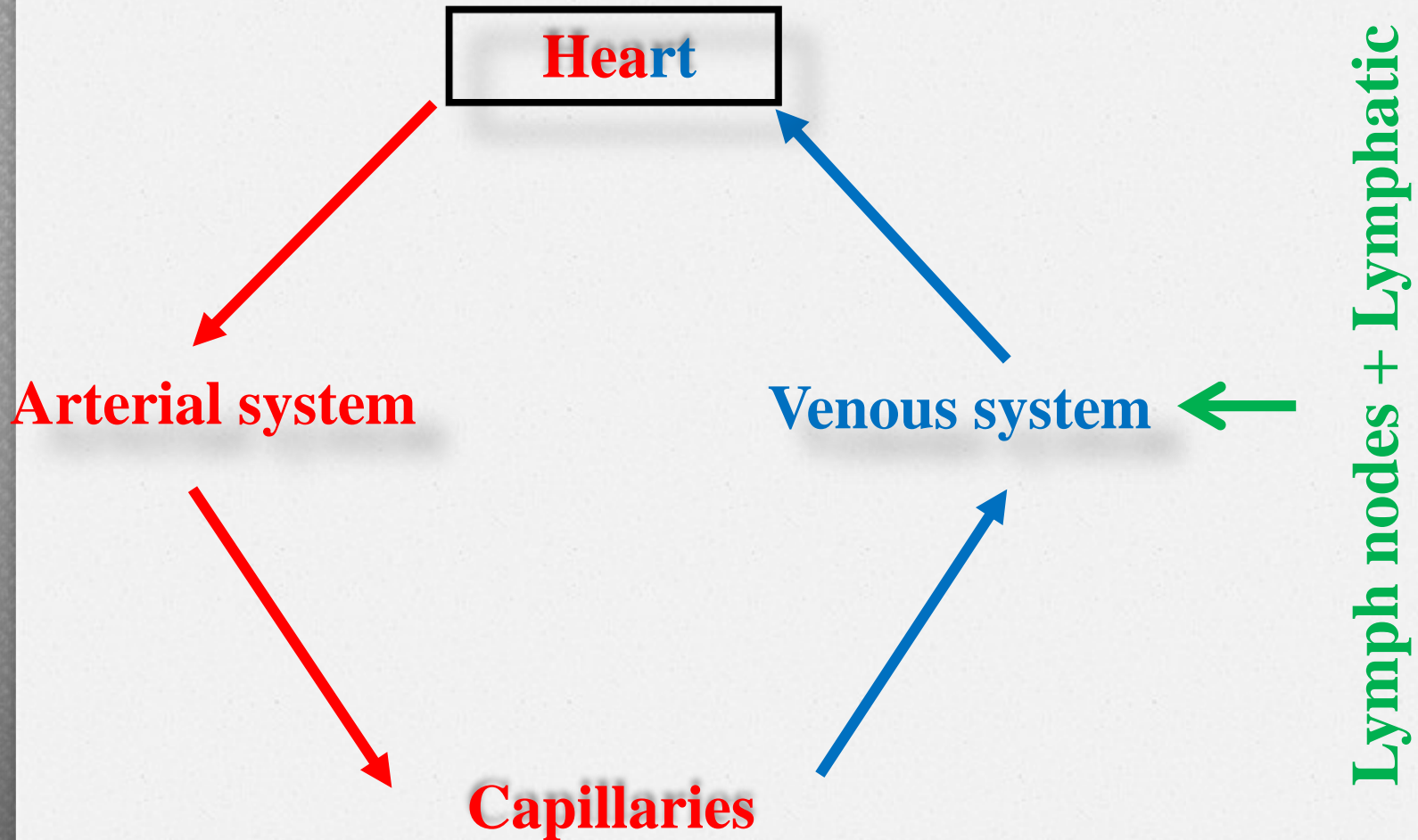
Blood vascular system



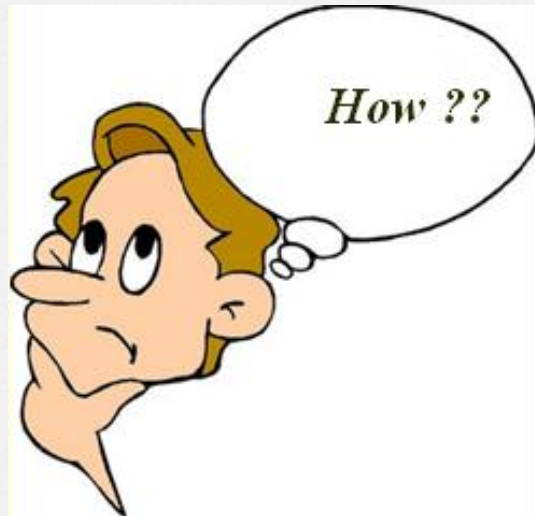
Lymphatic vascular system



Vascular system



Identification of different types of vessels



- *composition of layers*
- *thickness of each layer relative to the diameter*

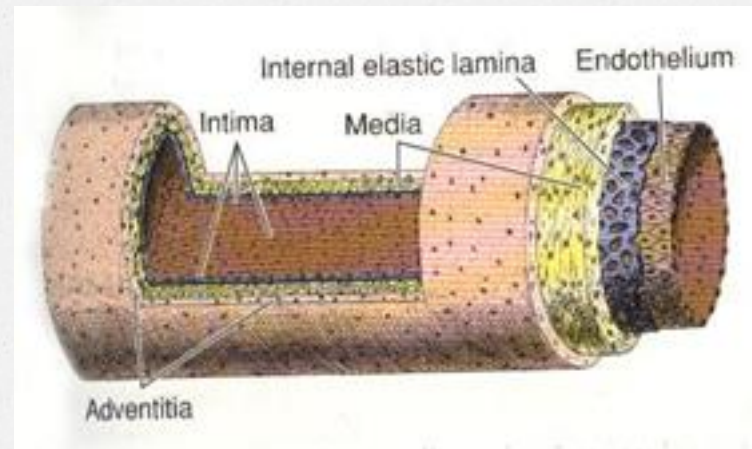
Blood vessels & heart walls: General organization

- *conventionally regarded as being constructed of 3 concentric coats or tunicae.*

1. Tunica intima

2. Tunica media

3. Tunica adventitia



(except blood capillaries, post-capillary venules & lymphatic capillaries)

Blood vessels : General organization

1. Tunica Intima (innermost coat)

constituents :

- endothelium - single layer of flattened epithelial cells
- basal lamina - an underlying basement membrane
- subendothelial layer of connective tissue
- internal elastic lamina

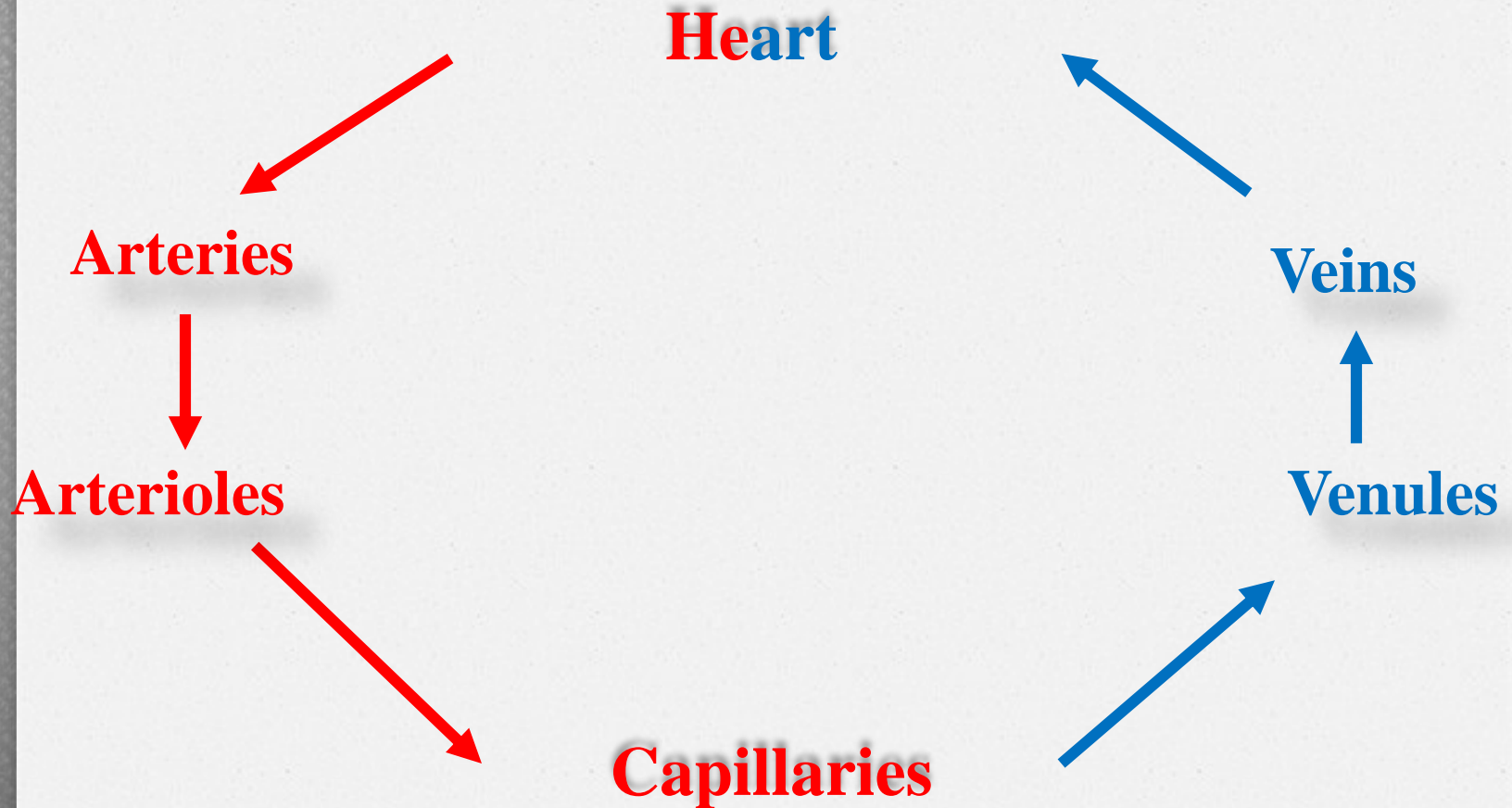
2. Tunica Media

concentric layers-smooth mm cells
elastic fibers & reticular fibers

3. Tunica Adventitia (outermost coat)

connective tissue with fibroblasts
vasa vasorum (vessels of the vessels)
vasomotor nerve fibers

Blood Vascular System



Blood Vascular System

Heart



Arteries



Elastic arteries

large diameter(>10mm)



Muscular arteries

or

Distributing arteries

0.1-10 mm in diameter

Histological structure & functions

Elastic arteries

Aorta

pulmonary artery

Common carotid artery

Subclavian artery

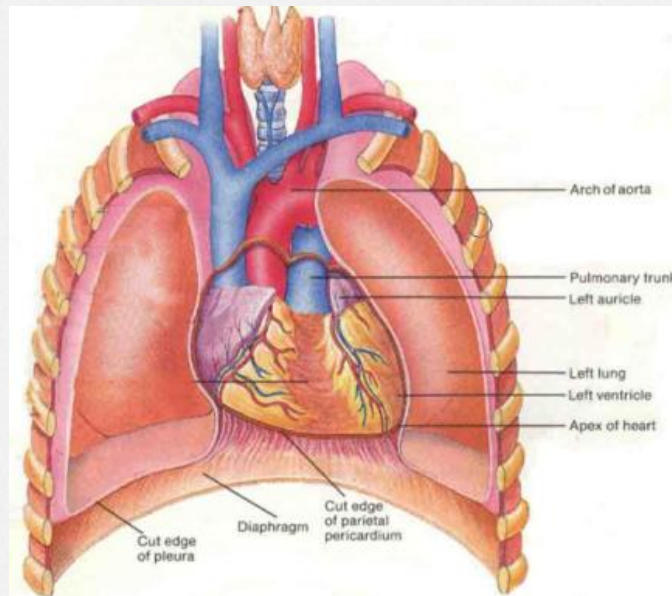
Muscular artery

Radial artery

Femoral artery

Coronary artery

Cerebral artery



Elastic artery

**Tunica
intima**



**Tunica
media**



**Tunica
adventitia**



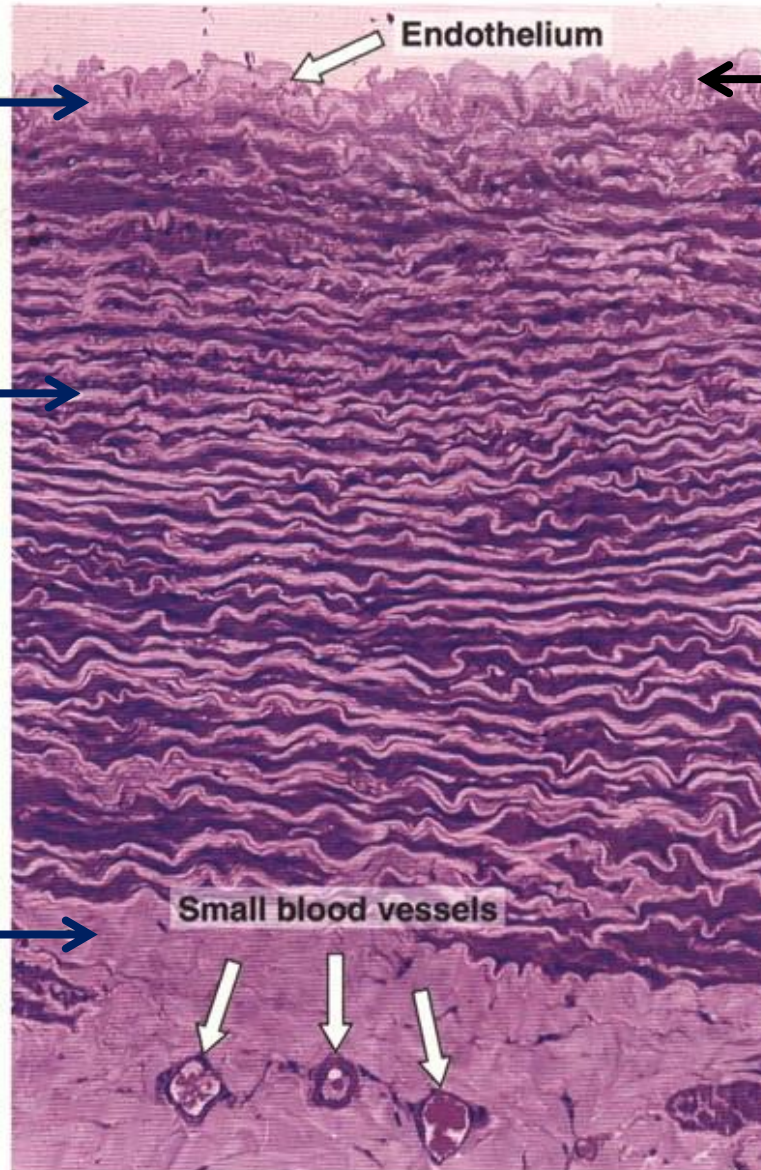
Endothelium



**Internal elastic
lamina**



Small blood vessels



Elastic artery

● Tunica intima

thicker than corresponding muscular artery.

endothelium supported by thick connective tissue layer.

subendothelial tissue: fibroblasts & myointimal cells (no basement membrane)

inconspicuous internal elastic lamina.

● Tunica media

particularly broad & extremely elastic (elastic fibers).

concentrically arranged, perforated elastic lamina.

number of elastic lamina increases with age.

(40-newborn & 70 adult)

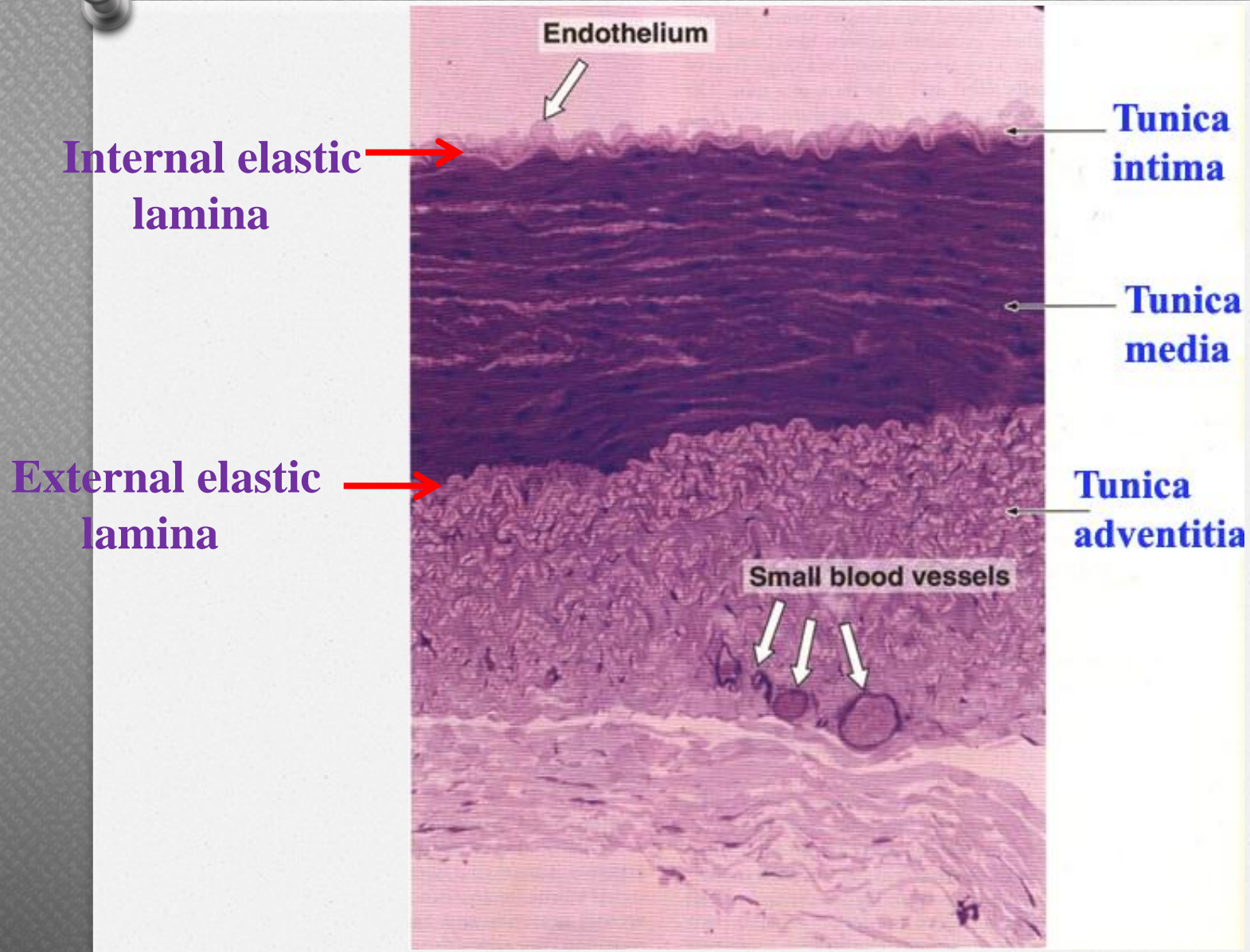
smooth mm cells, reticular fibers.

● Tunica adventitia

relatively underdeveloped.

vasa vasorum. This may penetrate the outer half of the tunica media.

Muscular/medium artery



Muscular/medium artery

- **Tunica intima**

thinner layer.

well defined, fenestrated elastic sheet - internal elastic lamina at its outer border

- **Tunica media**

thick media

circular layer of smooth muscle (40 layers)

elastic fibers + reticular fibers

less defined external elastic lamina at its outer border

- **Tunica adventitia**

thickness varies but comparable to the thickness of the media.

elastic fibers + collagen fibers

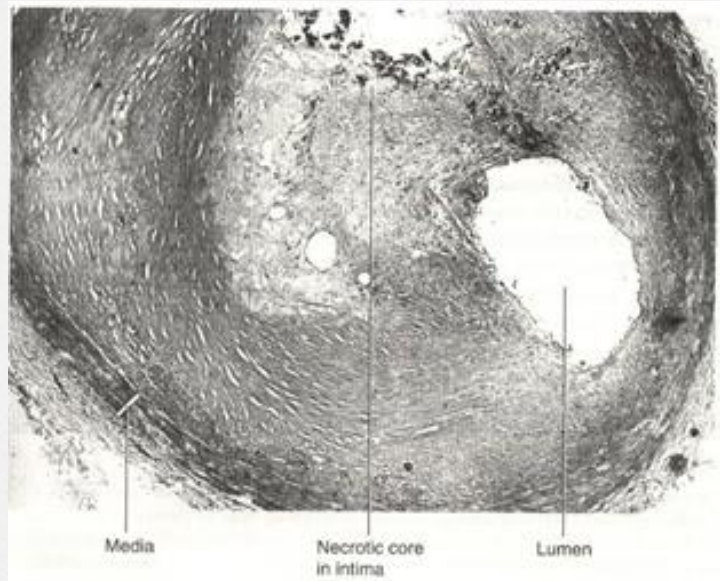
vasa vasorum & lymphatics

Clinical Implication

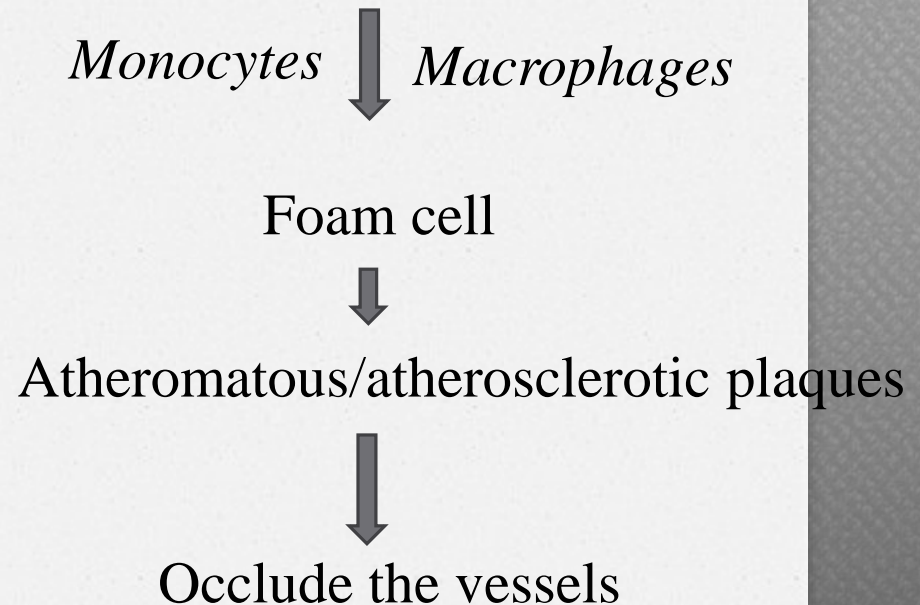
Artheroma

Most common disease of arteries.

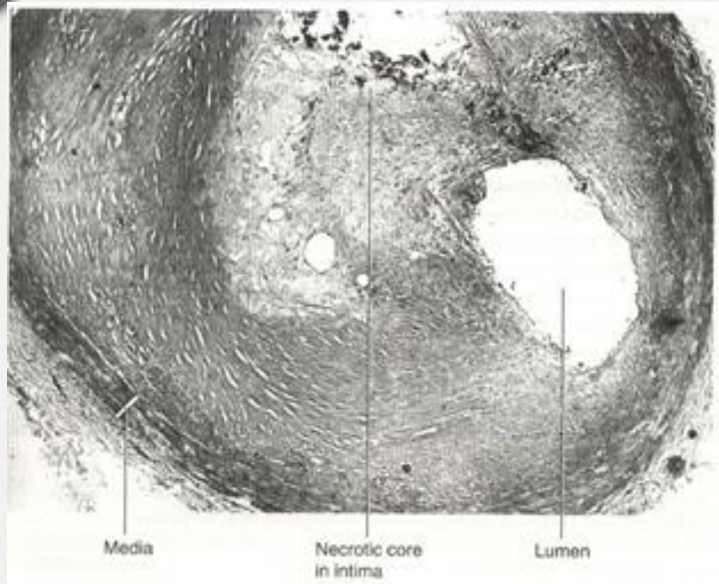
Characterized by thickening of the intima with fat and collagen.



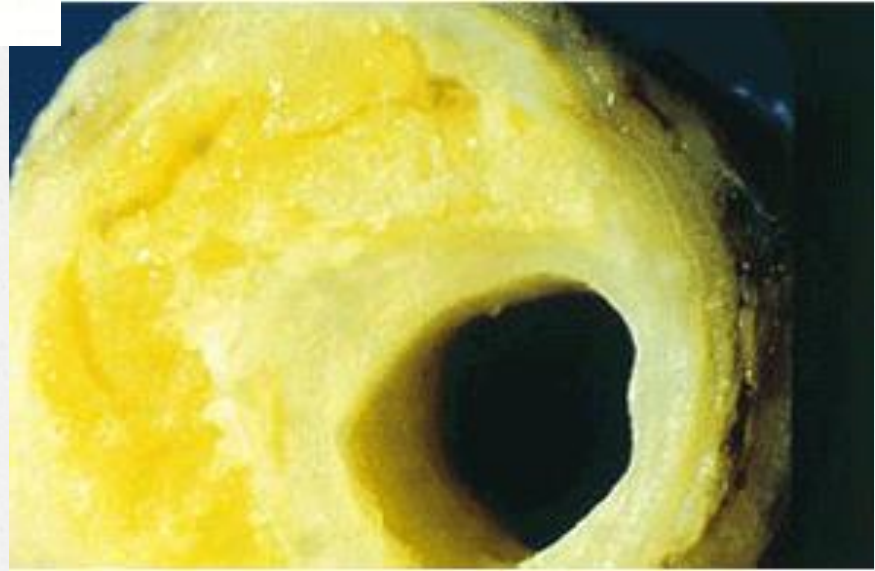
*Coronary artery – intimal thickening
with atherosclerotic plaques*



Clinical Implication



Artheroma



Clinical Implication

Damage to endothelium induce coagulation of blood



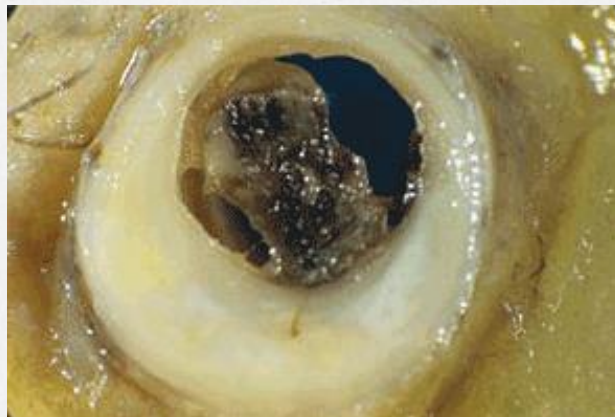
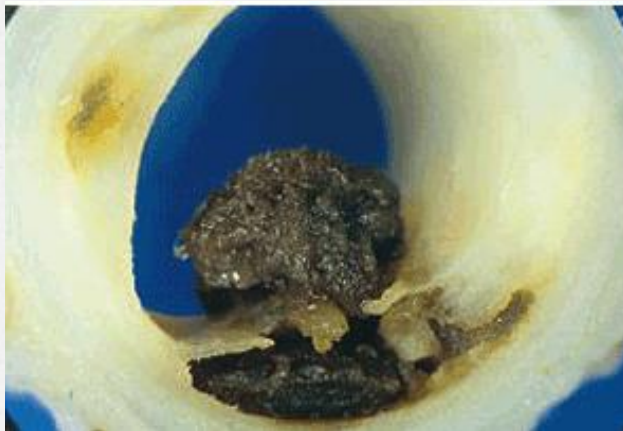
platelet clot



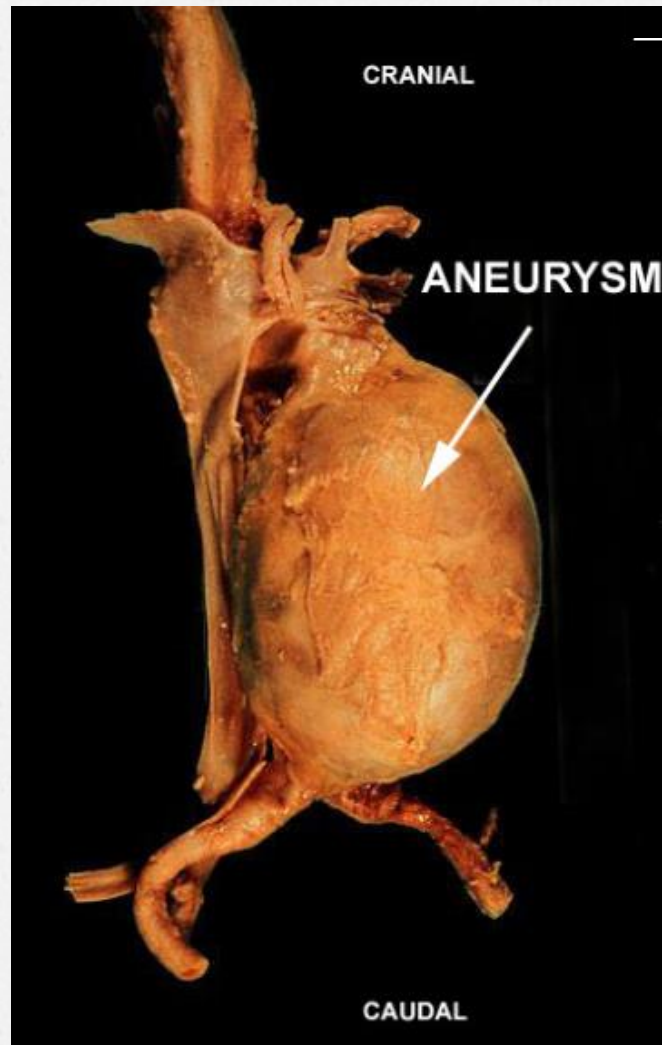
Form **thrombus**

coronary thrombosis - myocardial infraction

cerebral thrombosis - stroke & paralysis



Clinical Implication



Aneurysm

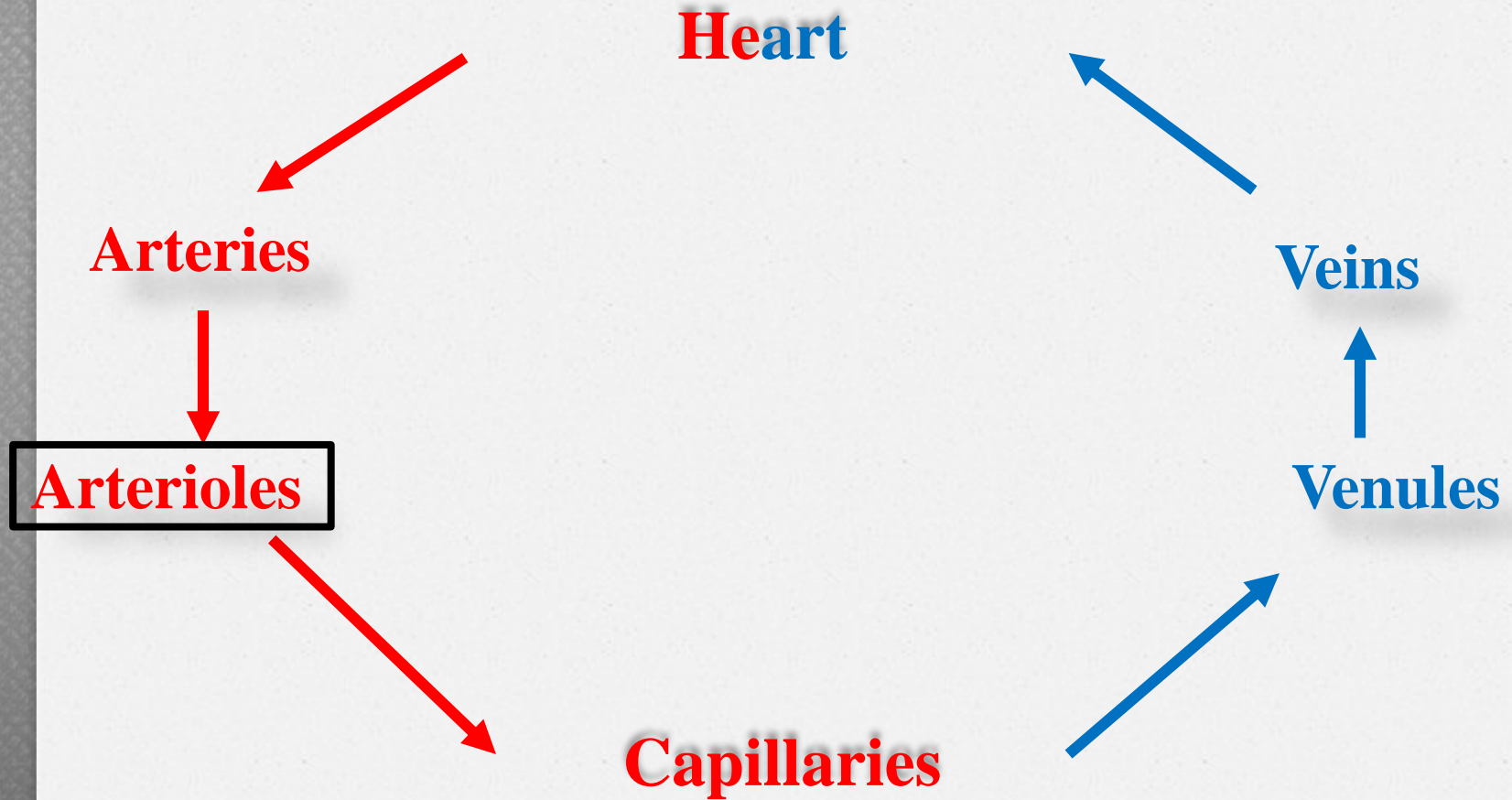
Tunica media of an artery – weakened

*embryonic defect
disease
lesion*

Wall of the artery dilate

Aneurysm

Blood Vascular System



Arterioles

Muscular arteries progressively decrease in caliber



Arterioles – diameter 100 μm or less



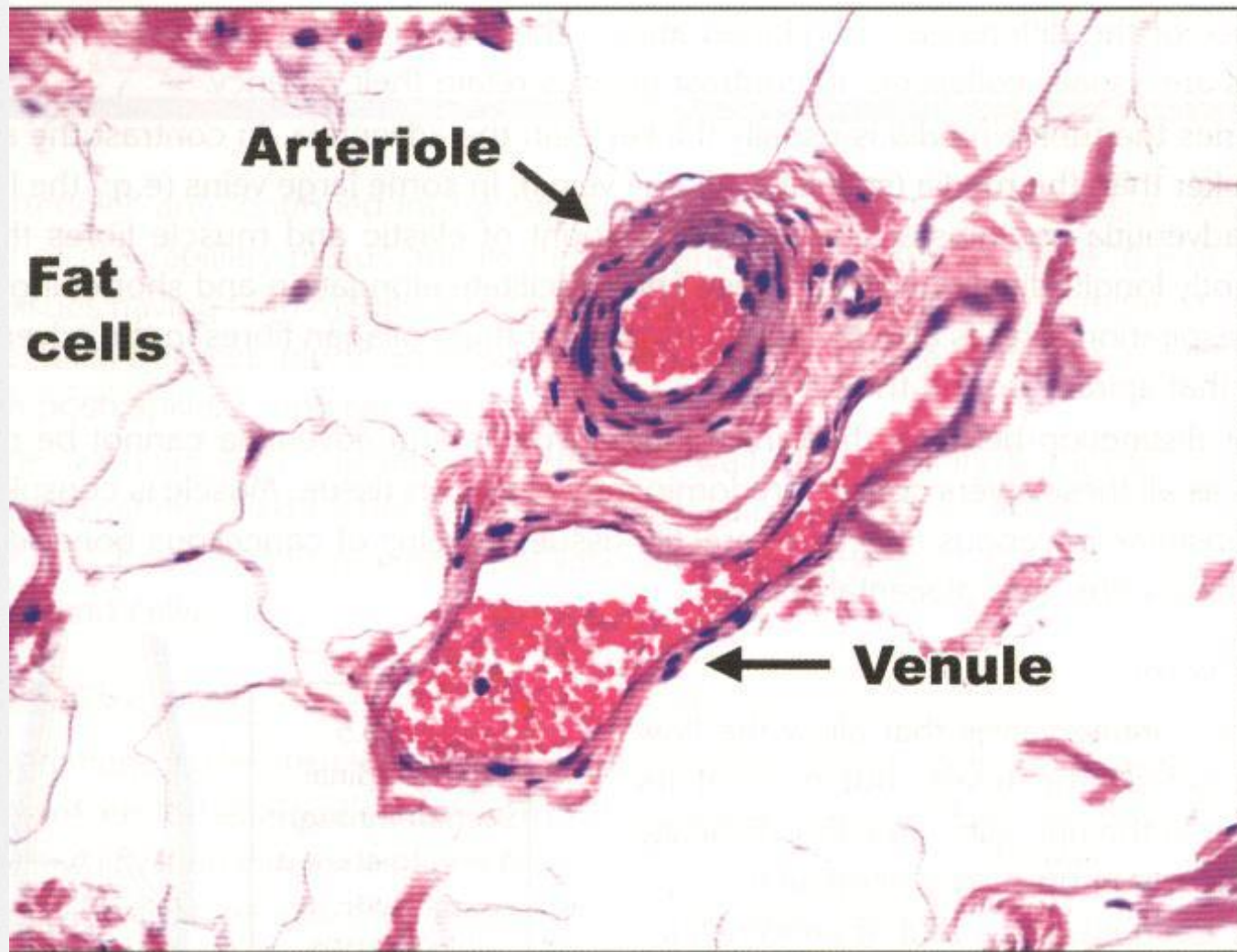
Larger muscular arterioles
100-50 μm



Terminal arterioles
<50 μm

Wall appears almost as wide as the lumen.

Arterioles



Arterioles

- **Tunica intima:**
 - Endothelium & basement membrane
 - Thin Subendothelial layer
 - Internal elastic lamina – absent in small arterioles
- **Tunica media:**
 - one/two circularly arranged layers of smooth mm cells*
 - no external elastic lamina
- **Tunica adventitia**
 - very thin
 - few elastic & collagen fibers

Arterioles- functions

- Regulate the blood flow through capillary bed

contraction of smooth mm of arteriole



reduce the diameter of the lumen



reduce the blood flow

- Generalized contraction of arterioles through out the body

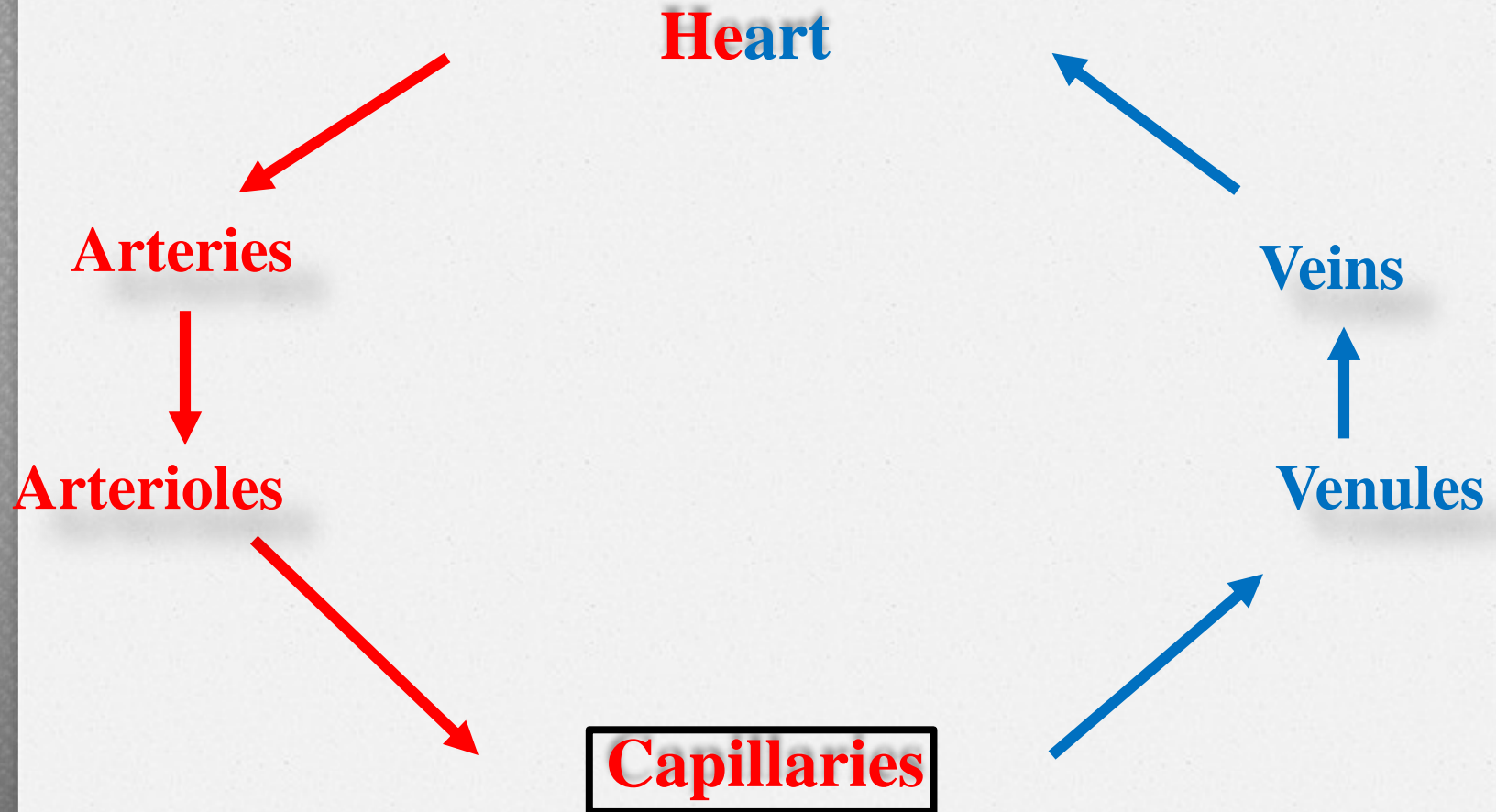


increase the peripheral
resistance to blood flow



regulate systemic blood pressure

Blood Vascular System



Capillaries

Smallest blood vessels (8-10 μ diameter).

Thin walled vessels.

Do not exist singly but in network – capillary bed.

Function : place of metabolic exchange between blood & tissue.

Compose of single layer of endothelial cells

No tunica media or tunica adventitia

Capillary classification

- Continuous capillary
- Fenestrated capillary
- Discontinuous capillary

Endothelial cells

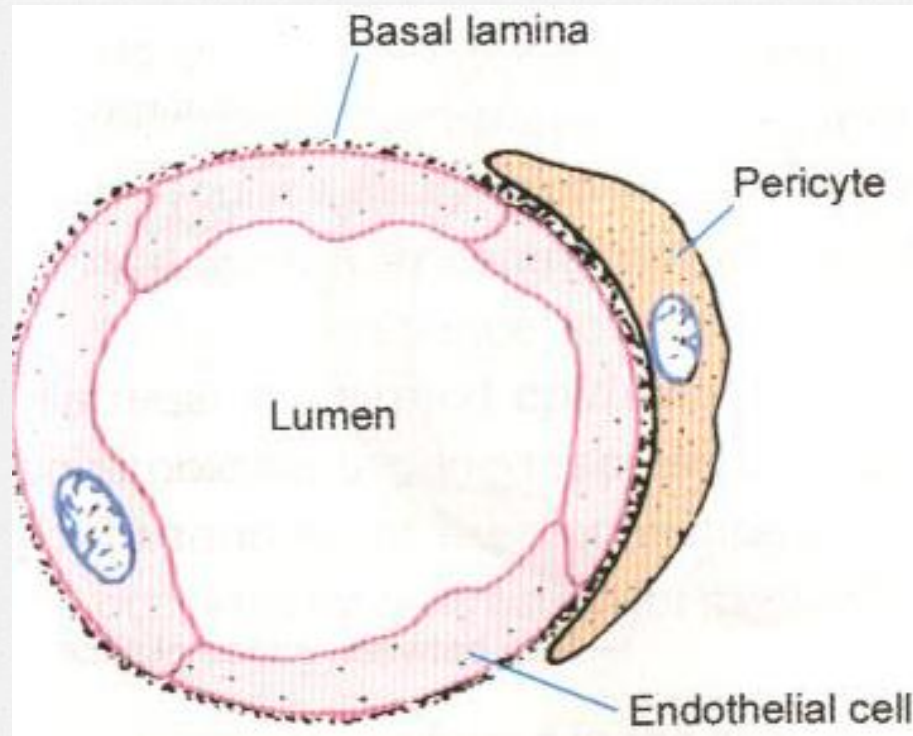
Polygonal and elongated

Few organelles

Zonula occludent junctions

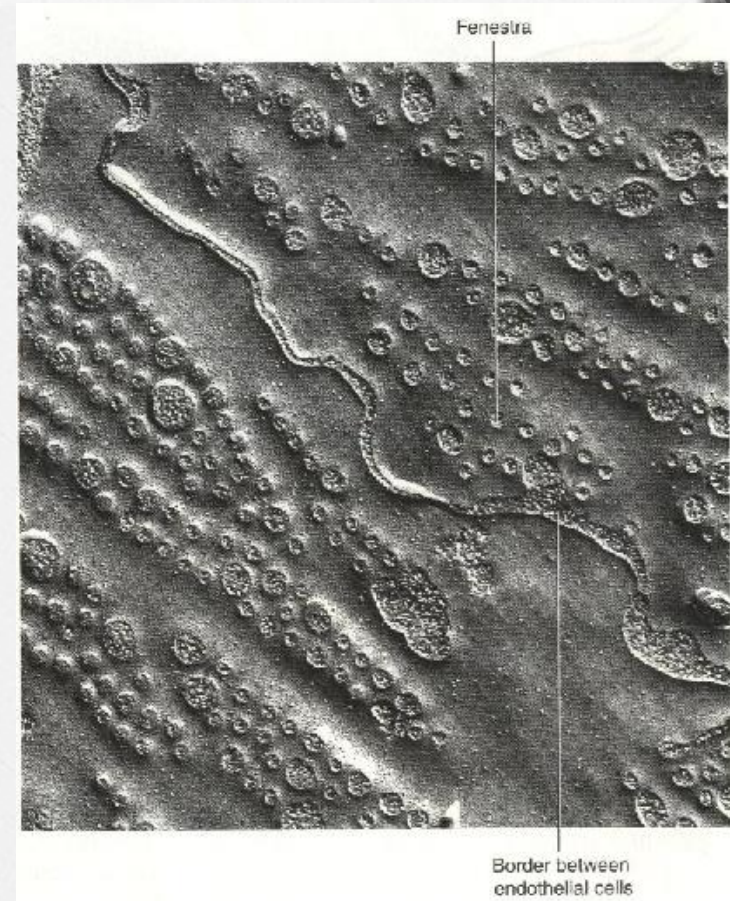
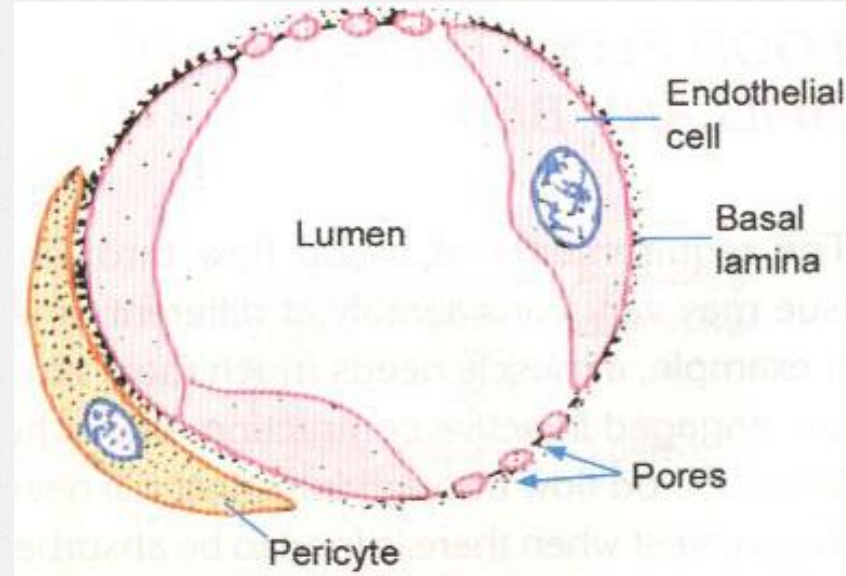
Pericytes – contractile function/repair

Continuous capillaries



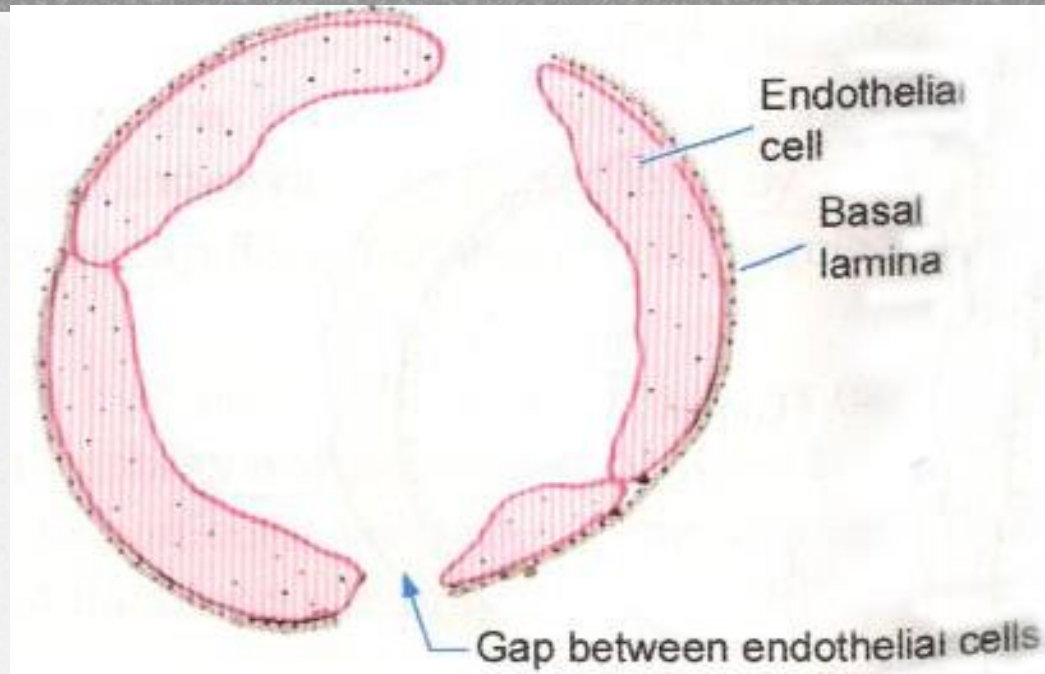
- Common type - Endothelial cells form a continuous layer
- Absence of fenestrae
- Endothelial cell nuclei bulge into the capillary lumen
- In muscle tissue, CNS, connective tissue, exocrine glands
- pinocytotic vesicles – macromolecule transport

Fenestrated capillaries



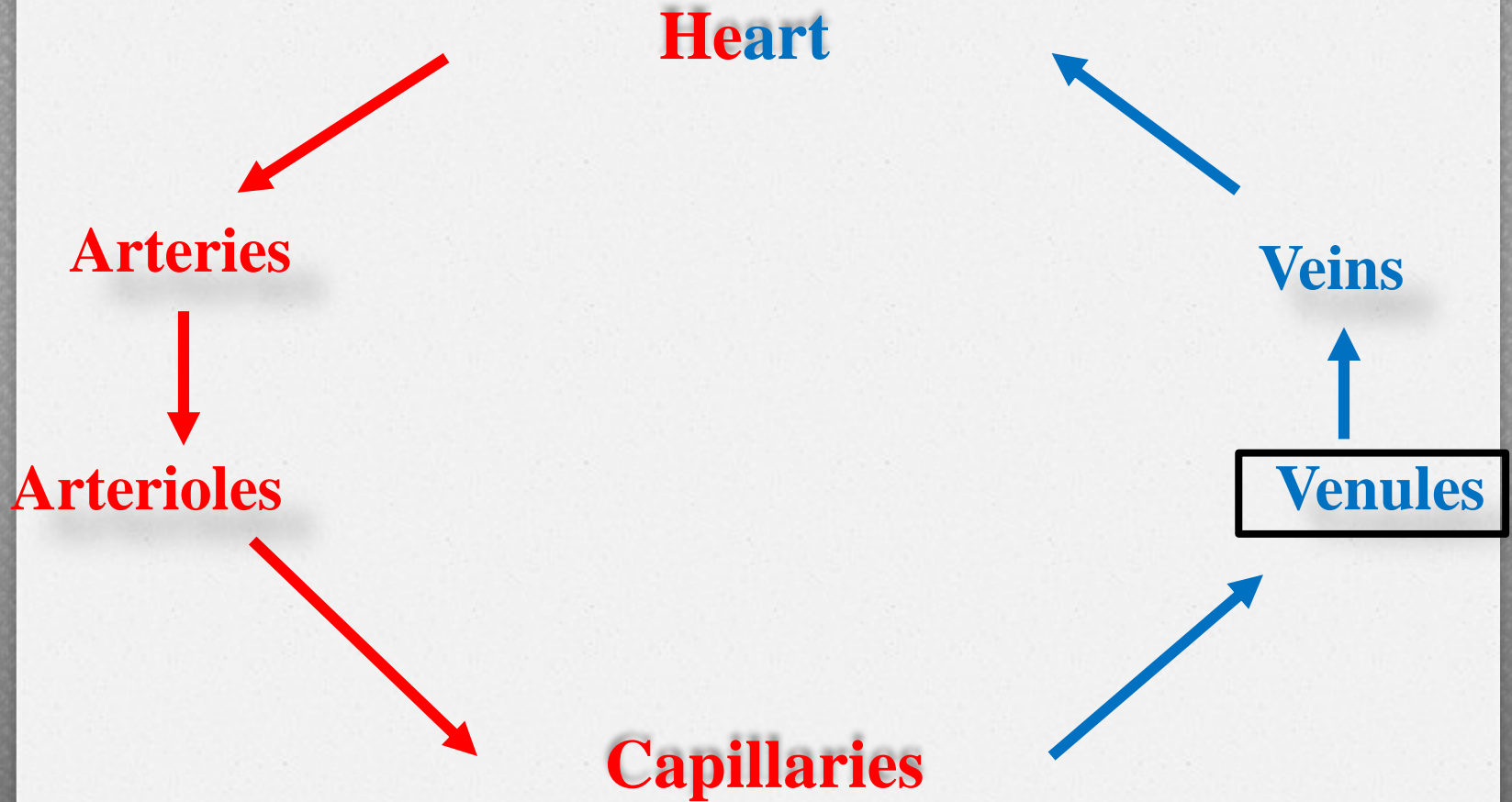
- Presence of openings.
- High permeability
- Fenestra obliterated by a cell membrane – diaphragm.
- In endocrine organs, absorptive intestinal lining, urinary filtrate

Discontinuous sinusoidal capillaries



- Enlarge diameter (30-40 μm)
- Endothelial cells form a discontinuous layer
- Separated from one another by wide spaces
- Cytoplasm has multiple fenestrations without diaphragms
- Basal lamina is discontinuous
- In liver, hematopoietic organs (bone marrow & spleen)

Blood Vascular System



Venules

Capillary beds drain into **post-capillary venules**



Smallest & thin walled

Tunica intima: endothelium & very thin subendothelial layer

Tunica media has only **pericytes**

Loose endothelial junctions: fluid leakage

0.1 – 0.5 mm diameter

Muscular venules

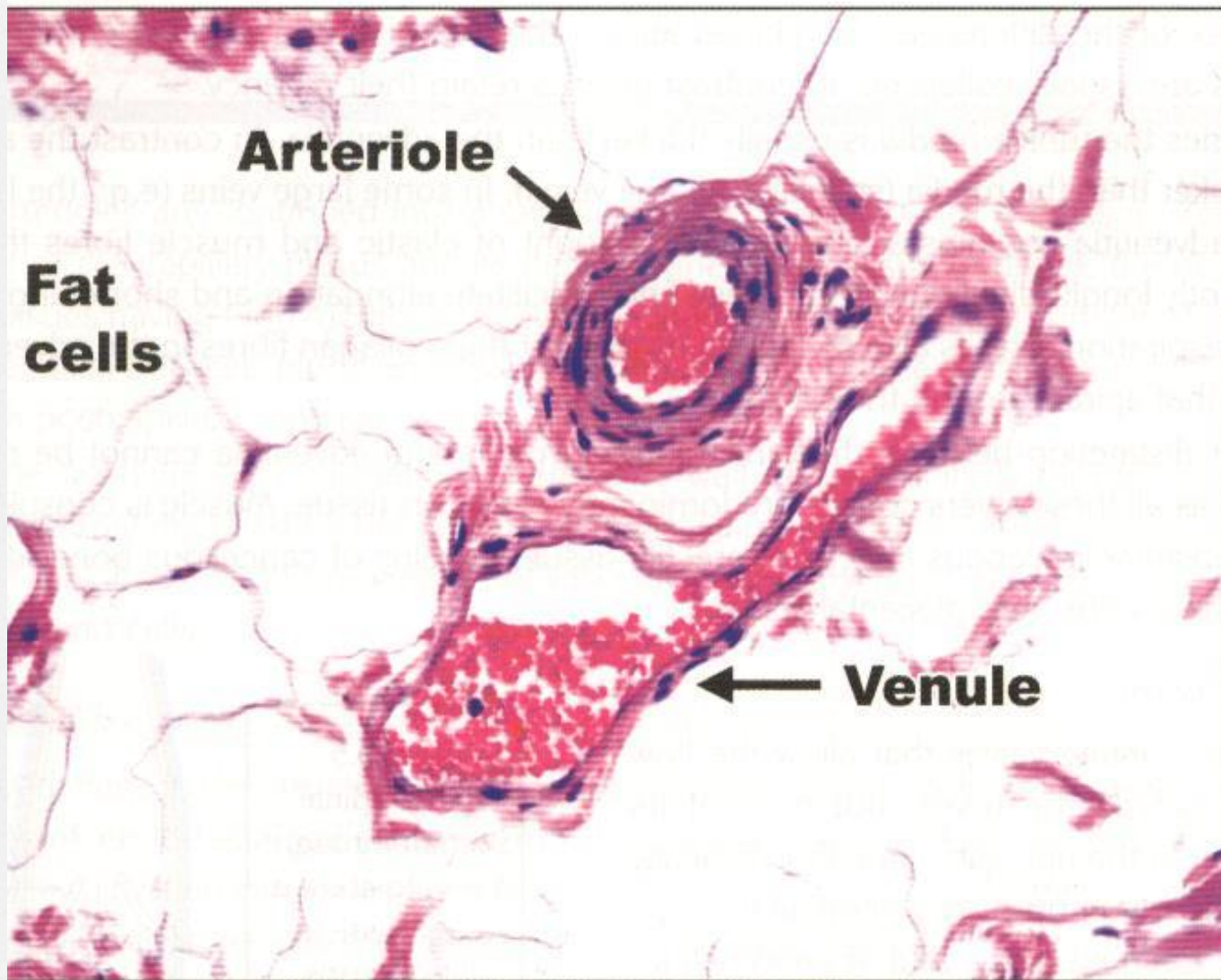
Endothelium & pericytes

Tunica media : Few smooth mm cells in the walls

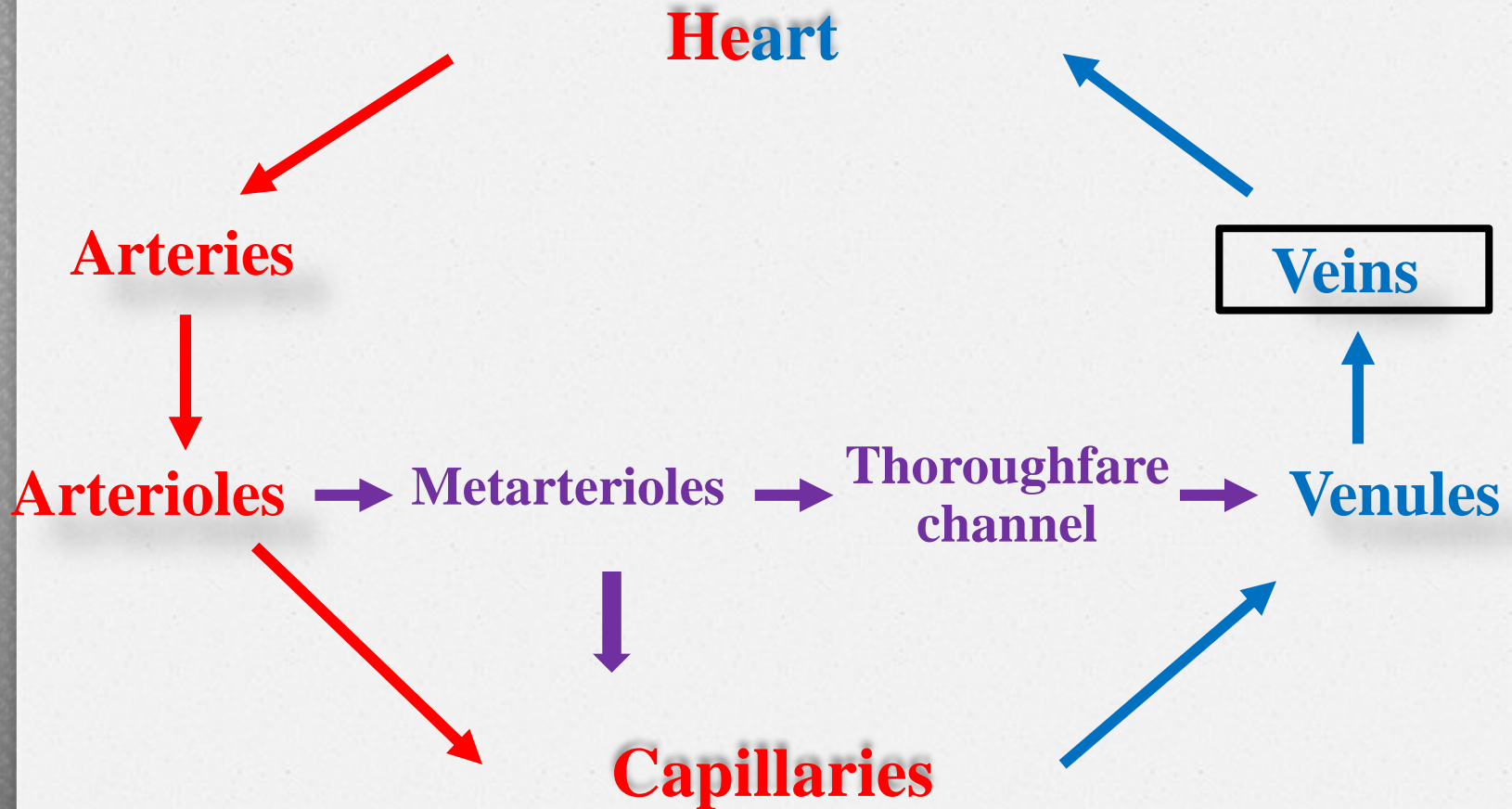
Accompany arterioles

Easily distinguished by thinner wall, irregular and collapsed lumen.

Venules

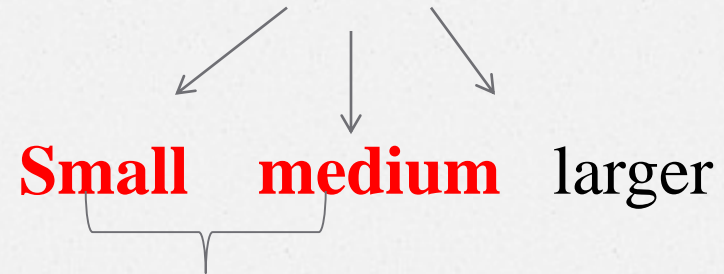


Blood Vascular System



Veins

From venules , blood is collected in **veins**.



majority

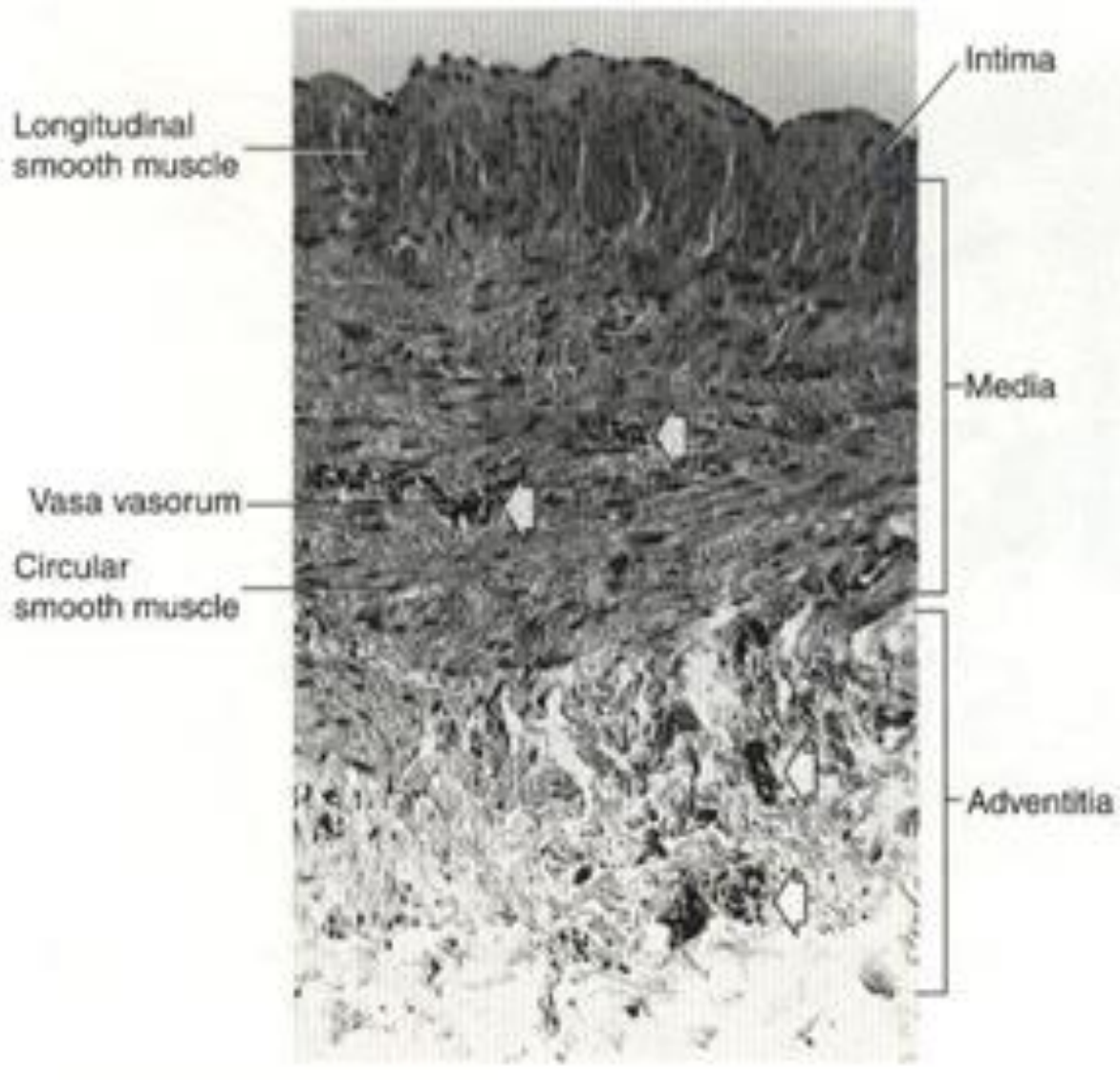
1-9 mm diameter

Tunica intima: thin subendothelial layer or absent
thin internal elastic membrane

Tunica media : small bundle of smooth mm cells,
longitudinal bundles of elastin
reticular fibers.

Tunica adventitia : well developed

Medium size Veins



Veins

The big venous trunks- close to heart → **Large veins**

Tunics are not as clearly defined as in arteries.

Thinner & more distensible than arteries of the same diameter.

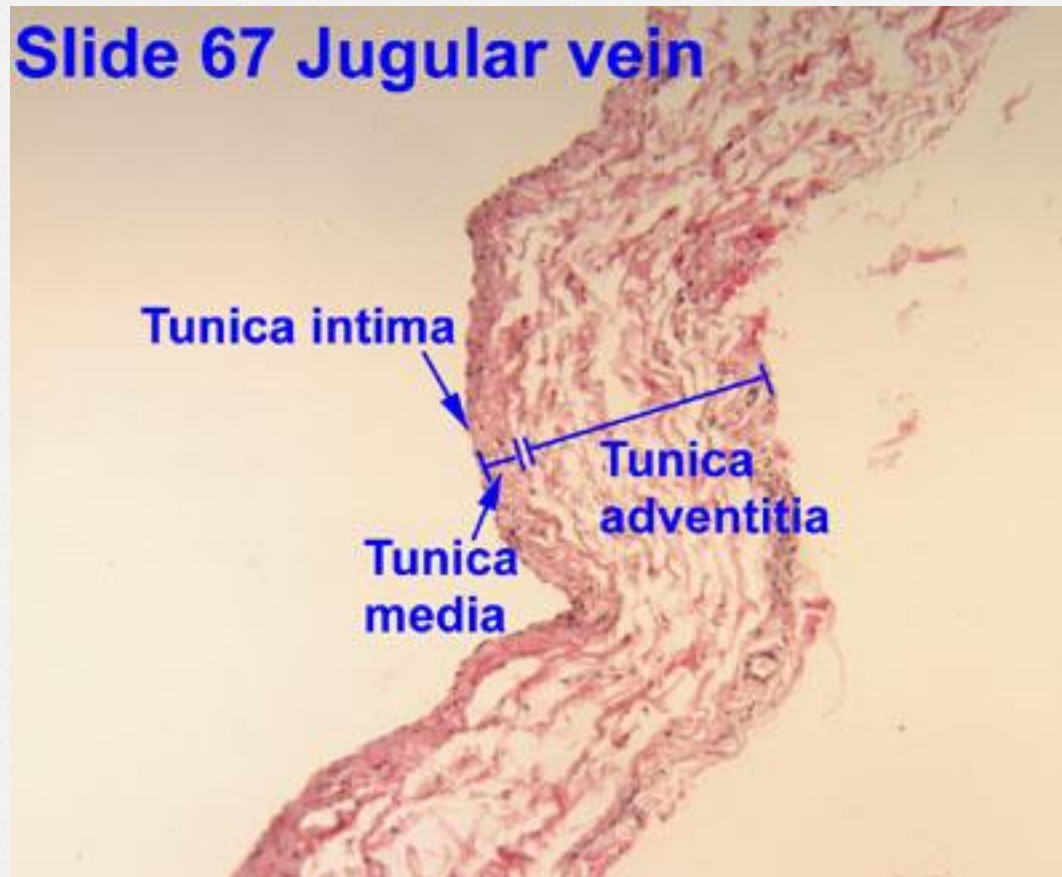
Tunica intima : thin connective tissue layer with smooth muscle
intima often is not distinct from media

Tunica media : 2-15 layers of smooth mm layers, connective
tissue

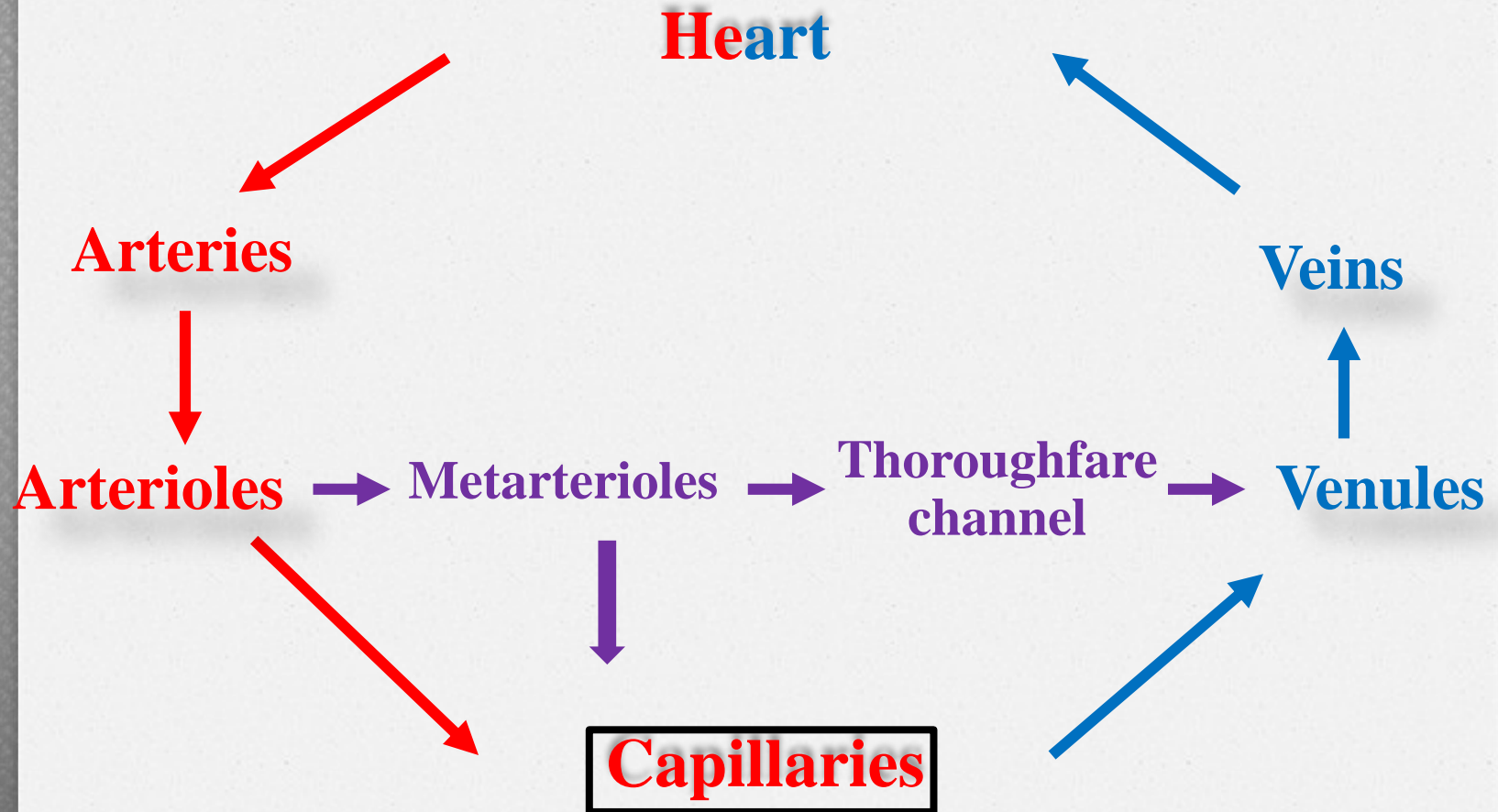
Tunica adventitia : thickest & best developed
longitudinal smooth mm bundle

Valves present – from tunica intima (folds of endothelium and
small amounts of connective tissue)

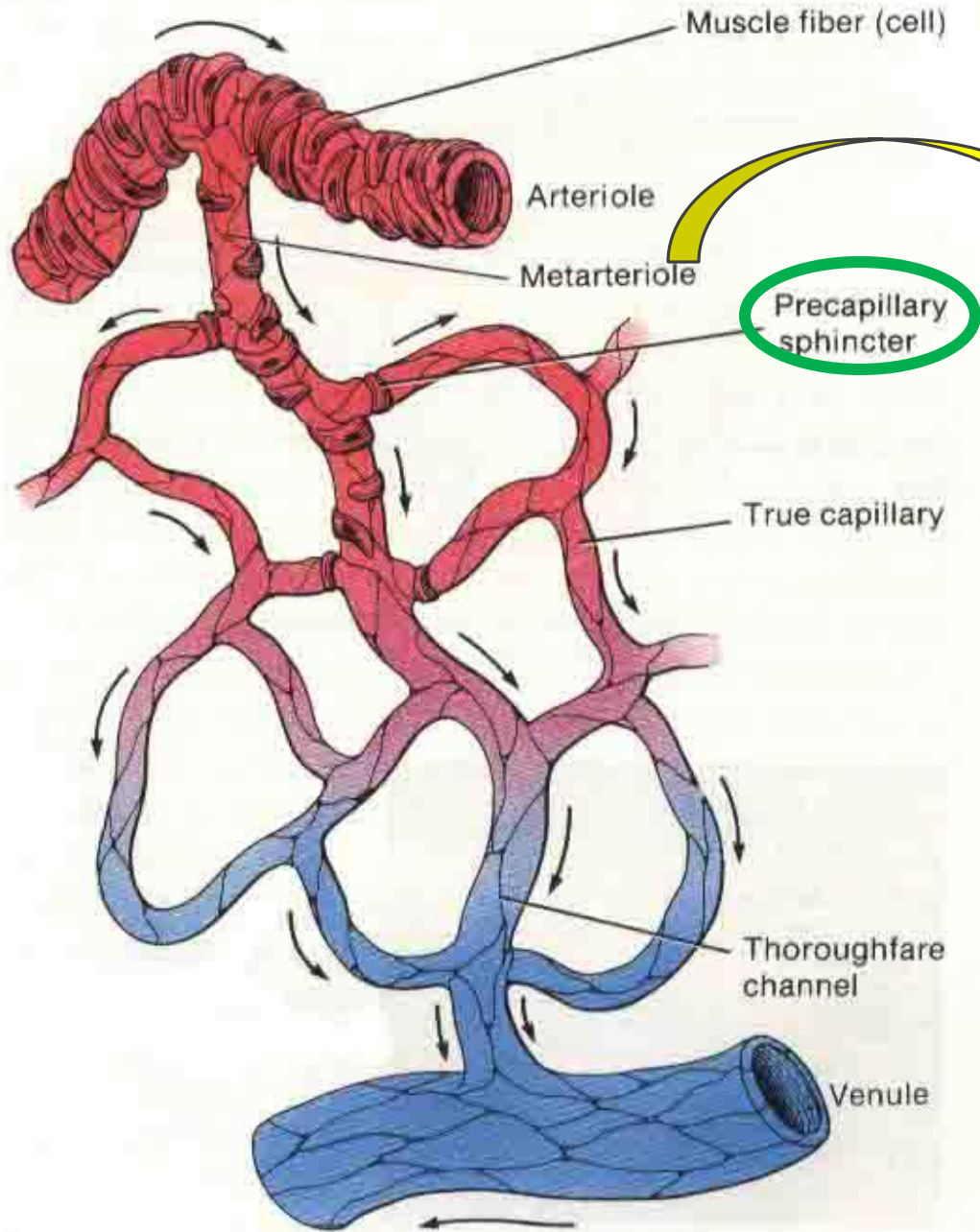
Slide 67 Jugular vein



Blood Vascular System



Mechanisms controlling blood flow through the capillary bed

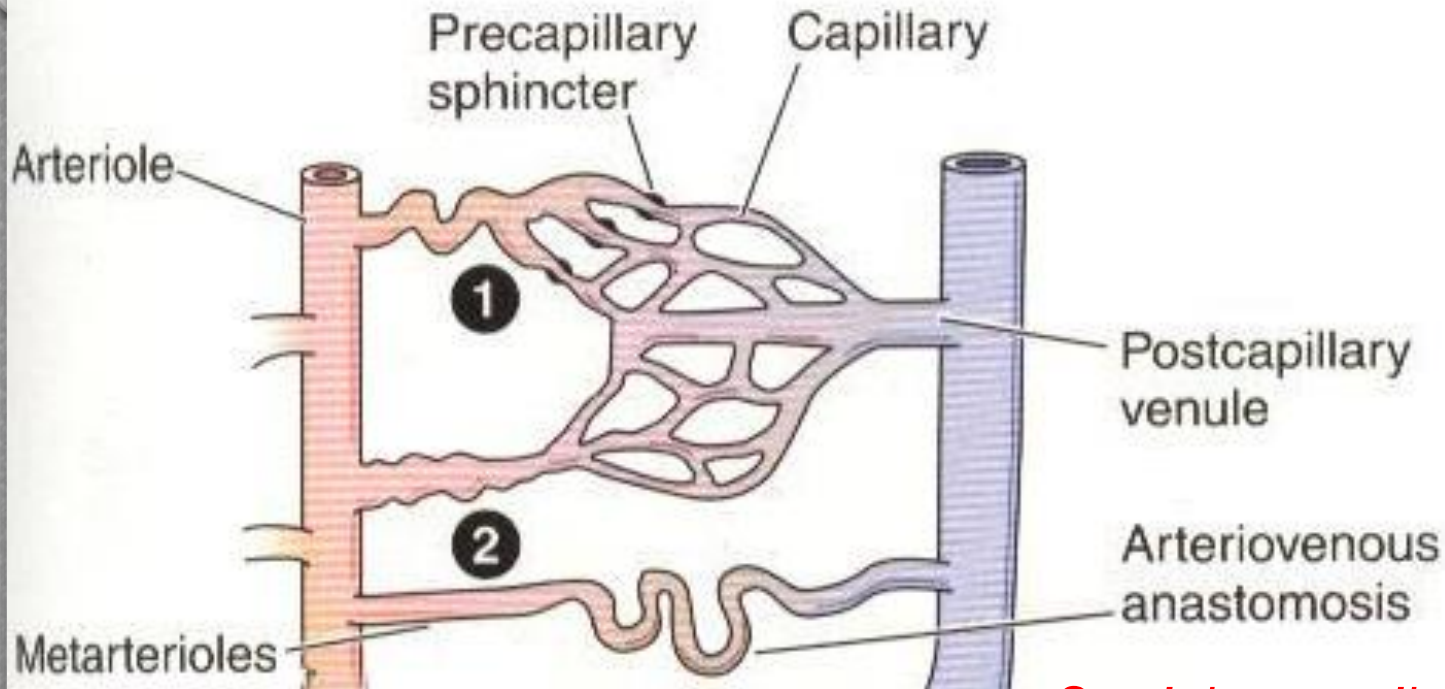


Resembles wide capillaries

Endothelial cells

Discontinuous layer of smooth muscle

Capillary circulation



Straight or coiled

Skin – external ear , nose

Mucous membranes of nose & GIT

Tongue thyroid gland, thyroid, ...ect

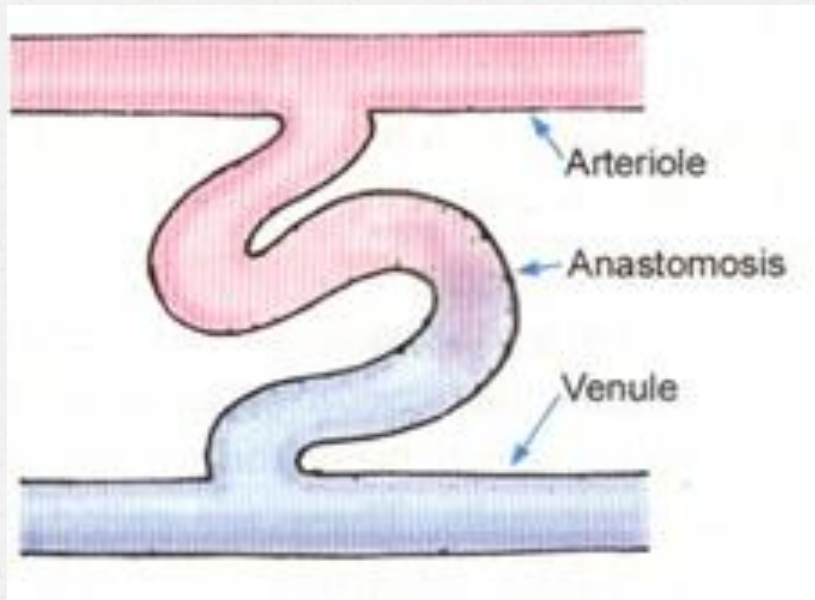
Capillary circulation

AV anastomoses - special kind



Form of rounded bunch covered by connective tissue

Glomus



Tips of the fingers & toes

Home work

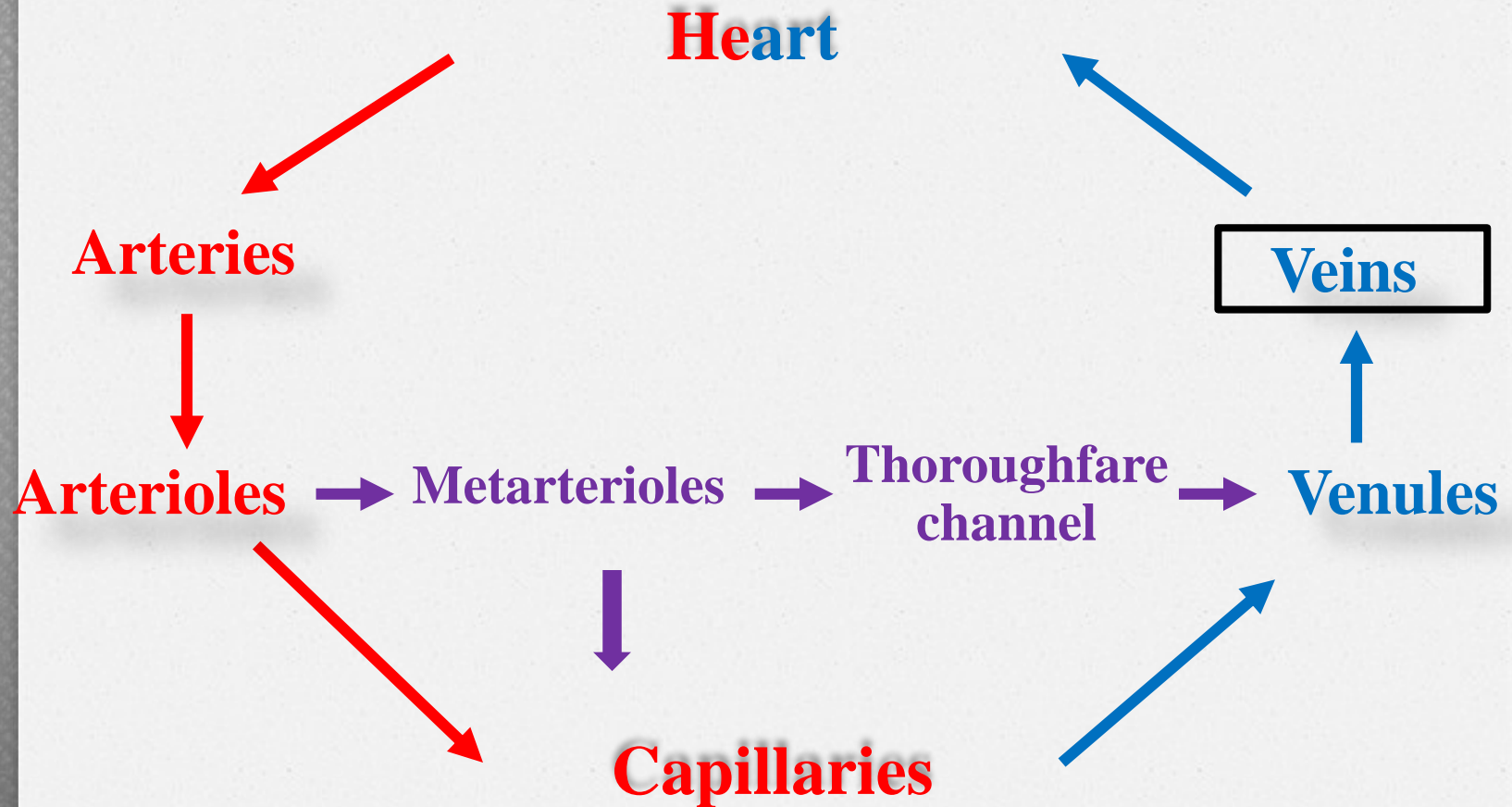
Arteries of special sites - umbilical cord

End arteries coronary arteries

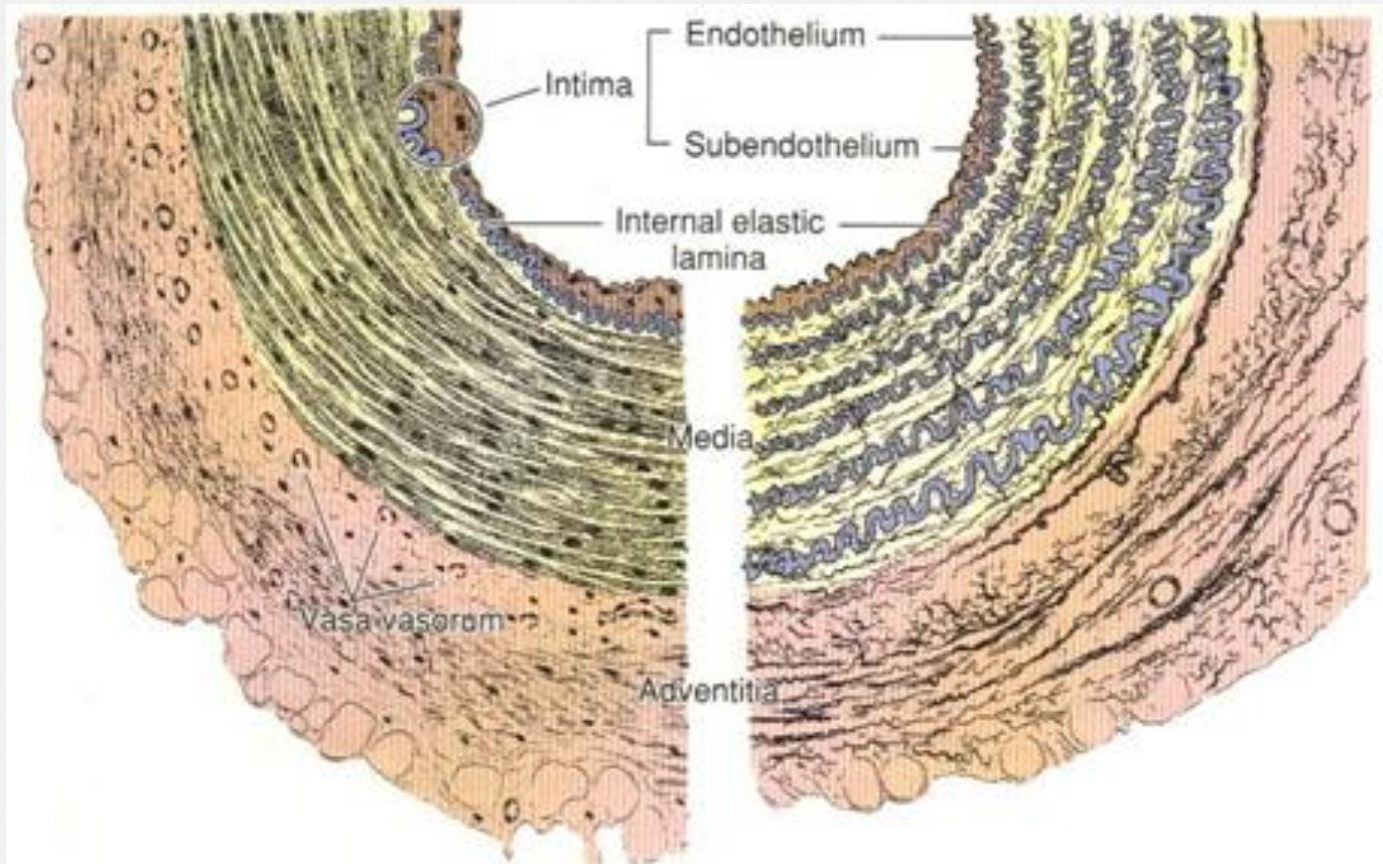
Arterial portal circulation

Venous portal circulation

Summary



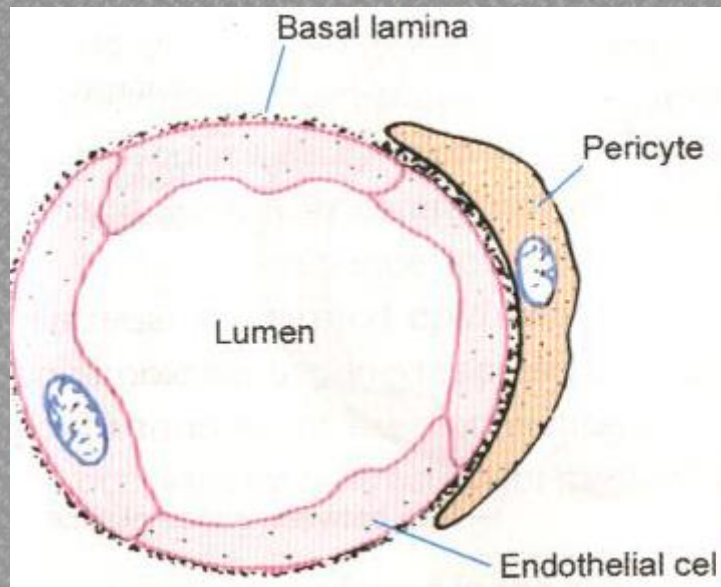
Summary



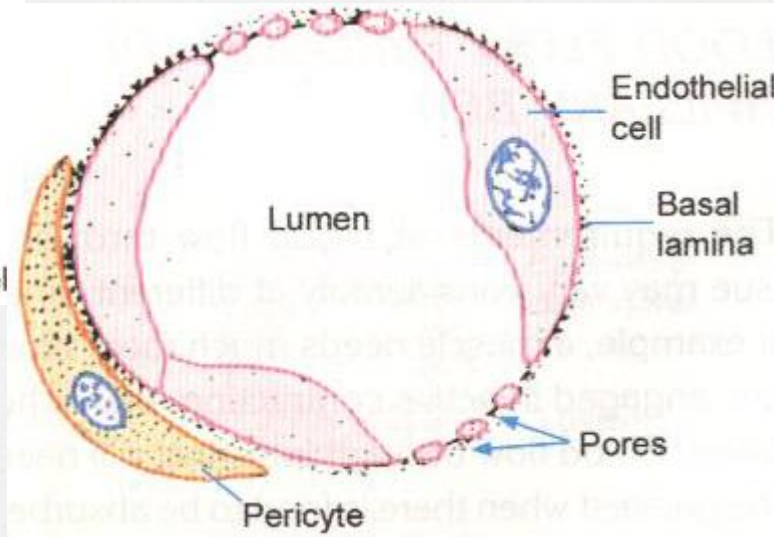
Muscular arteries

Elastic arteries

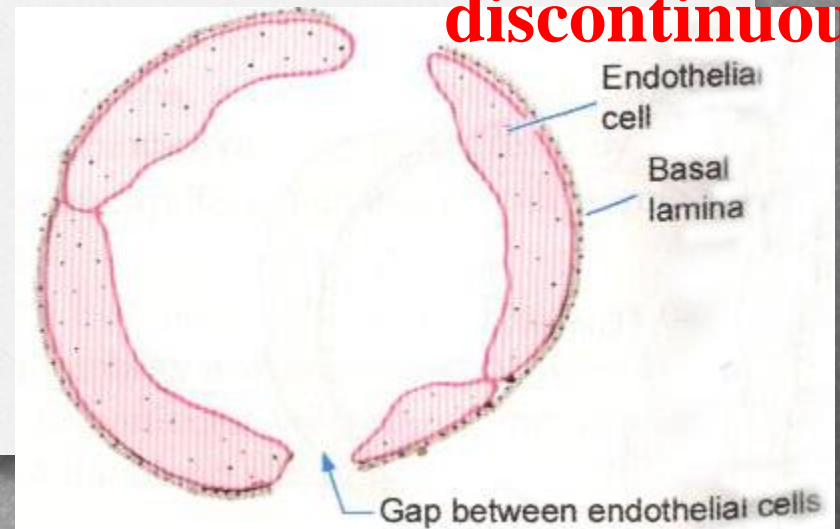
Capillary classification



continuous



fenestrated



discontinuous

Summary

Wall of veins – thinner than artery of the same size

Clear distinction between the tunics cannot be made out in small veins because of more fibrous tissue

Tunica media of veins contain much larger quantity of collagen in arteries. Amount of elastic fibers is less.

In arteries tunica media is thicker than the adventitia. Opposite in veins.

Larger veins adventitia contains longitudinal run elastic & muscle fibers

References

Basic Histology - L.U.Junqueira

Wheater's Functional Histology

References



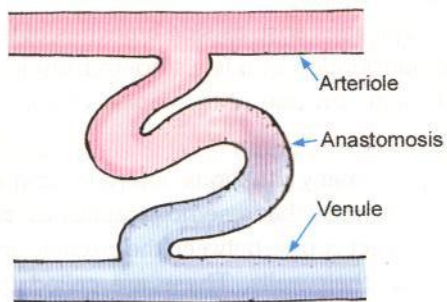
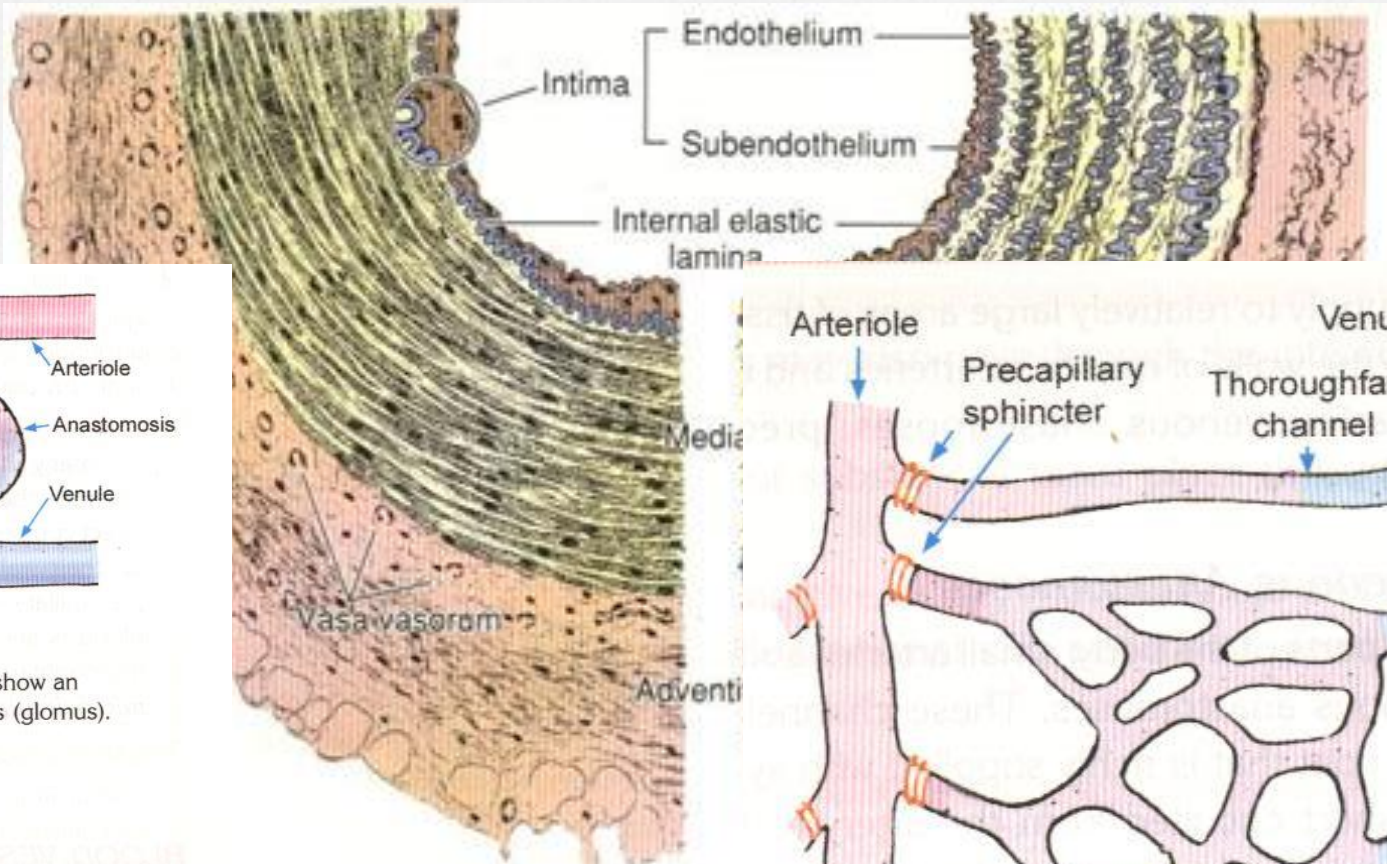


Fig. 10.9. Diagram to show an arteriovenous anastomosis (glomus).

