

The Circulatory System

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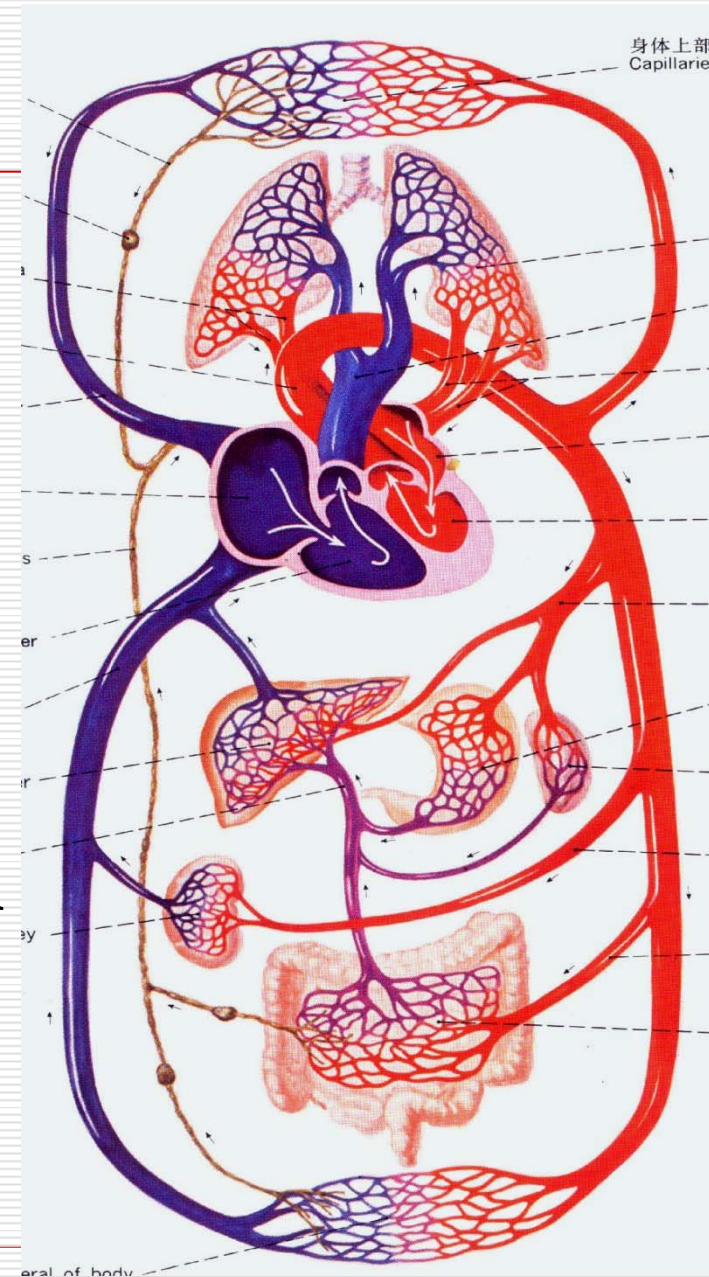
The Circulatory System

■ Cardiovascular system (blood vascular system)

- ◆ Heart
- ◆ Artery
- ◆ Capillary
- ◆ Vein

■ Lymphatic vascular system

- ◆ Lymphatic capillary
- ◆ Lymphatic vessel
- ◆ Lymphatic duct

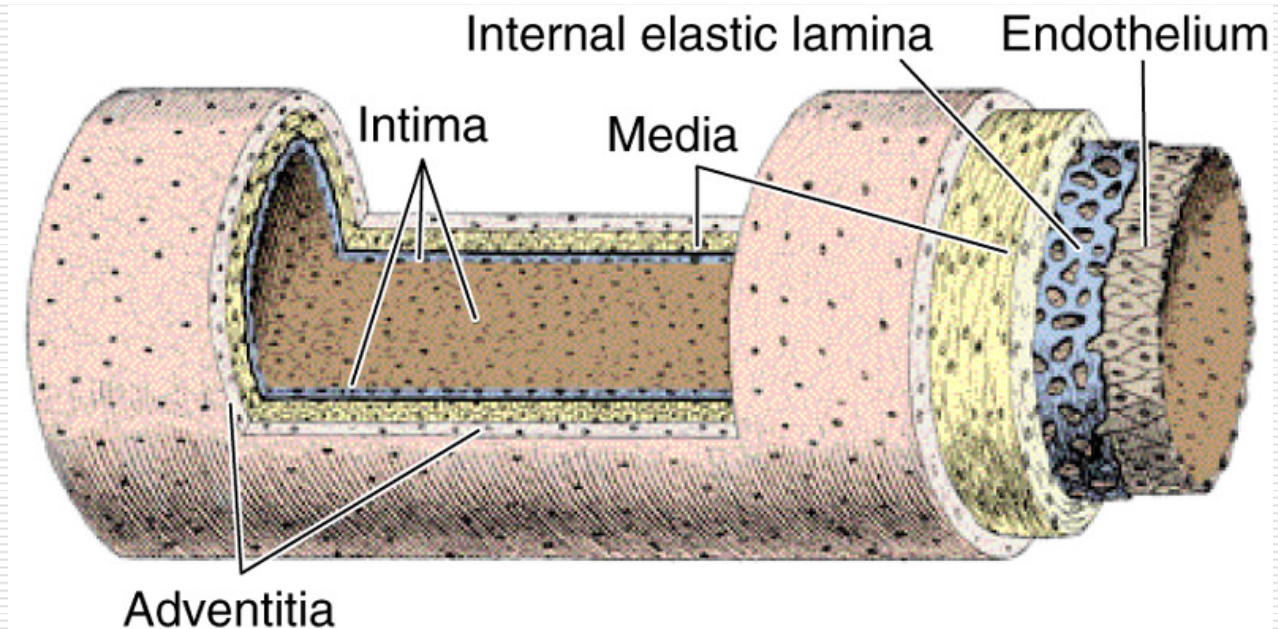


I General structure of the blood vessels

- Tunica intima

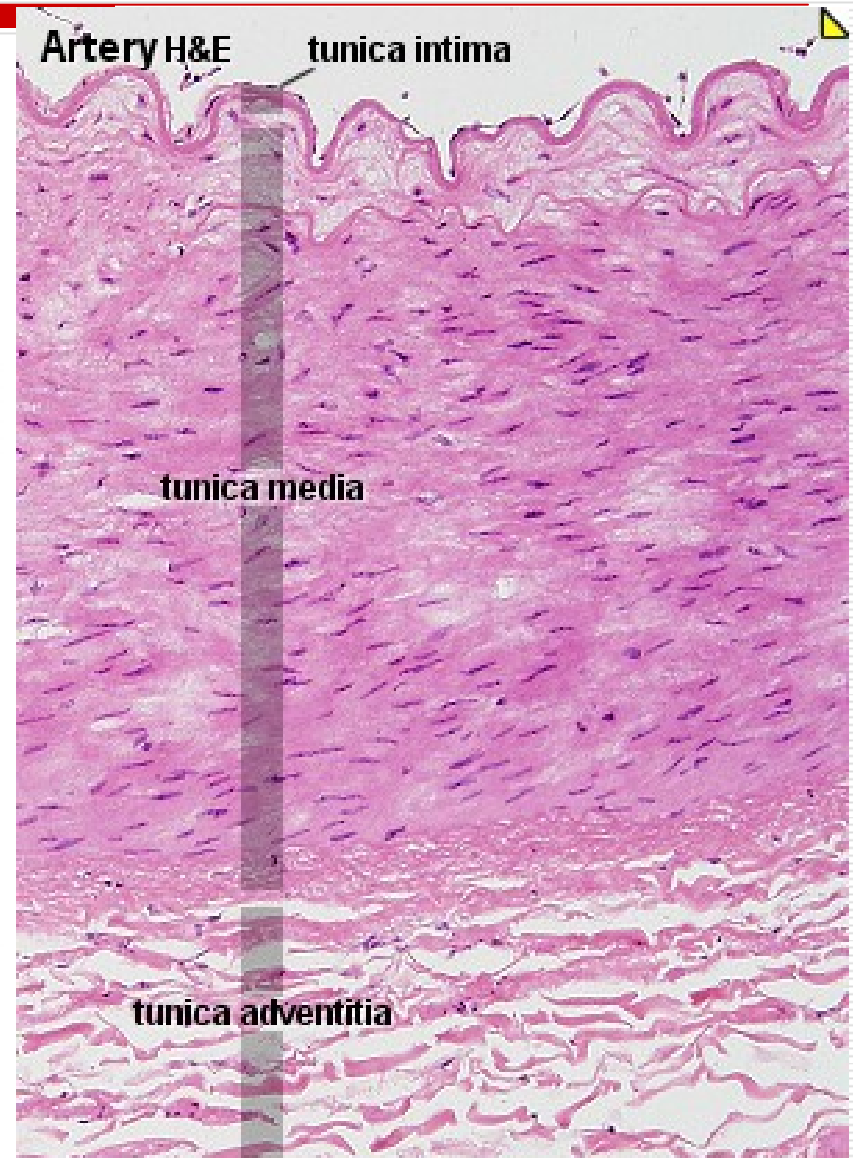
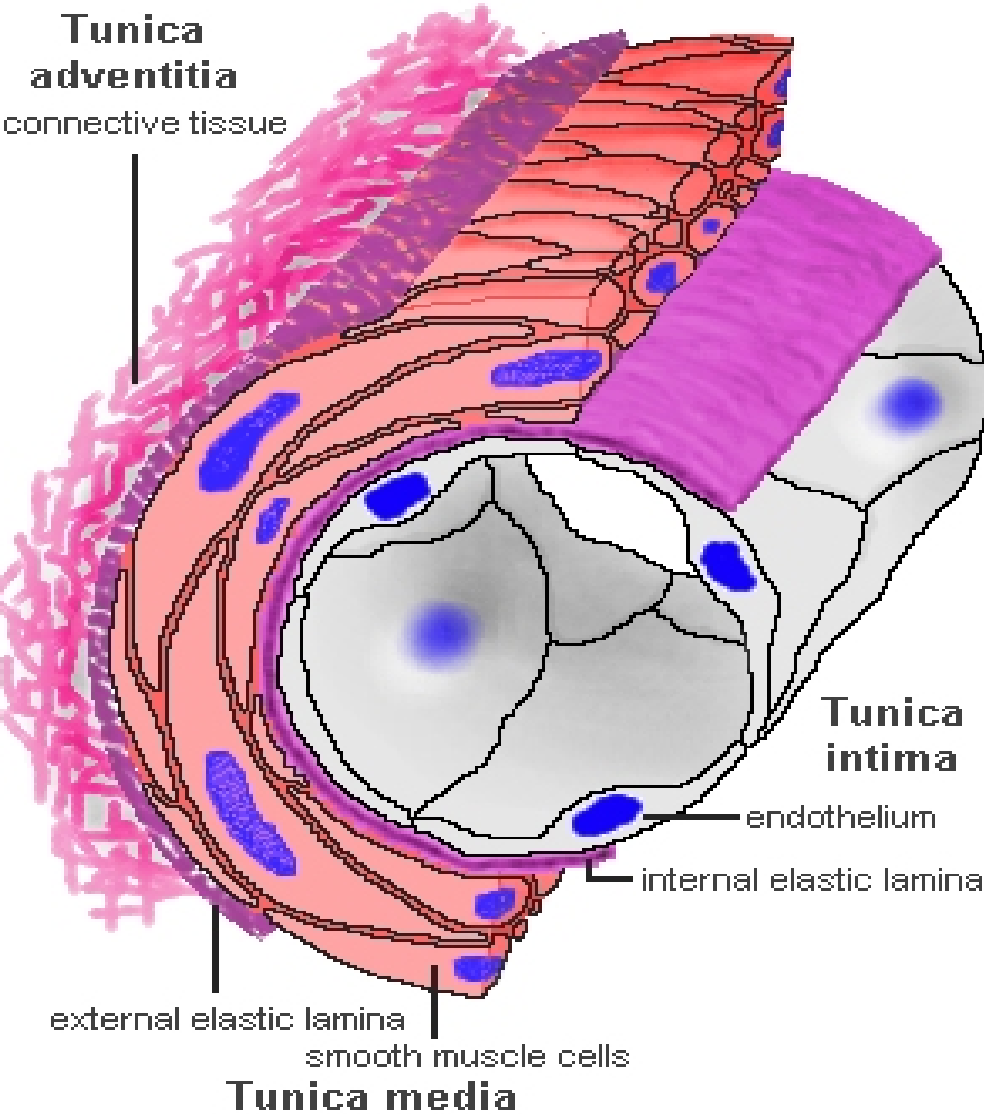
- Tunica media

- Tunica adventitia



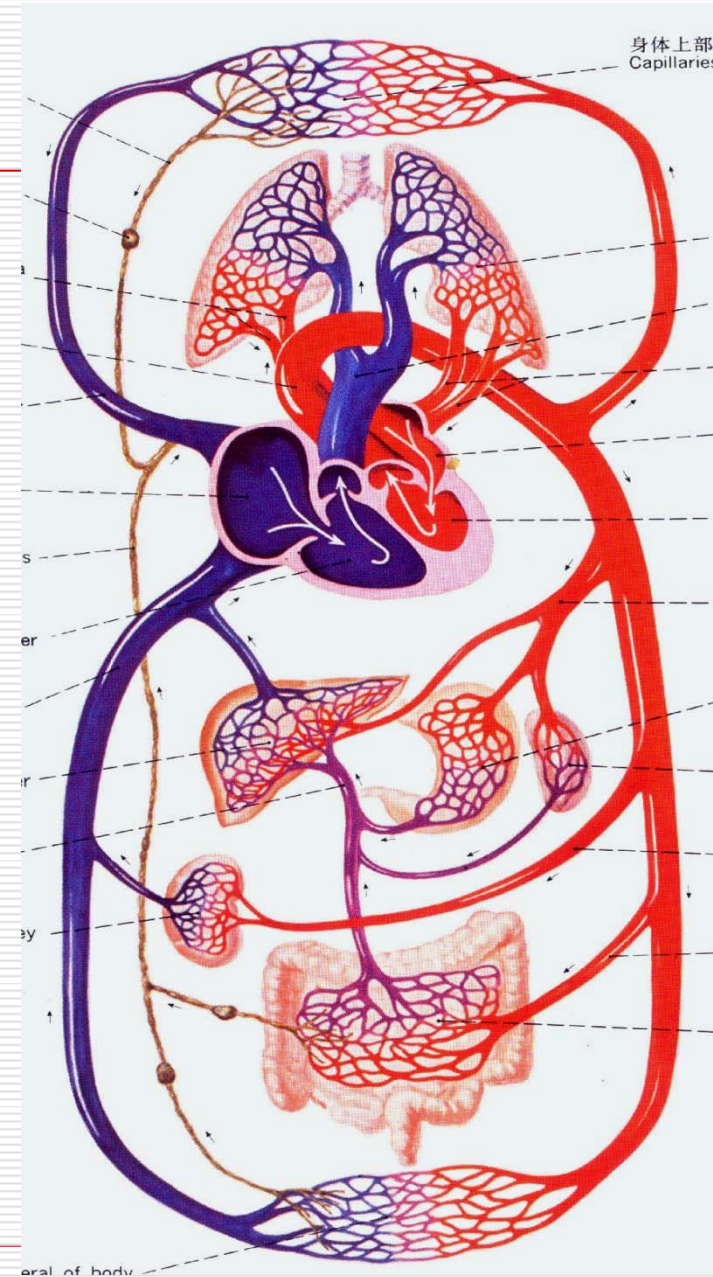
Drawing of a medium-sized muscular artery, showing its layers.

I General structure of the blood vessels



II Artery

- Large artery
- Medium-sized artery
- Small artery
- Arteriole



Large artery

■ Structure

- ◆ **Tunica intima**

- ◆ **Tunica media**

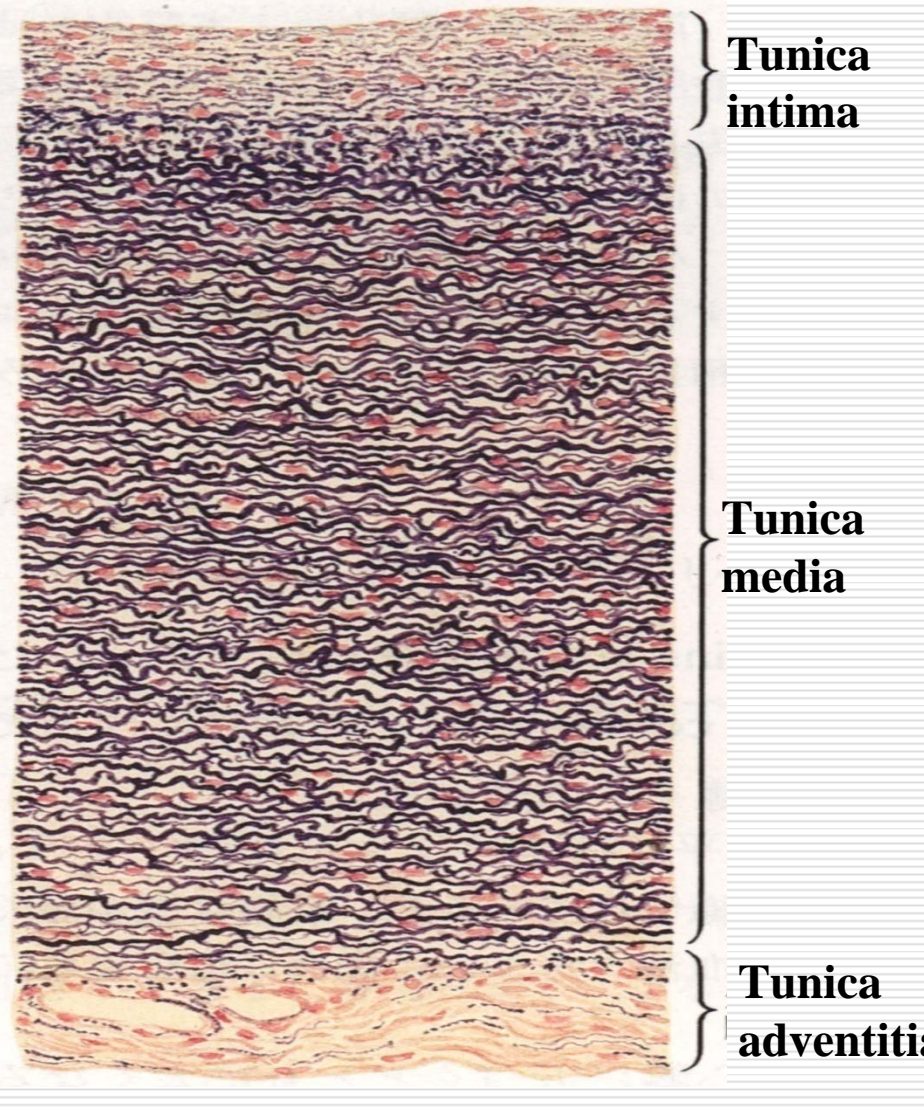
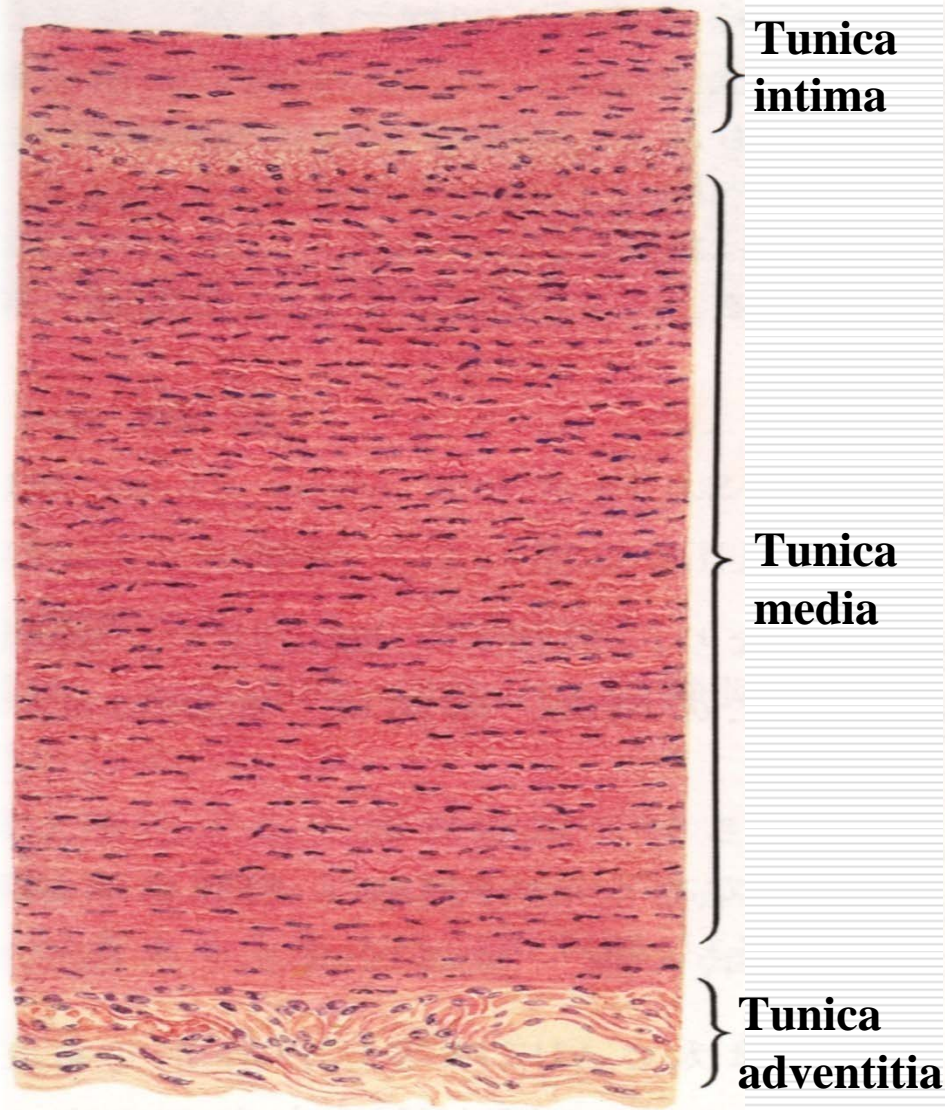
 - **40-70 layers of elastic lamina**

 - **Smooth muscle cells, collagenous fibers**

- ◆ **Tunica adventitia**

■ **Function**

- ◆ **Carry the blood from the heart to the middle arteries**



Transverse sections showing part of a large elastic artery showing a well developed tunica media containing several elastic laminas.

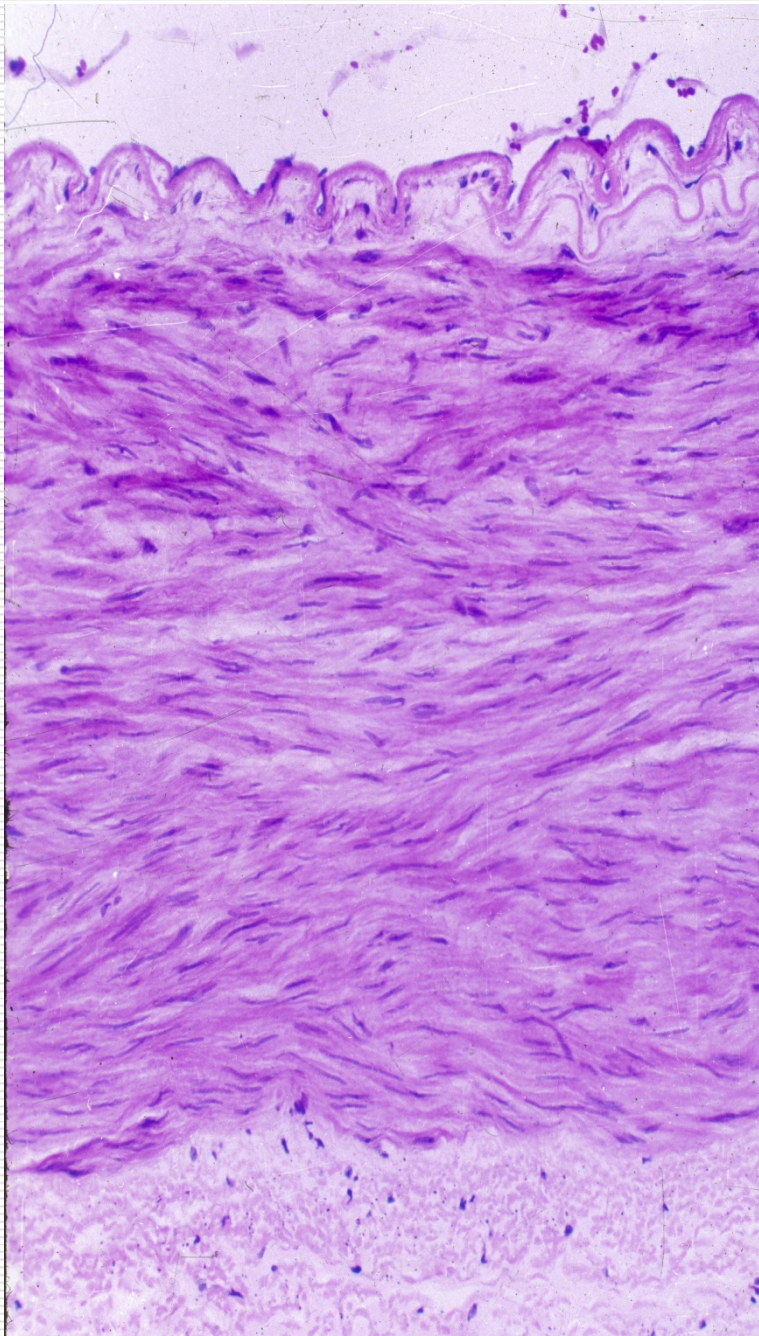
Medium-sized artery

■ Structure

- **Tunica intima: clear internal elastic membrane**
- **Tunica media: 10-40 layers of smooth muscle cells**
- **Tunica adventitia: external elastic membrane**

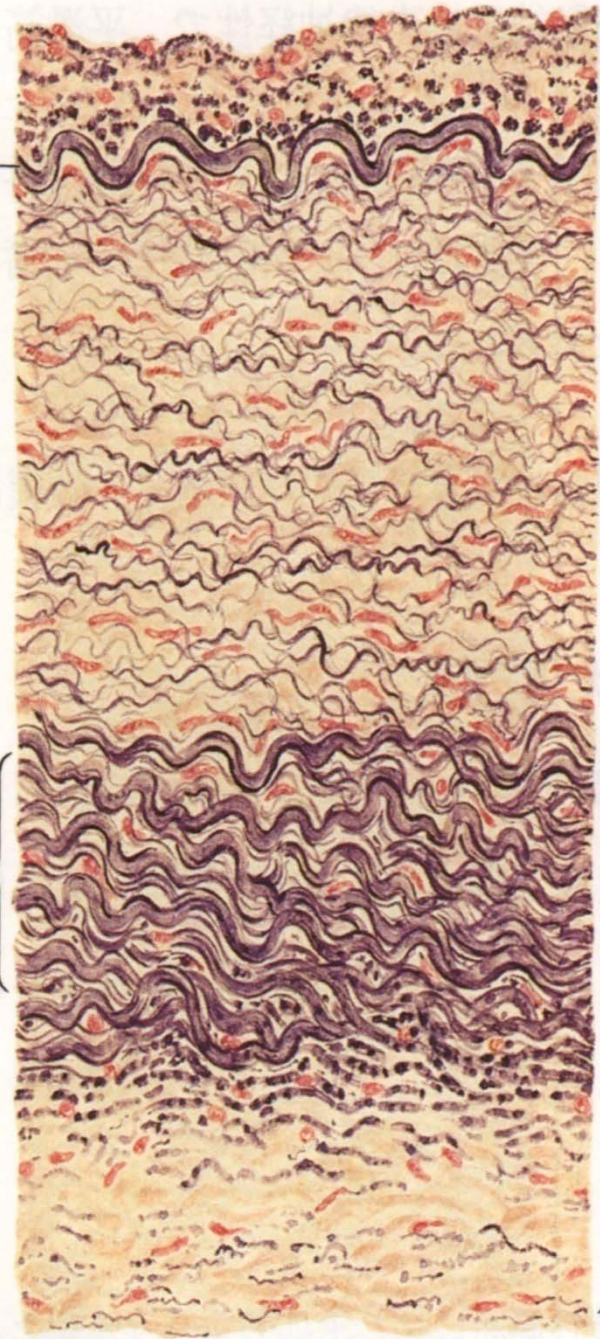
■ Function

- **Regulate the distribution of the blood to various parts of the body**
-



**Internal
elastic
membrane**

**External
elastic
membrane**



**Tunica
intima**

**Tunica
media**

**Tunica
adventitia**

Small artery

■ Structure characteristic

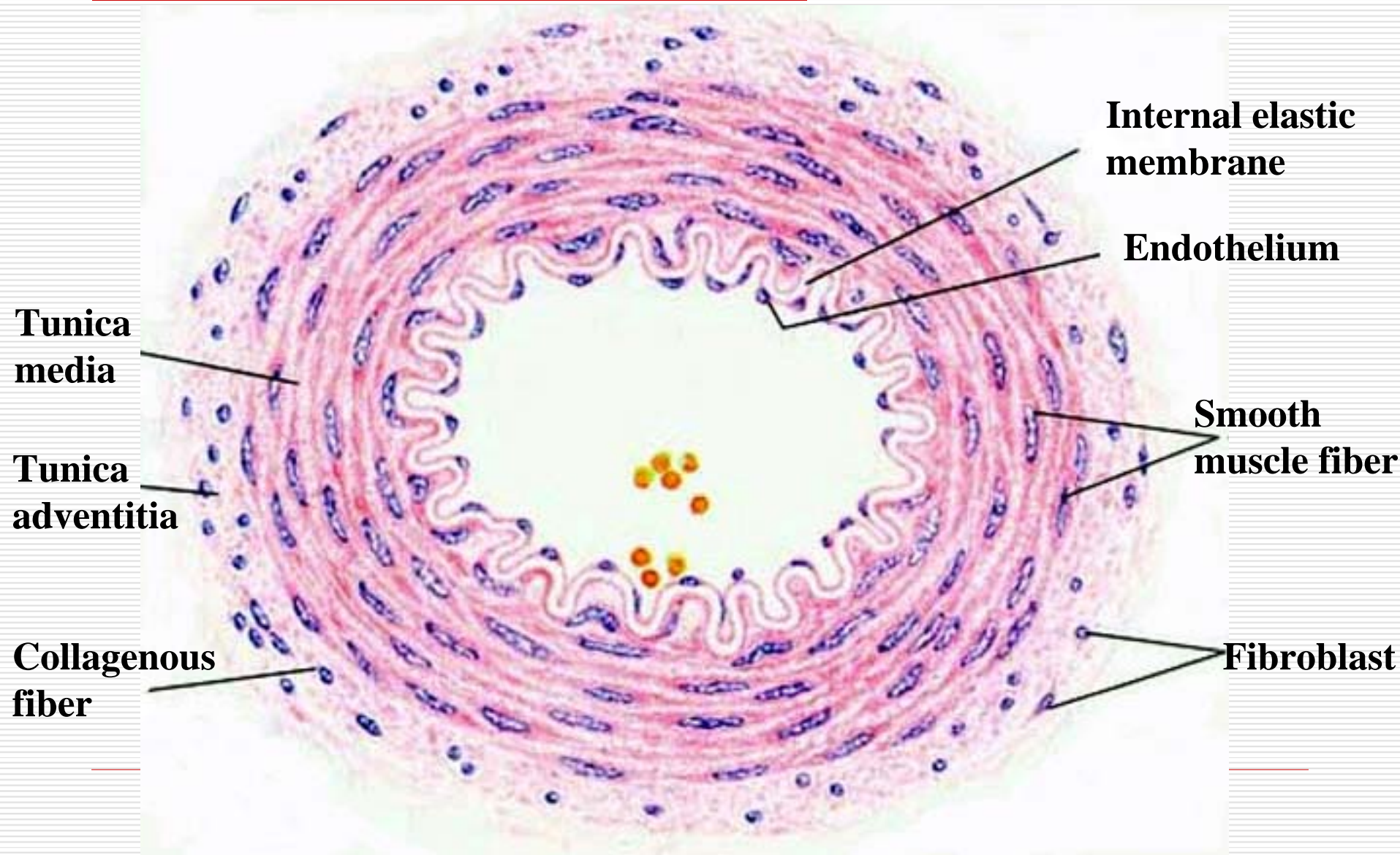
- **Diameter:0.3-1mm**
- **Tunica intima: clear internal elastic membrane**
- **Tunica media: 3-4 layers of smooth muscle cells**
- **Tunica adventitia: no external elastic membrane**

■ **Function**

- **Adjust blood flow and blood pressure of organs and tissues**
-

II Artery

Small artery



Arteriole

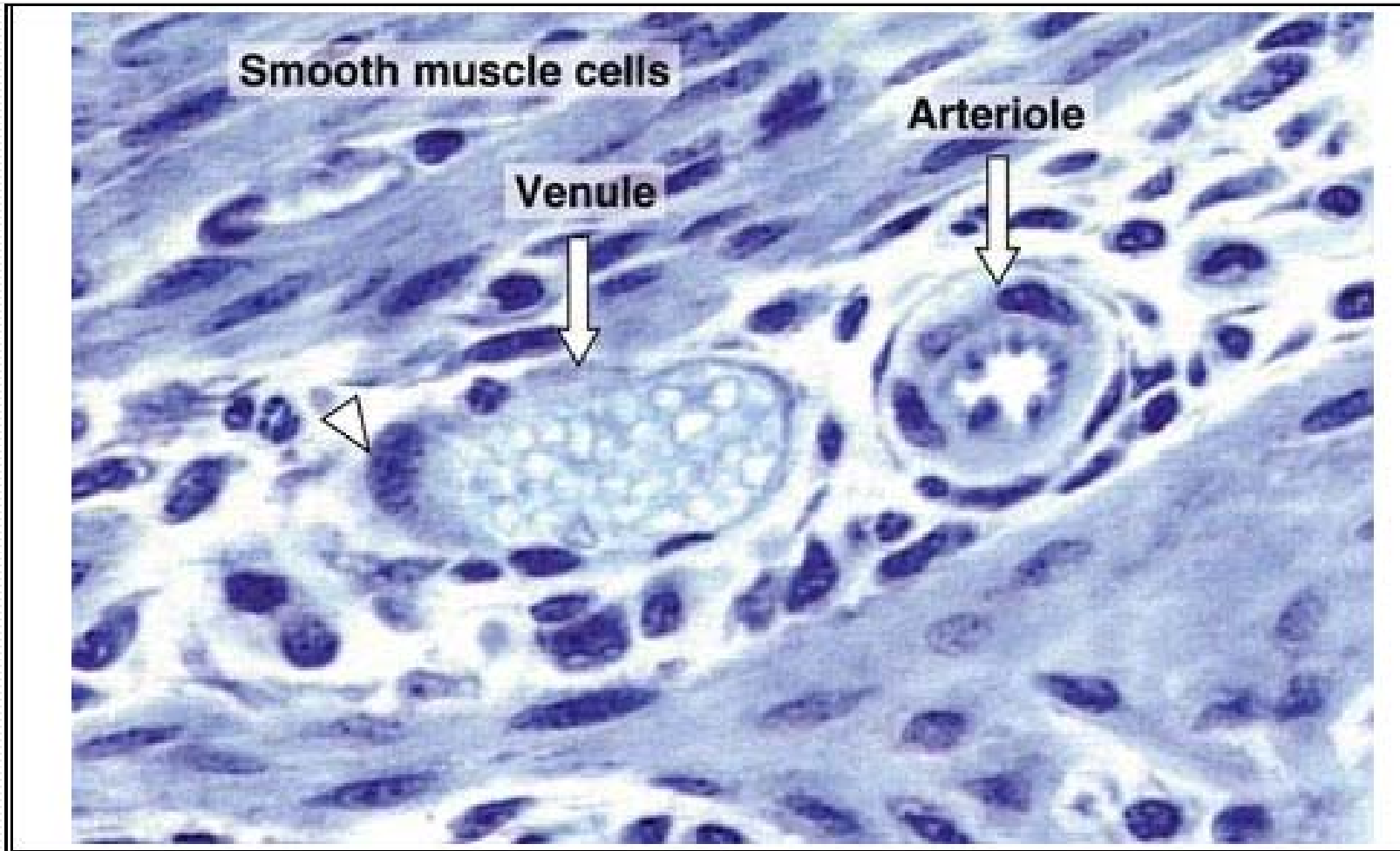
■ Structure characteristic

- ◆ Diameter: less than 0.3mm
- ◆ Endothelial cell
- ◆ 1-2 layers of smooth muscle cells

■ Function

- ◆ Participate in microcirculation of tissue
-

Arteriole



Relationship between structure and function of vascular wall

■ Large artery

- ◆ **40-70 layers of elastic lamina**
- ◆ **Help to stabilize the blood flow**

■ Medium-sized artery

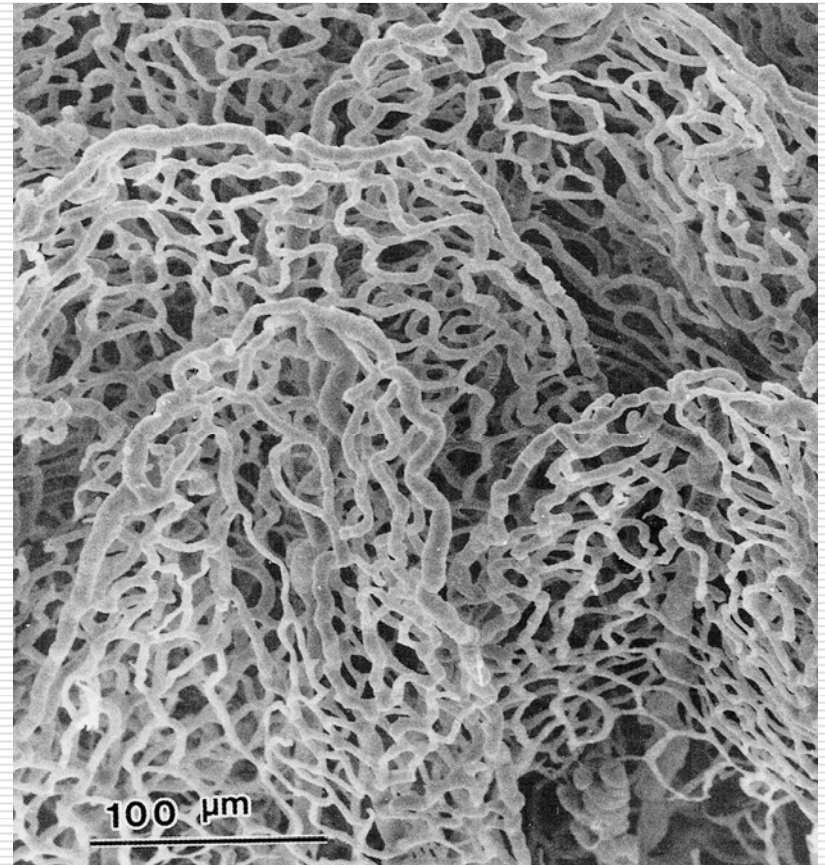
- ◆ **10-40 layers of smooth muscle cells**
- ◆ **Control the affluence of blood to the organs by contracting or relaxing the smooth muscle cells**

■ Small artery & Arteriole

- ◆ **Participate in microcirculation of tissue**
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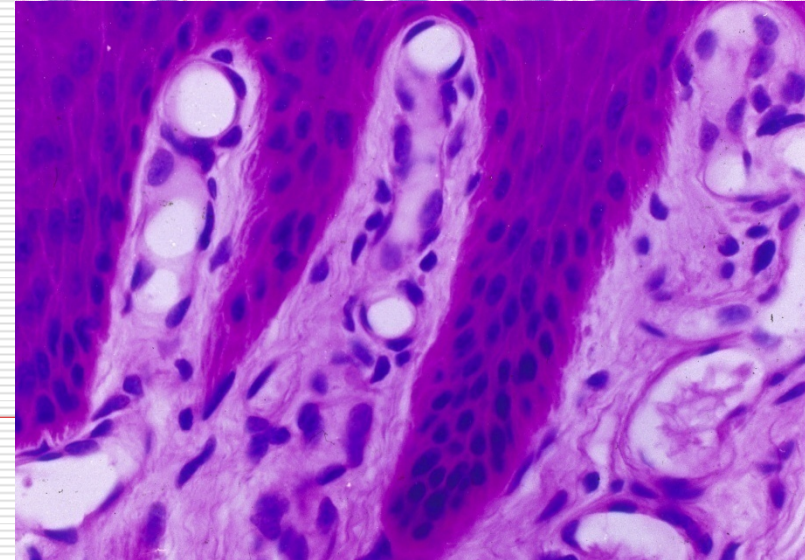
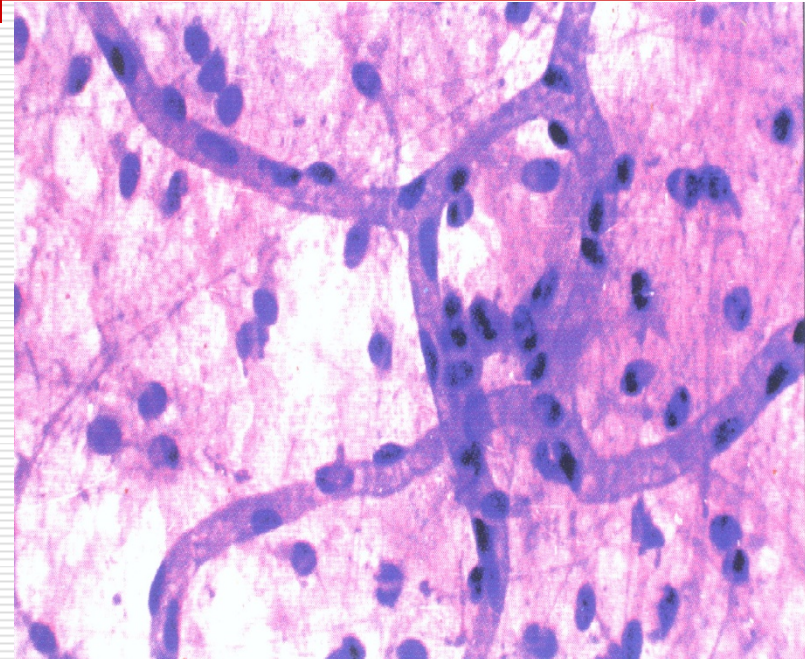
III Capillary

- **Microstructure of the capillary**
- **Types of the capillary**
- **Functions of the capillary**

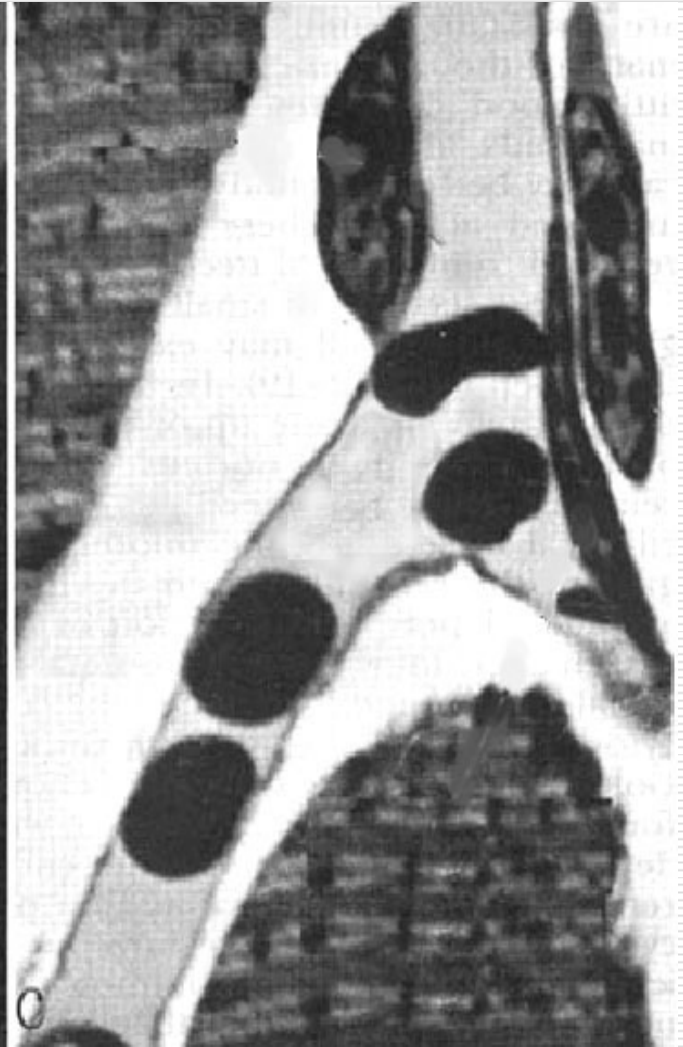
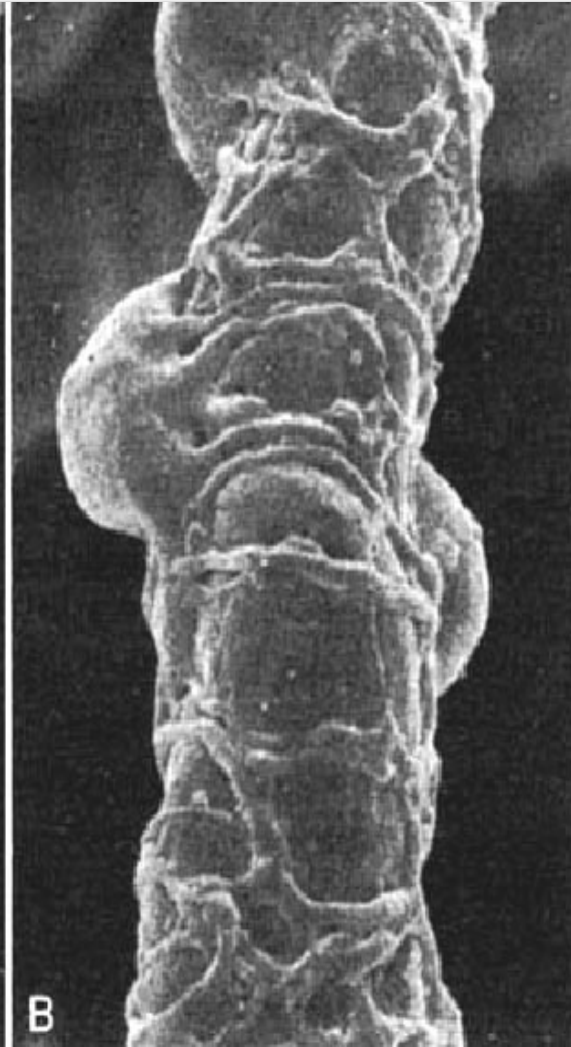
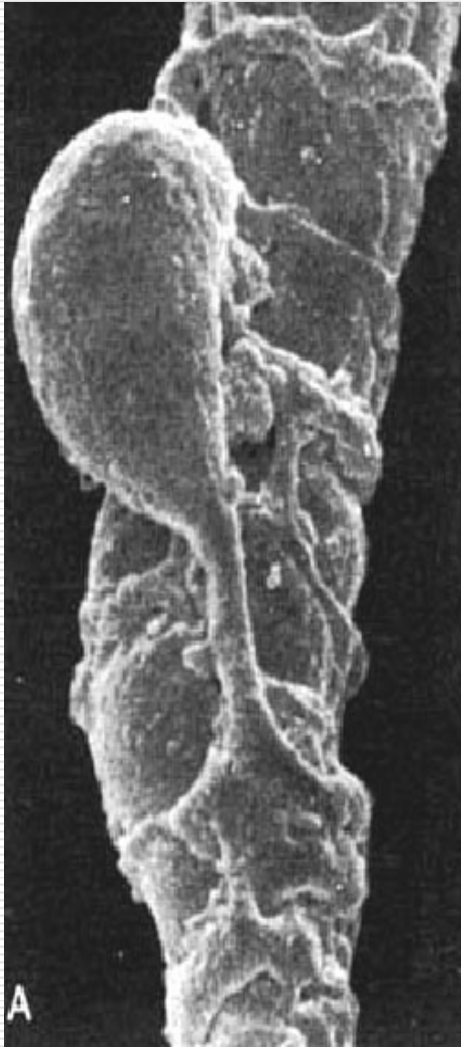


Microstructure of the capillary

- **Characteristic**
 - ◆ **Diameter: 6~8 μ m**
- **Structural components**
 - ◆ **A single layer of endothelial cell**
 - ◆ **Basal lamina**
 - ◆ **Pericyte**



III Capillary
Pericyte



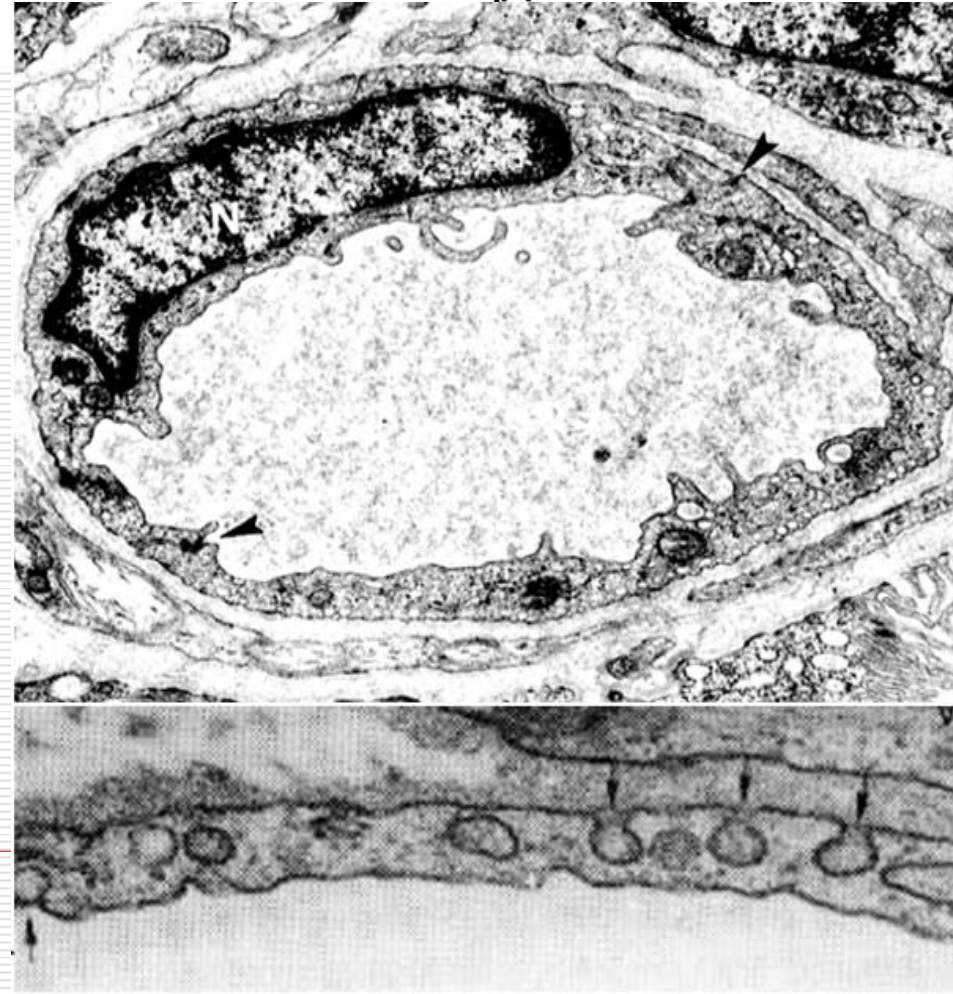
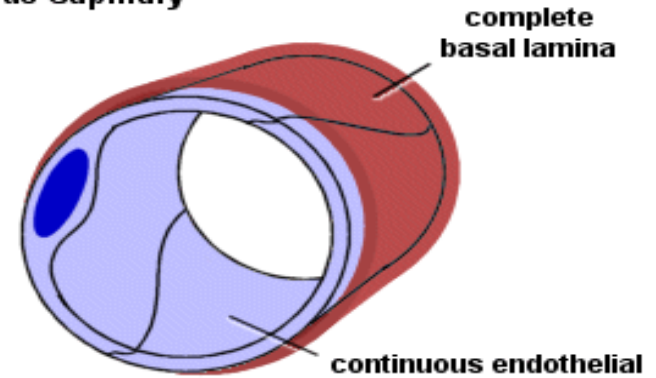
Types of capillary

- **Continuous capillary**
 - **Fenestrated capillary**
 - **Sinusoid capillary**
-

Continuous capillary

- **Characteristic**
 - ◆ **Tight junction of endothelium**
 - ◆ **Continuous basal lamina**
 - ◆ **Pinocytotic vesicles in cytoplasm of endothelial cells**
- **Distribution**
 - ◆ **Skin, connective tissue, striated and smooth muscles, lungs and brain**

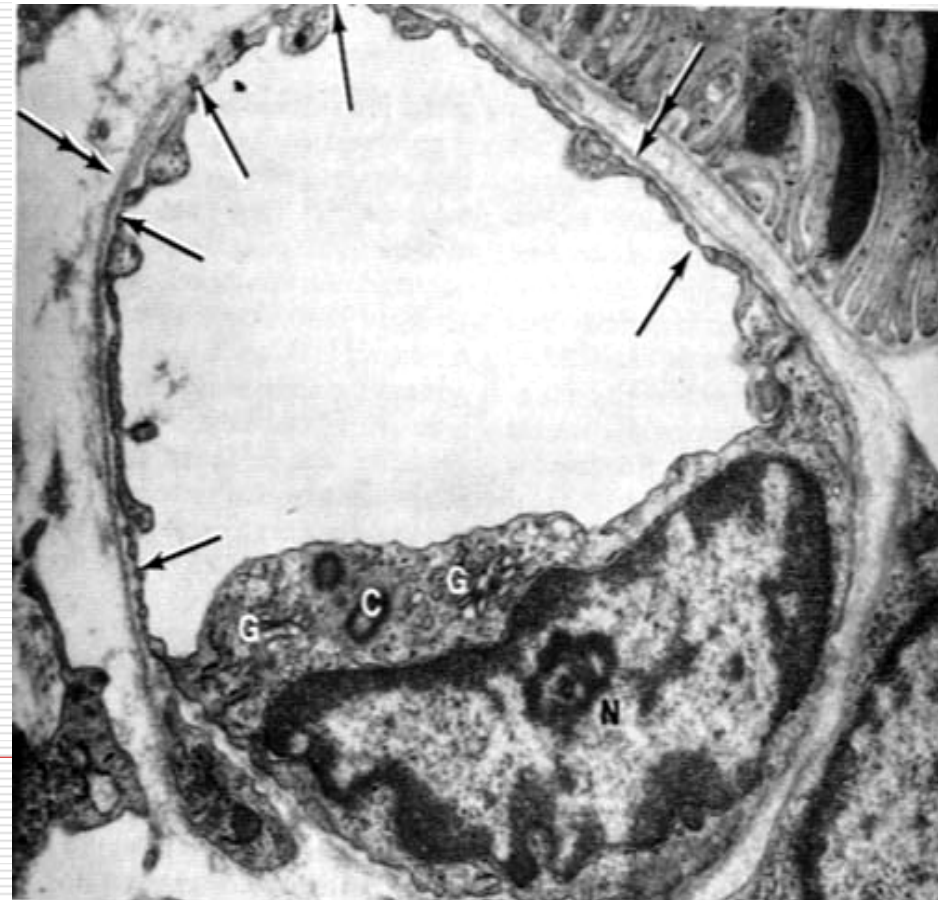
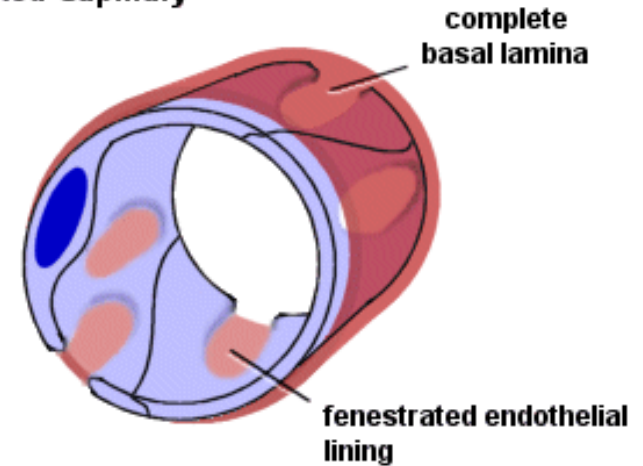
Continuous Capillary



Fenestrated capillary

- **Characteristic**
 - ◆ Fenestrated endothelium
 - ◆ Continuous basal lamina
- **Distribution**
 - ◆ Tunica mucosa of stomach and intestine, some endocrine glands, glomerulus of kidney

Fenestrated Capillary



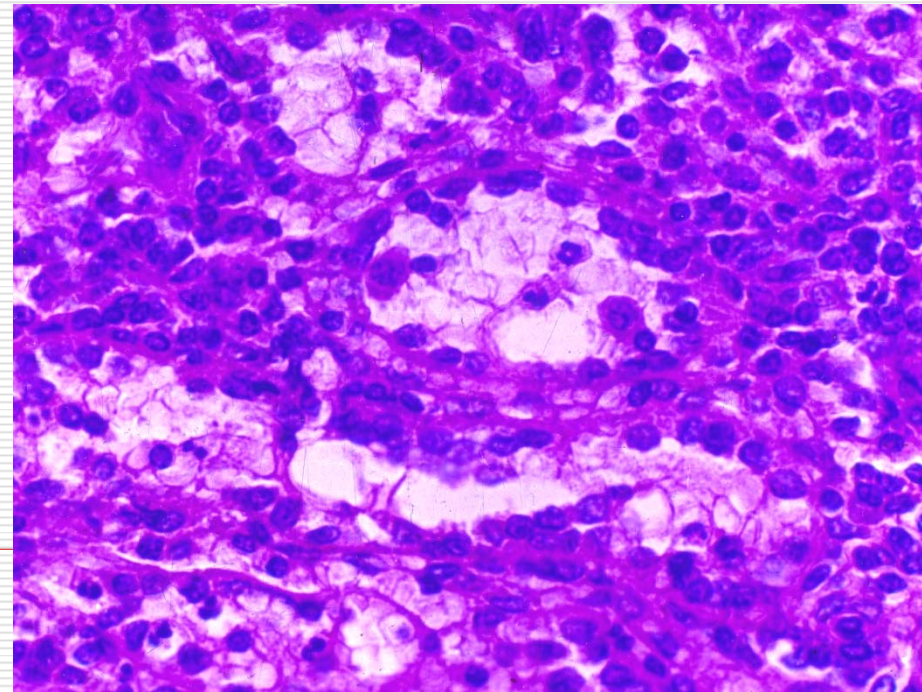
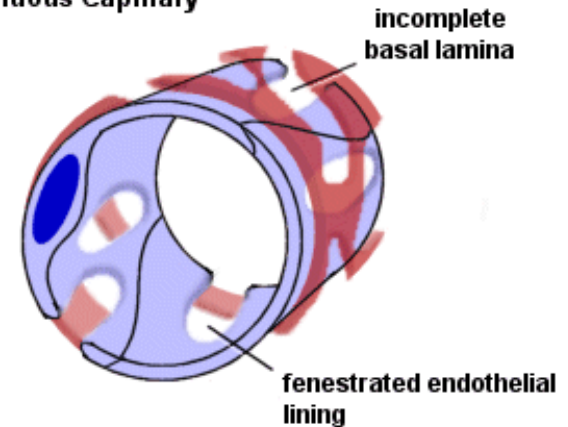
Sinusoid (discontinuous) capillary

■ Characteristic

- ✦ Greatly enlarged diameter (5~40 μ m)
- ✦ Fenestrated endothelium
- ✦ Wide gaps between two endothelial cells
- ✦ Continuous, discontinuous or no basal lamina

■ Distribution

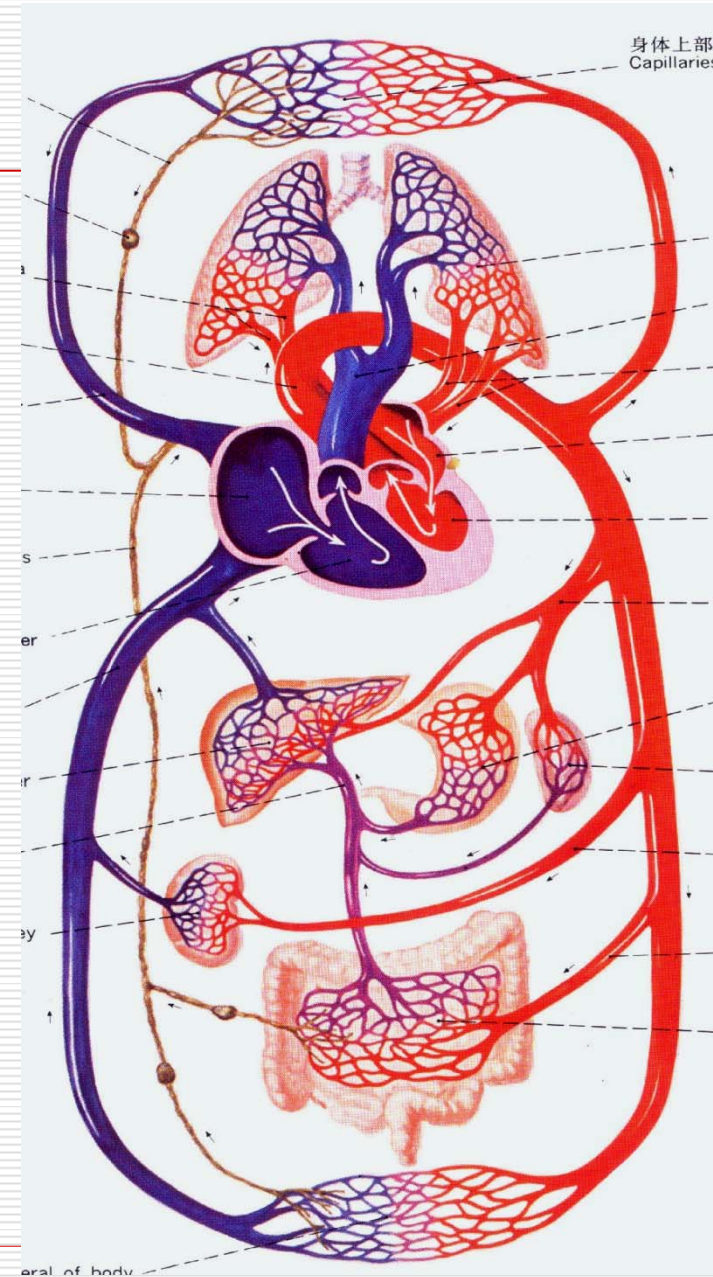
Discontinuous Capillary



III Capillary

■ Function

- Interchanges of substances between blood and tissues



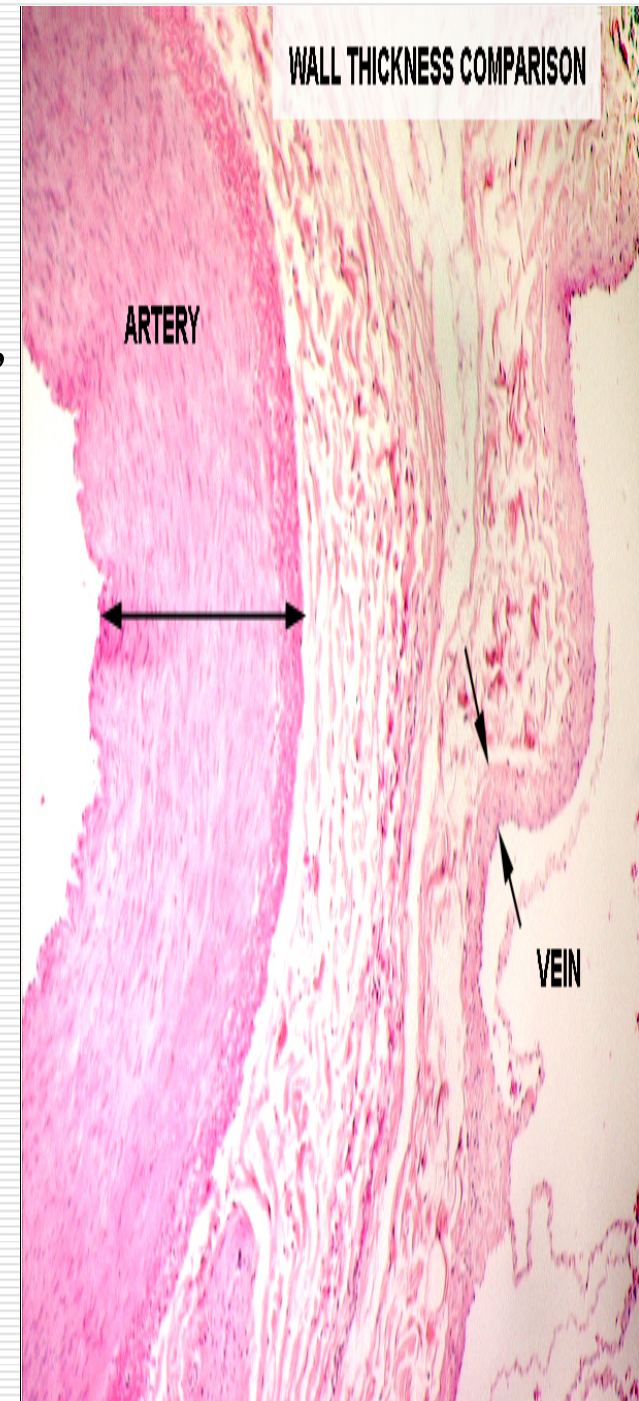
IV Vein

■ (a) Veins are generally more numerous than arteries and have a larger diameter and thinner walls than their accompanying arteries. In sections, their walls tend to collapse, so that their lumina frequently appear irregular.

■ (b) The boundaries between the three tunicae of a vein's wall are not as clear as in arteries, because the inner and external elastic membranes are often absent in veins.

■ (c) The tunica media is thinner than that of arteries and there are relatively less smooth muscle and elastic tissue and more collagenous fibers. The tunica adventitia is the thickest layer of a vein and constitutes the main part of the vein's wall.

■ (d) Many veins, especially veins in the limbs, are provided with semilunar-like valves which prevent back-flow of the blood.

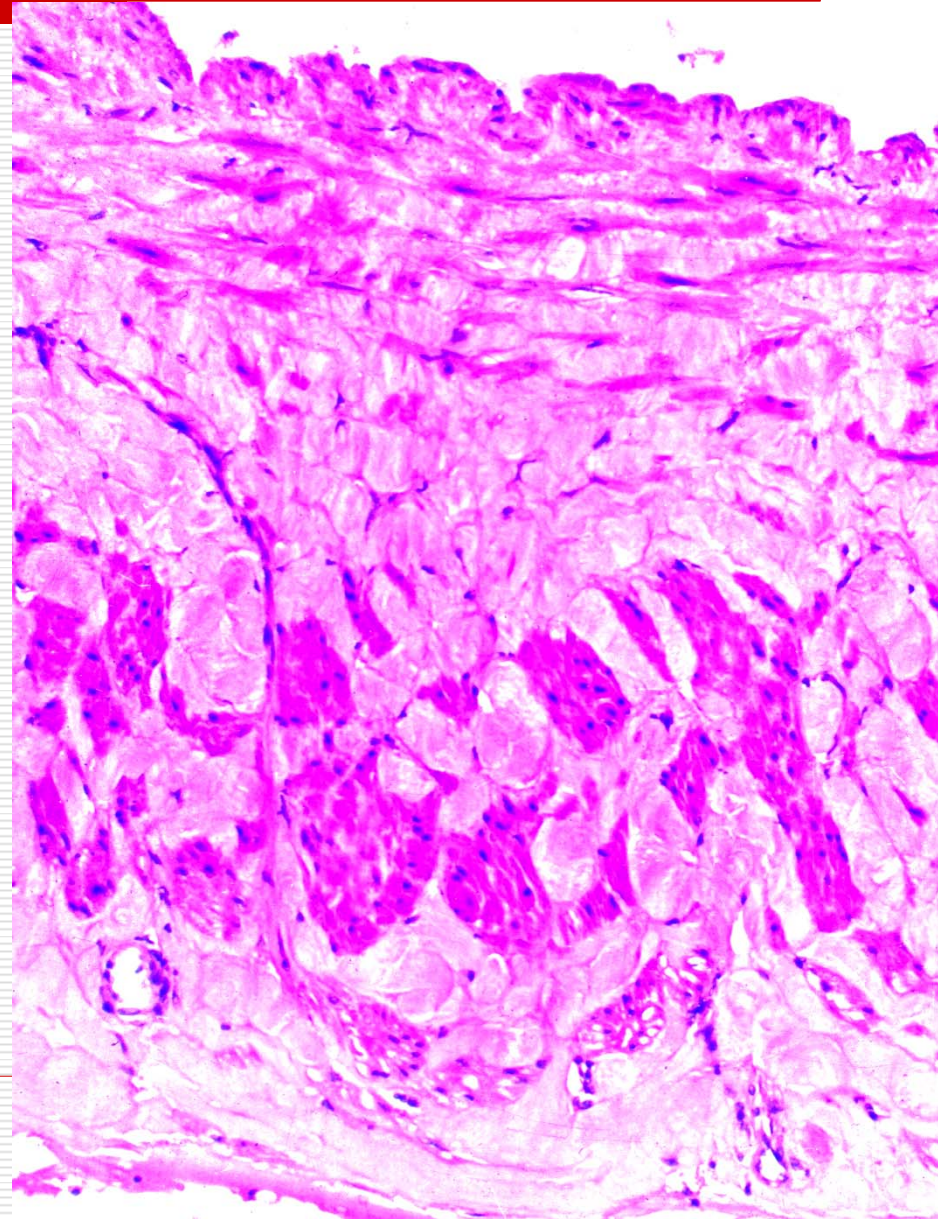


-
- **Large vein**
 - **Medium-sized vein**
 - **Small vein**
 - **Venule**
-

Large vein

■ Characteristic

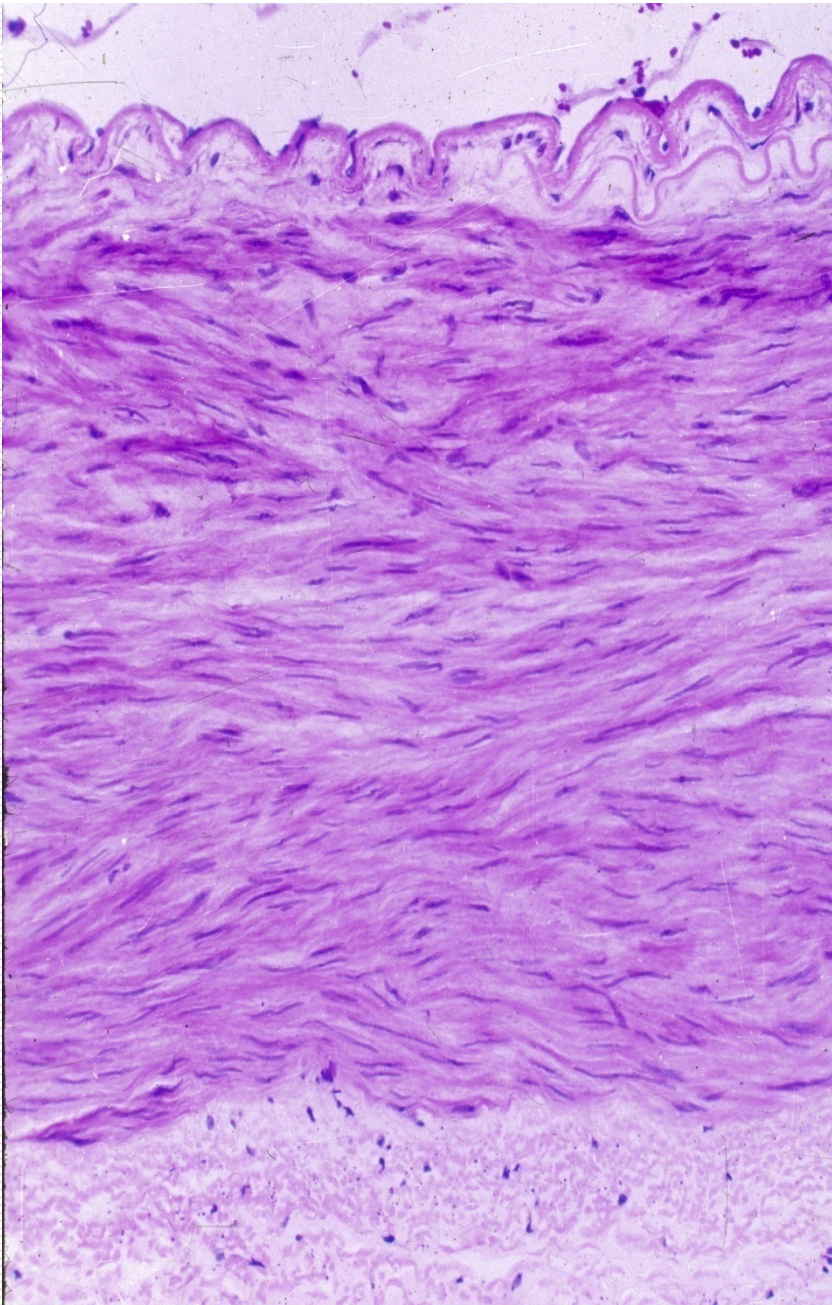
- ◆ **Diameter: above 10mm**
- ◆ **Poor developed tunica media, contains a few layers of smooth muscle cells**
- ◆ **Thicker tunica adventitia, contains longitudinal bundles of smooth muscle**



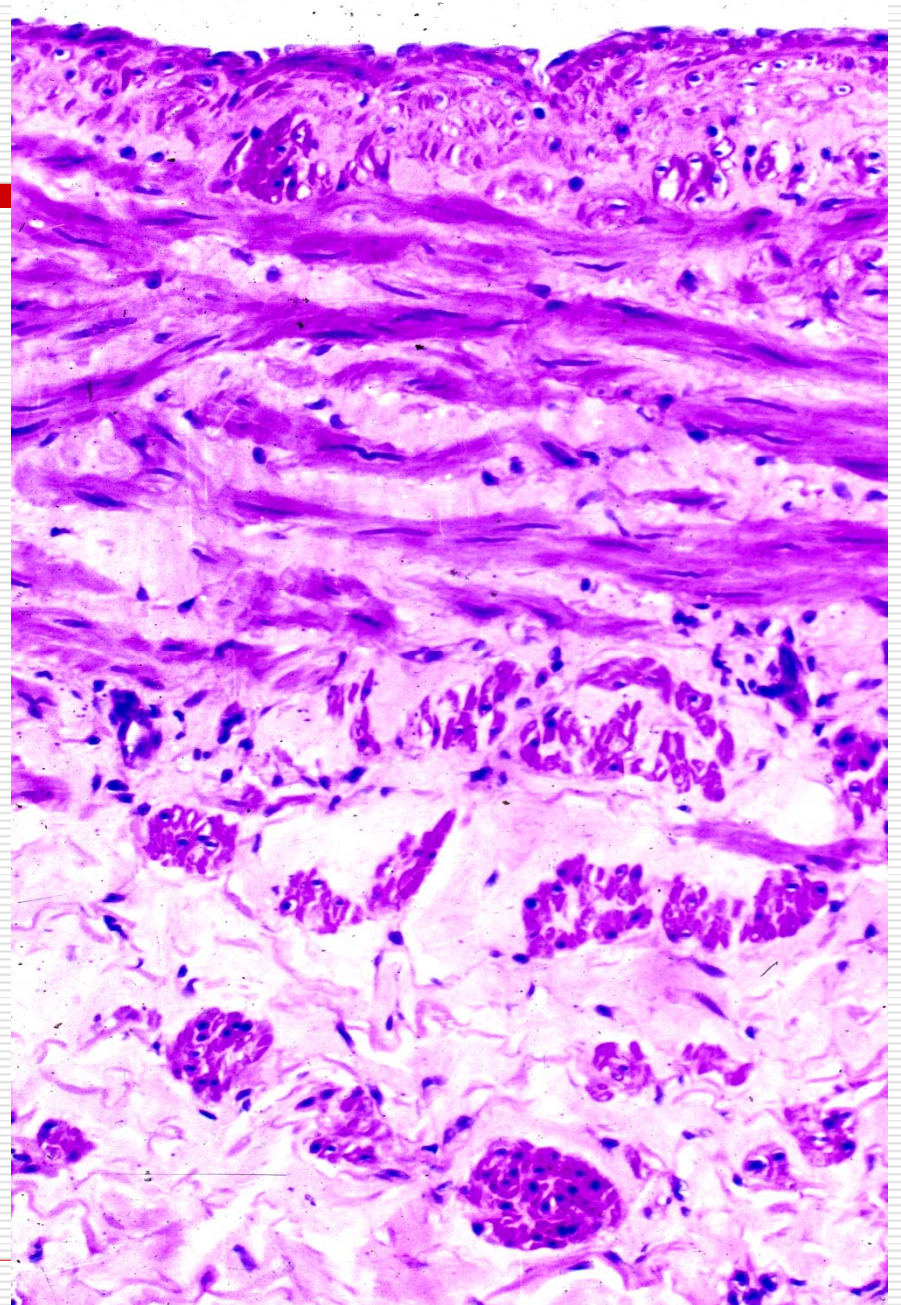
Medium-sized vein

■ Characteristic

- ◆ Diameter: 1~10mm
 - ◆ Small amount of smooth muscle cells in tunica media
 - ◆ Longitudinal bundles of smooth muscle cells in tunica adventitia
-



Medium-sized artery

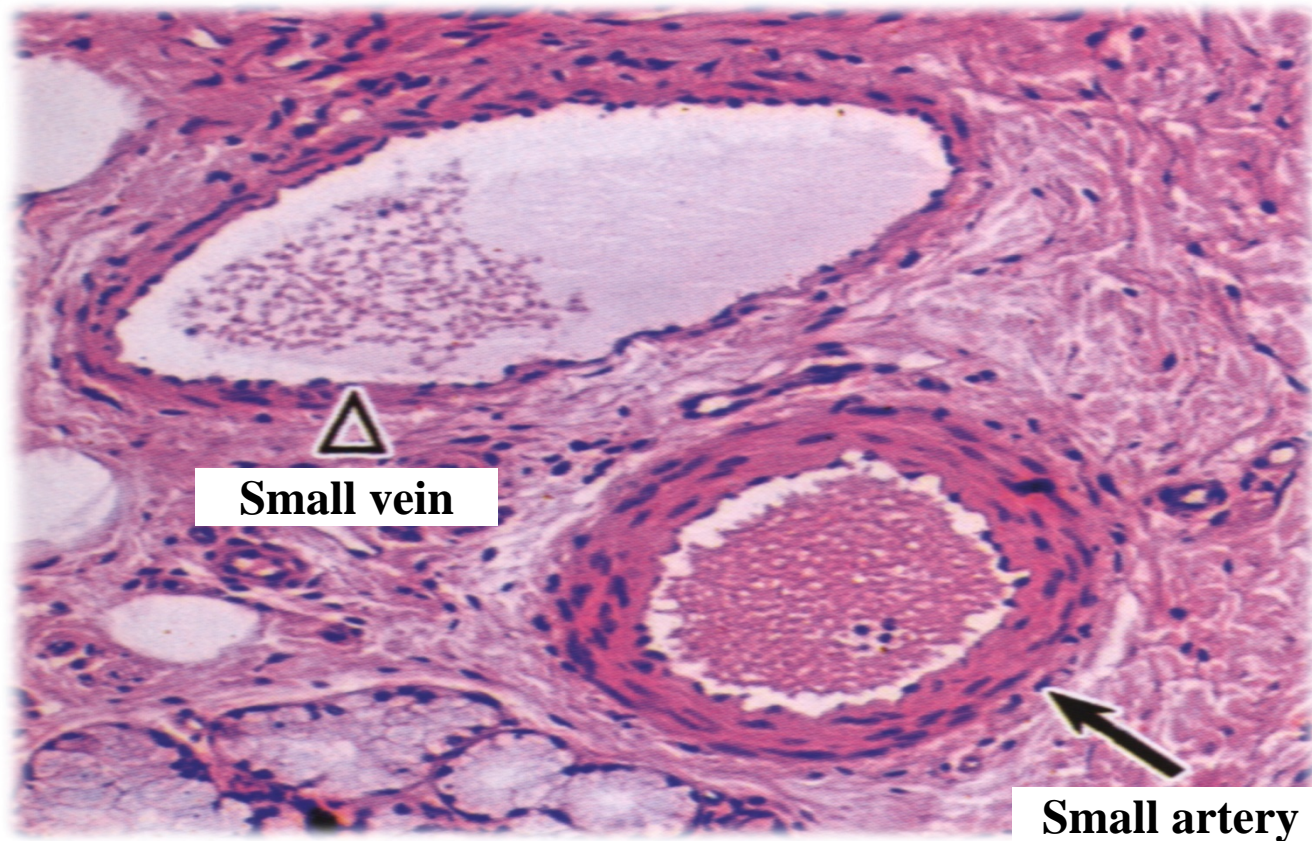


Medium-sized vein

IV vein

Small vein

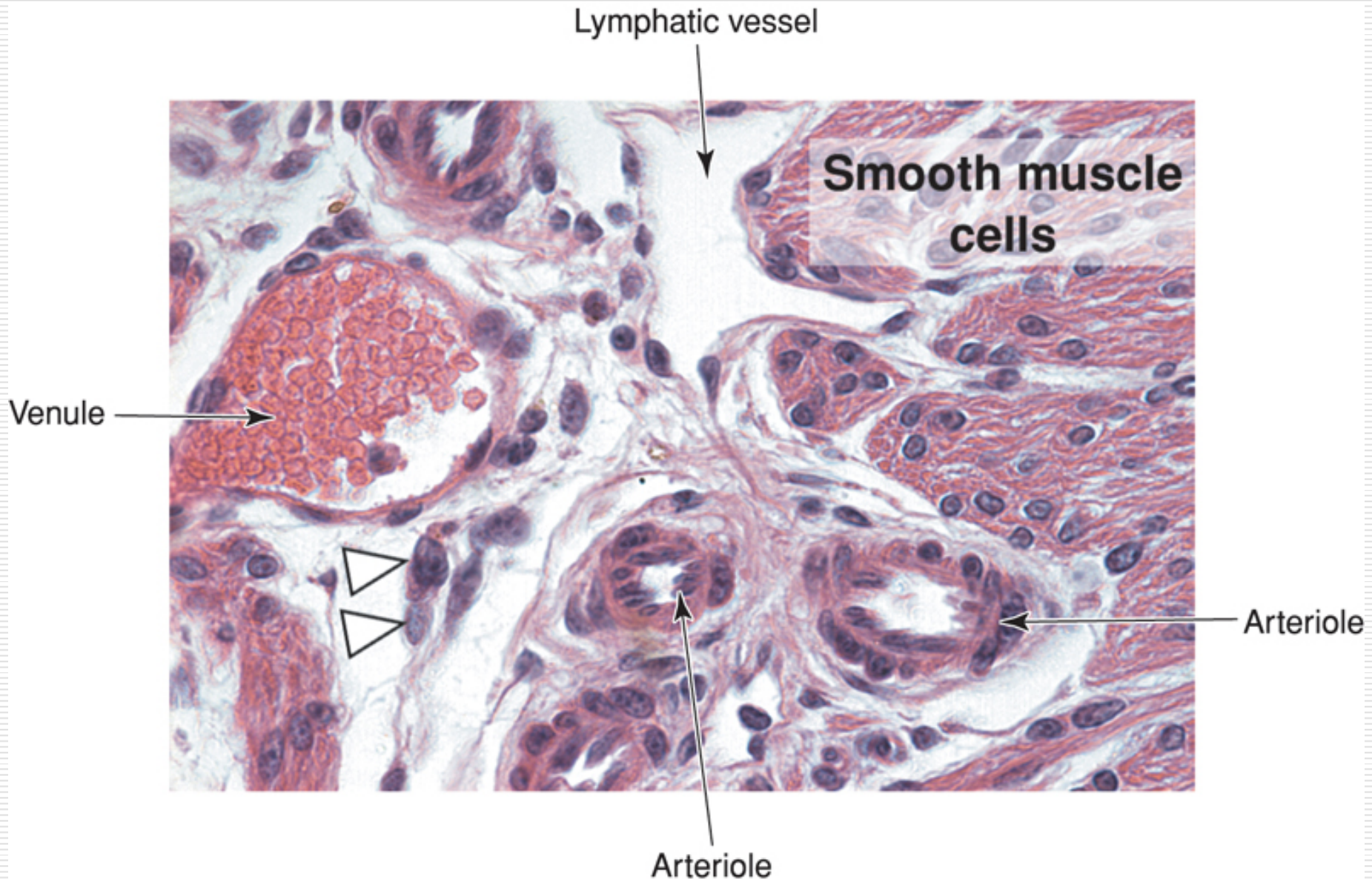
- Diameter: 0.1~1mm
- 1-4 layers of smooth muscle cells

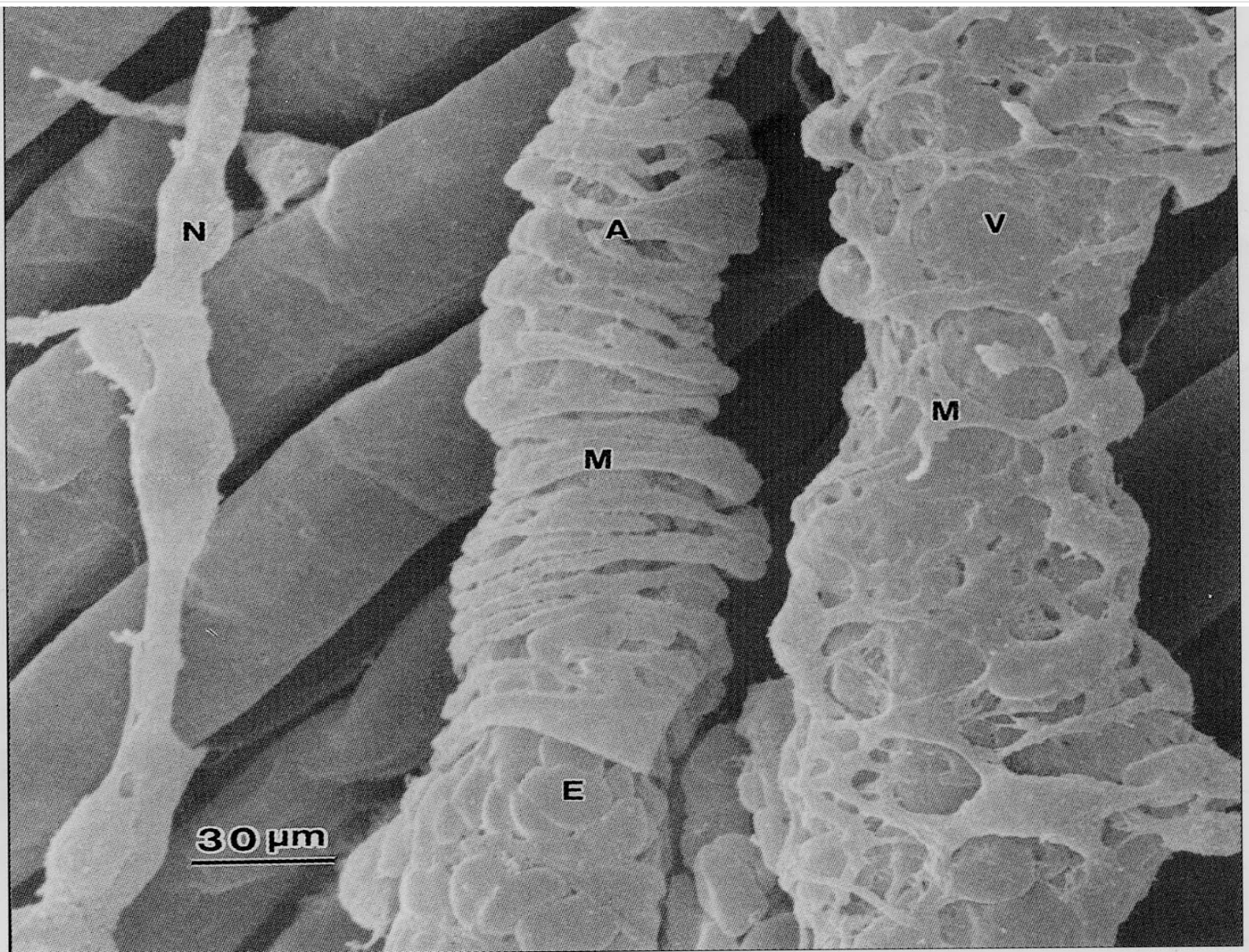


Venule

- **Diameter: 50~200 μ m**
 - **Little smooth muscle or no smooth muscle**
 - **Thin tunica adventitia**
 - **Postcapillary venule**
 - ◆ **Diameter: 10~50 μ m**
 - ◆ **Endothelium and very thin subendothelial layer**
 - ◆ **Loose endothelial junctions**
 - ◆ **Participation in inflammatory processes and exchange of cells and molecules between blood and tissue**
-

Venule & Arteriole

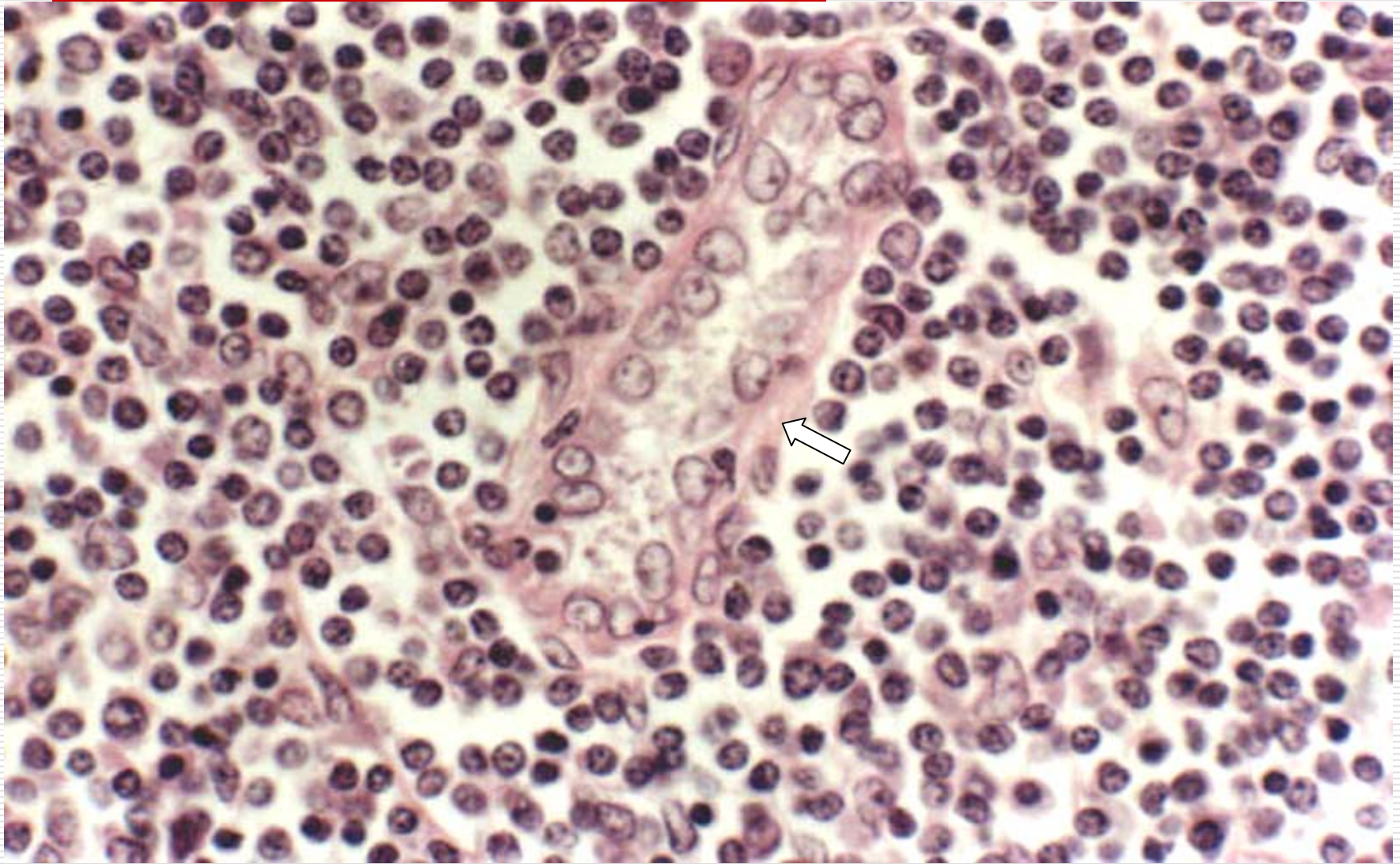




A. Arteriole V. Venule

IV vein

Postcapillary venule

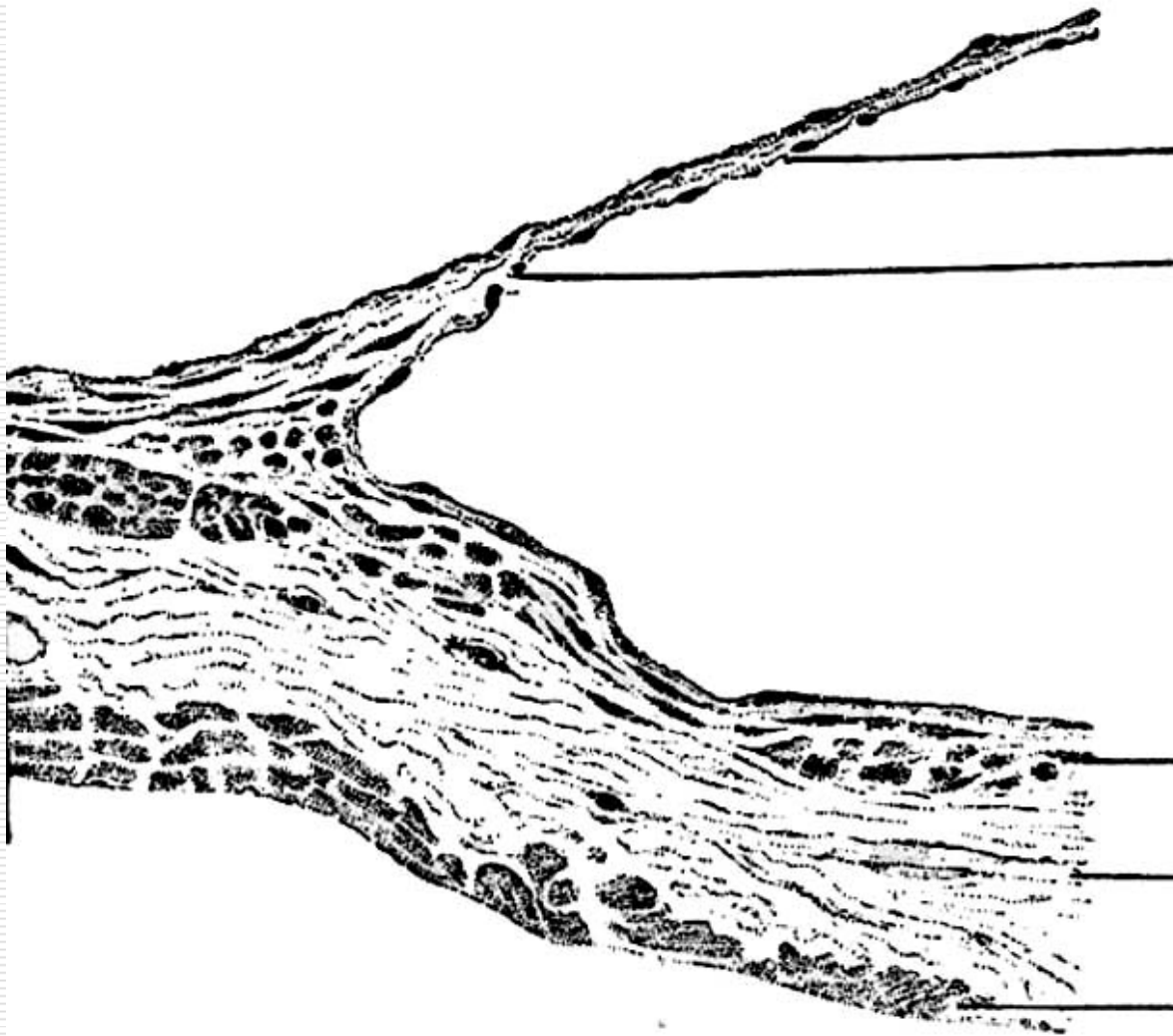


↑ Postcapillary venule

Vein valve

- **2 semilunar folds of the tunica intima**
 - **Be composed of connective tissue rich in elastic fibers**
 - **Be covered by endothelium**
 - **Direct the venous blood toward the heart**
-

IV vein
Vein valve



Vein valve

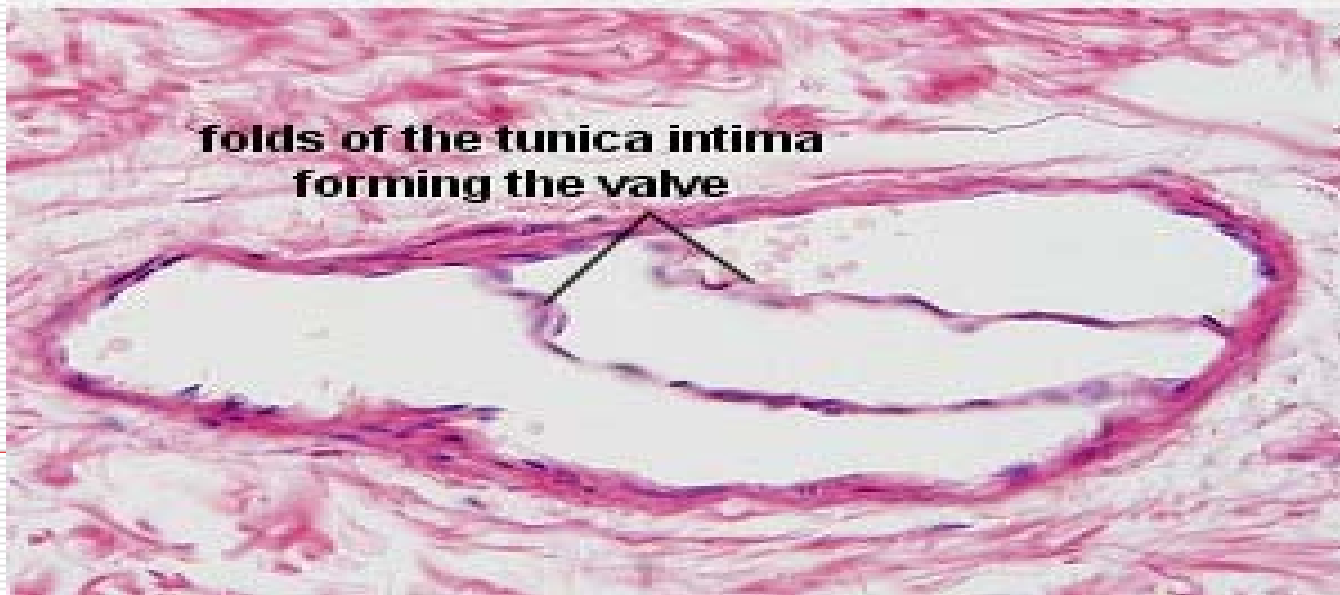
Endothelial cell

**Smooth muscle of
Tunica media**

Tunica adventitia

Collagenous fiber

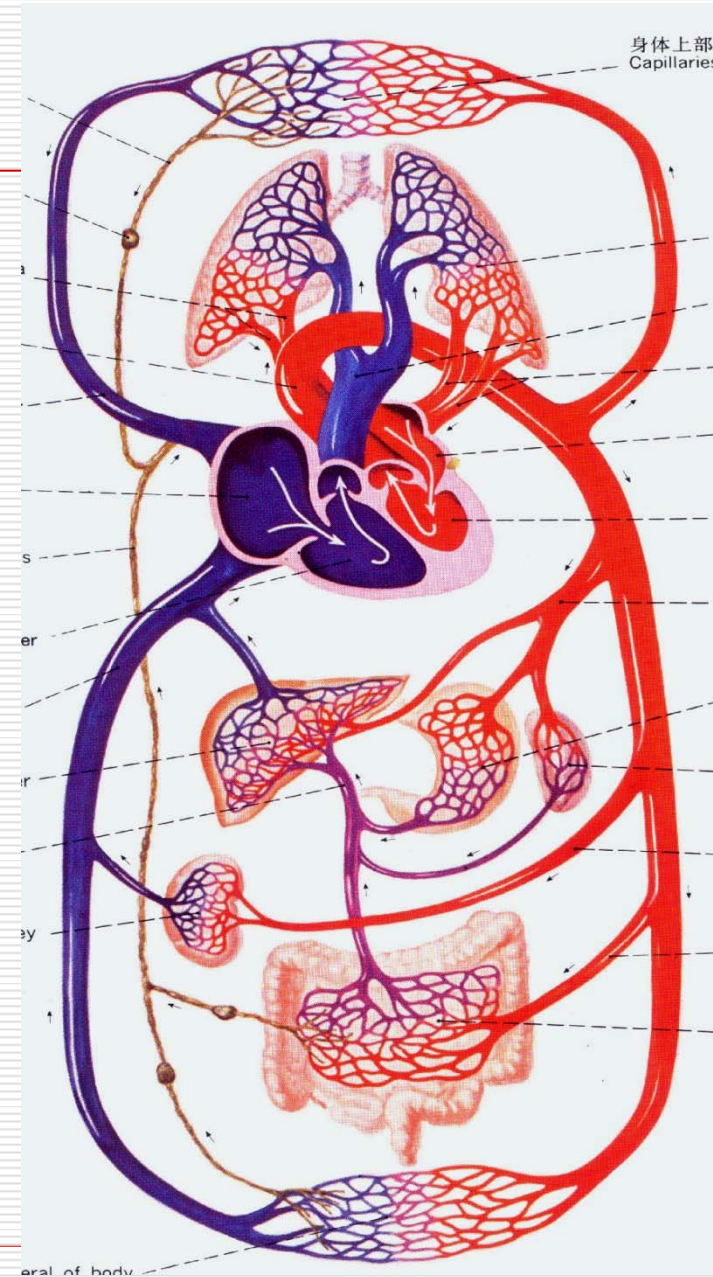
Vein valve



V Heart

■ Structure components of the heart wall

- ◆ Endocardium
 - Cardiac valve
- ◆ Myocardium
- ◆ Epicardium



Endocardium

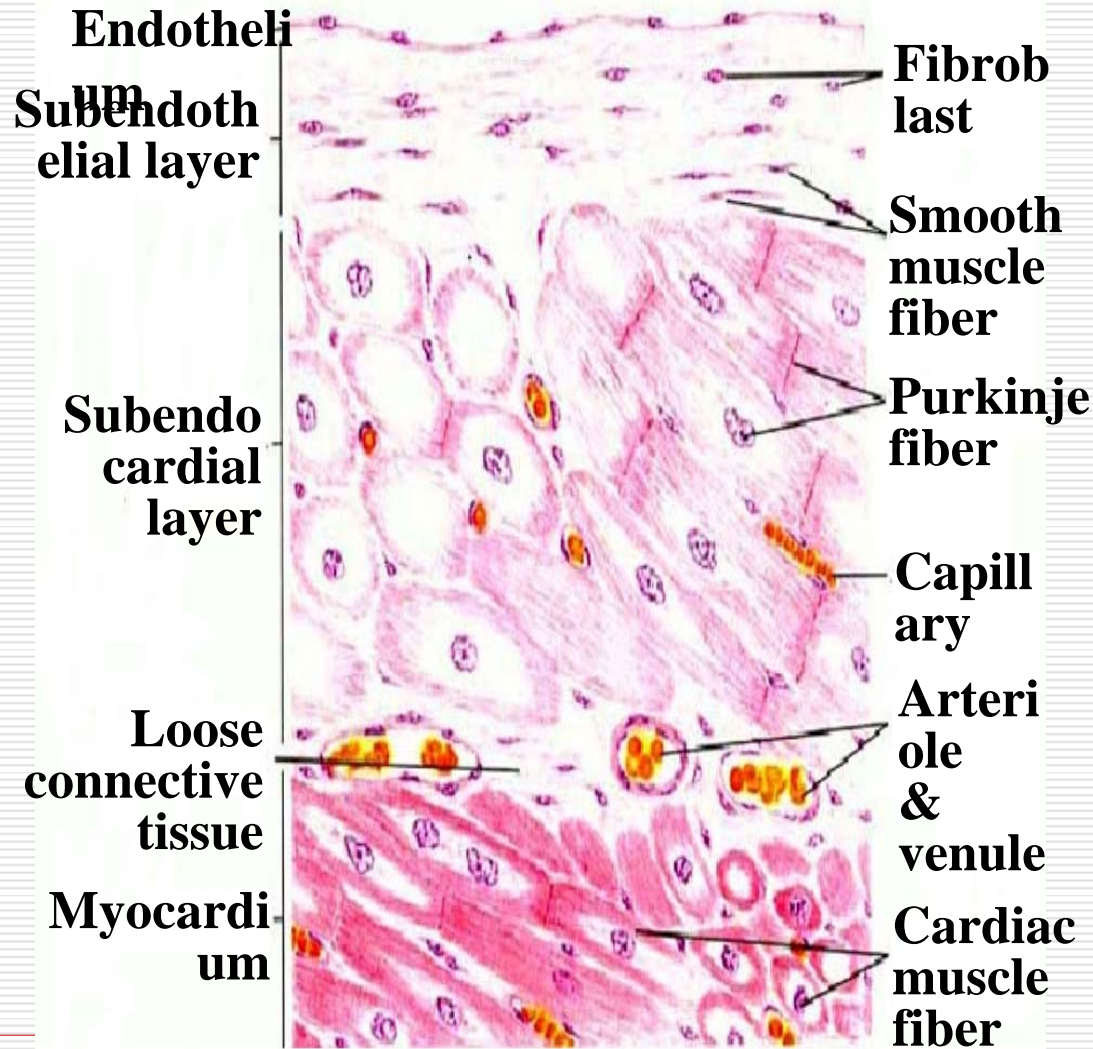
Endothelium

Subendothelial layer

◆ Dense connective tissue

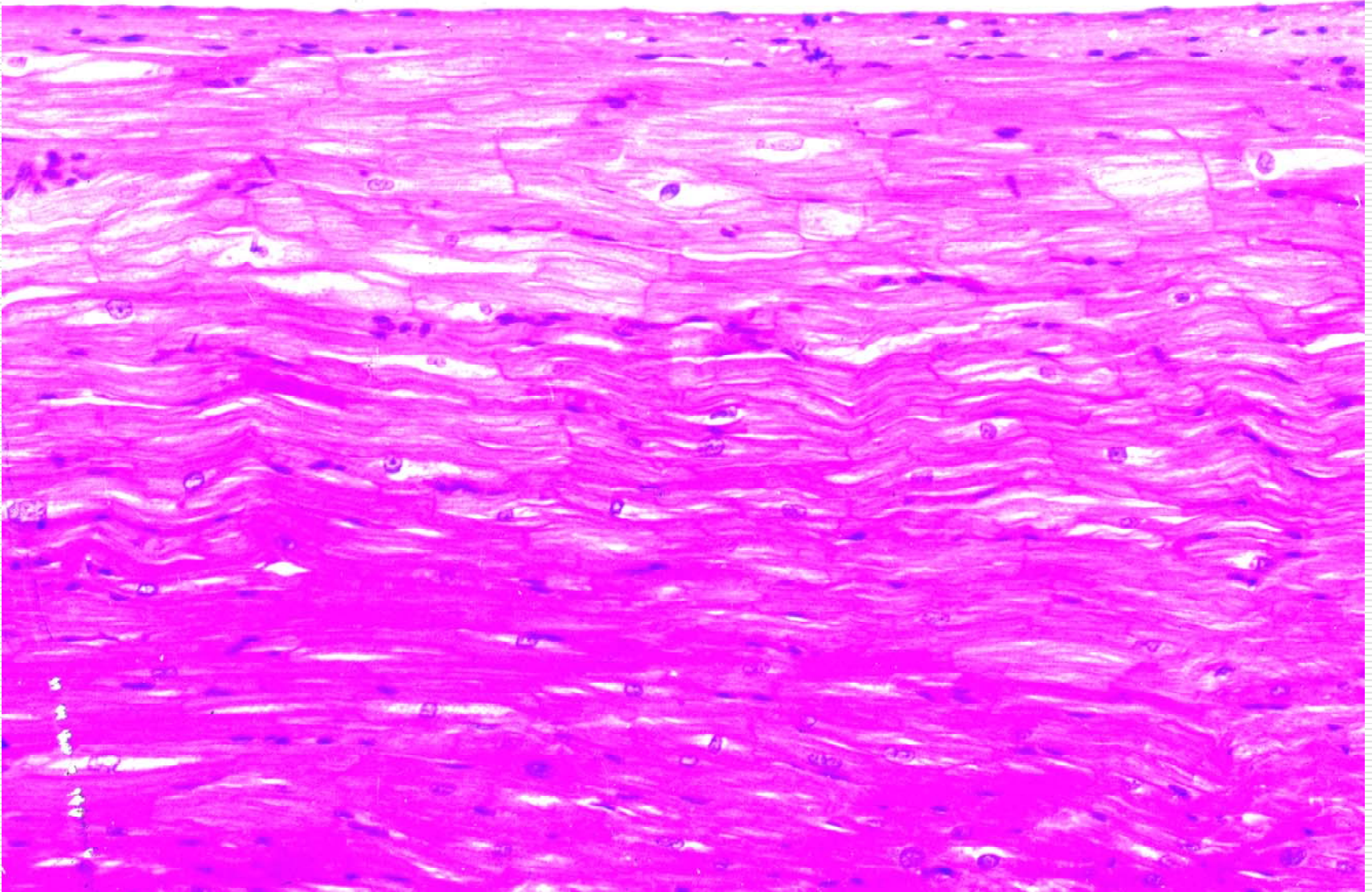
Subendocardial layer

◆ Loose connective tissue

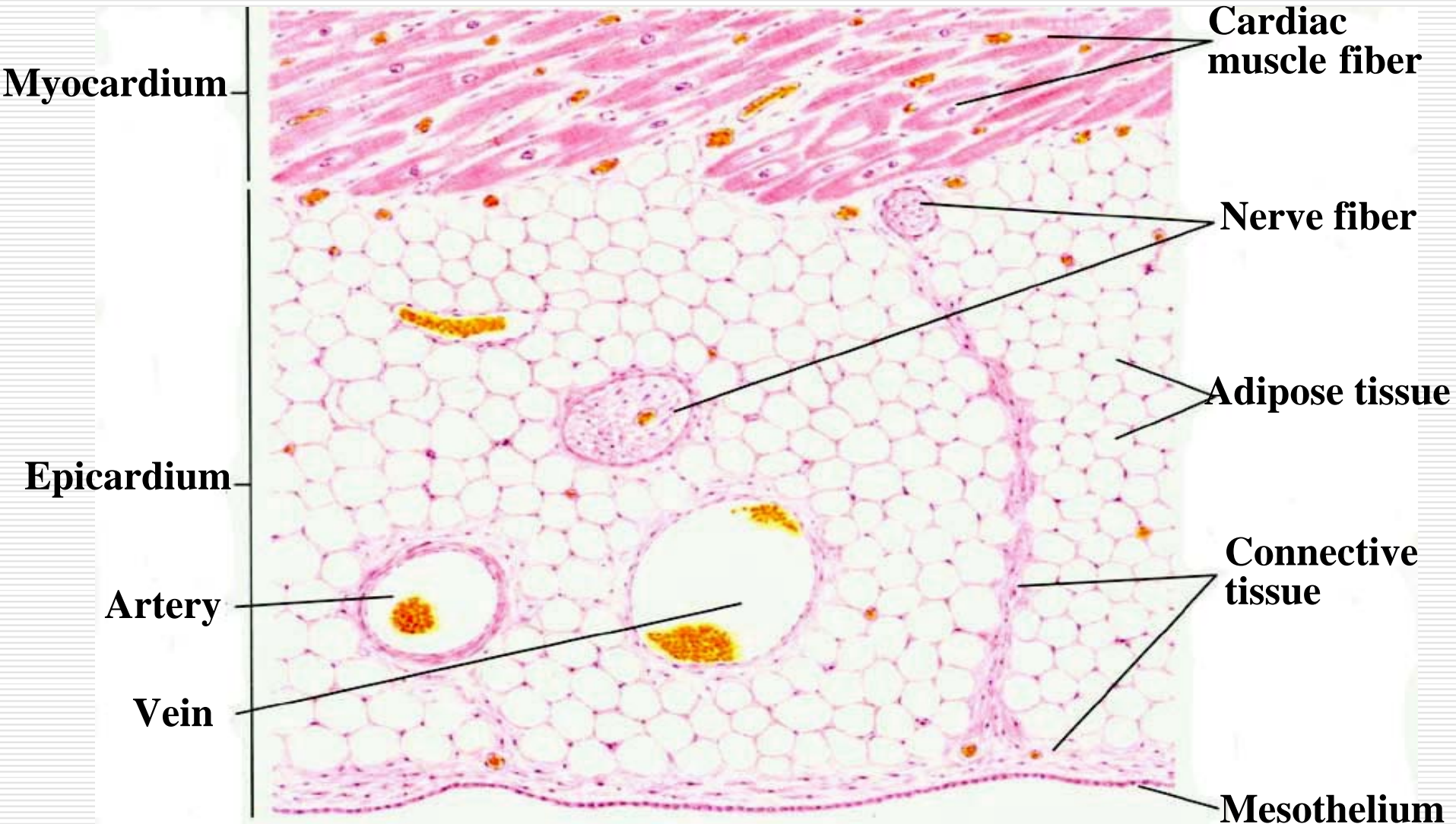


V Heart

Endocardium & myocardium

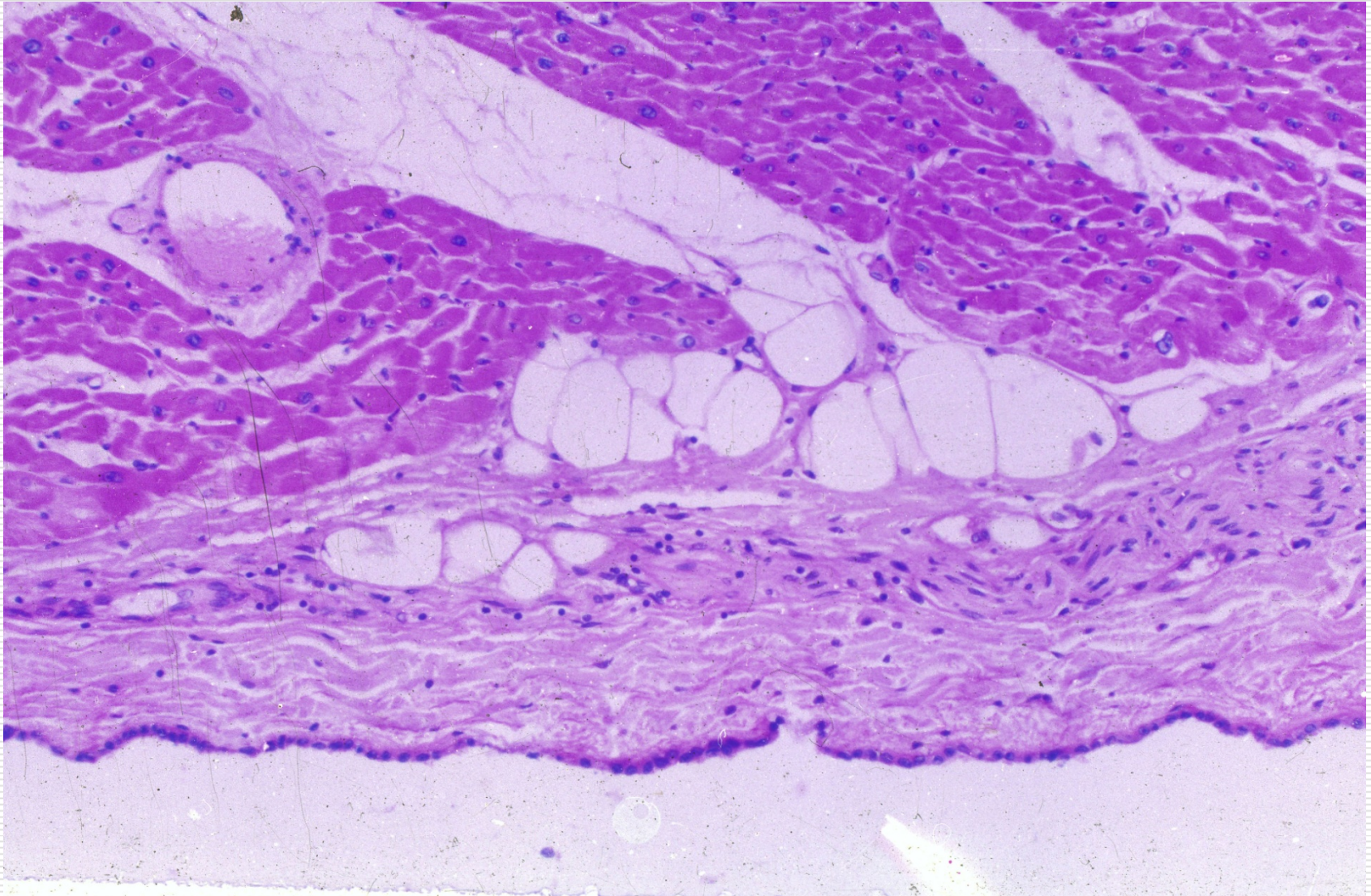


Myocardium & Epicardium



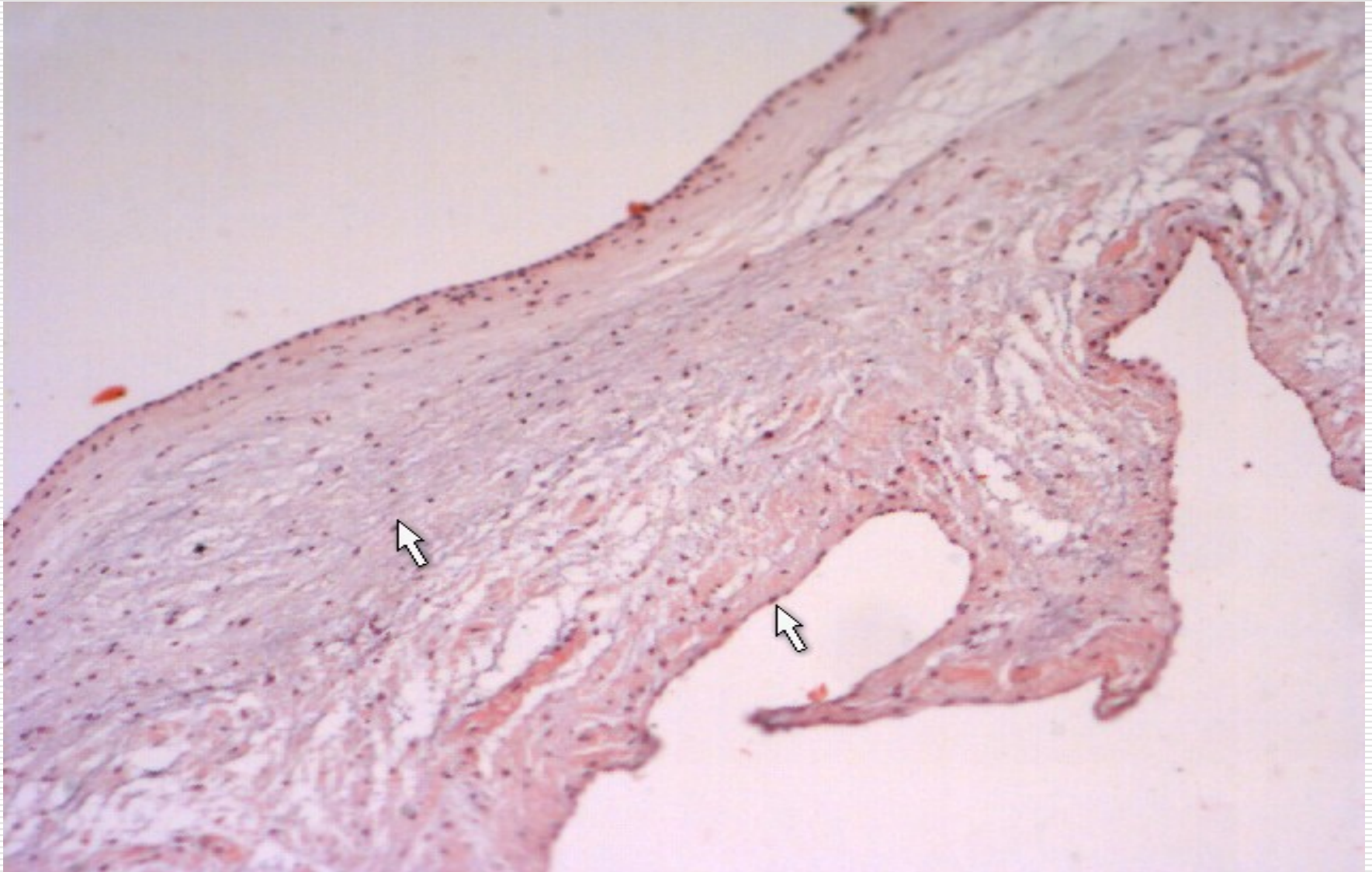
V Heart

Myocardium & Epicardium



V Heart

Cardiac valve



Conducting system of the heart

■ Structural components

■ Types of the cells

- ◆ Pacemaker cell (P-cell)

- ◆ Transitional cell

- ◆ Purkinje fiber

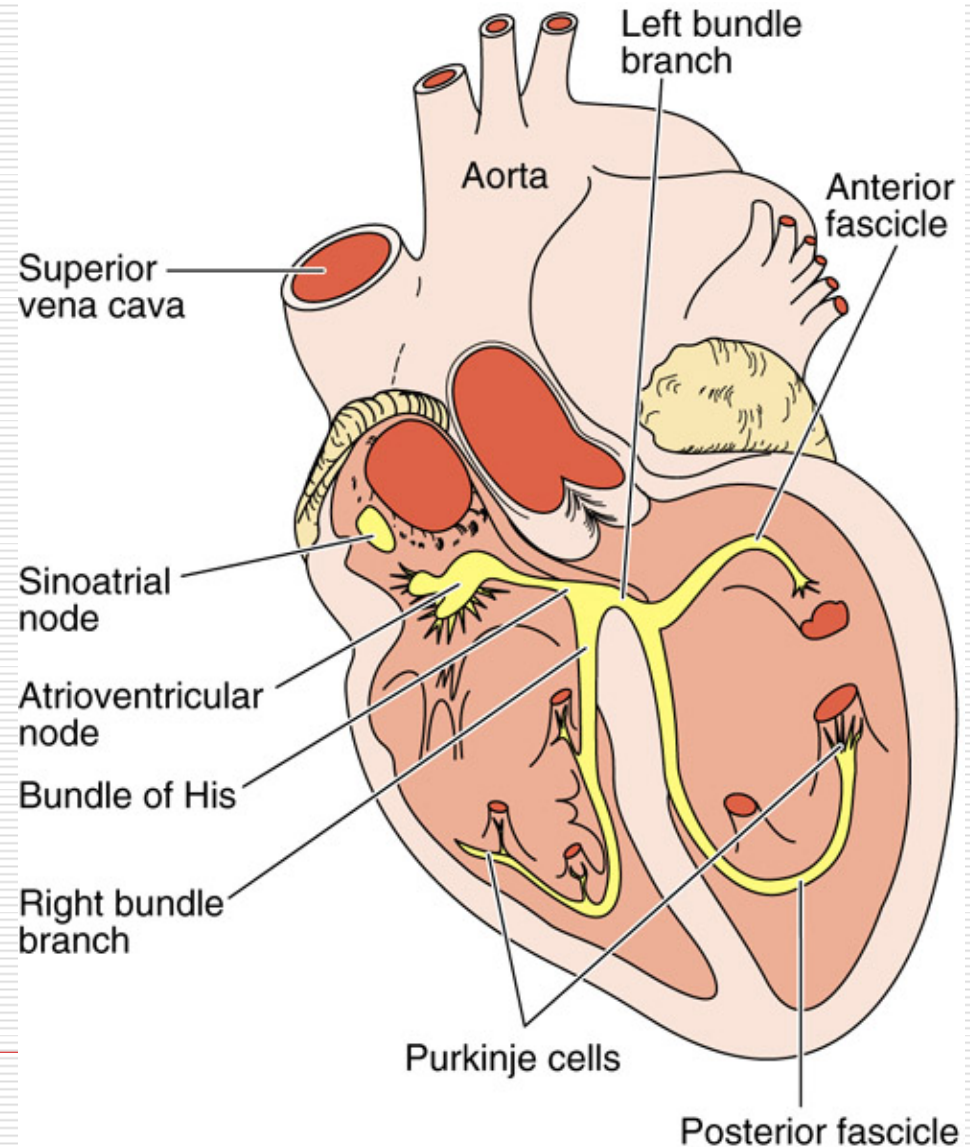
■ Function

- ◆ Generates and conducts impulses in order to coordinate the heart beat

Conducting system of the heart

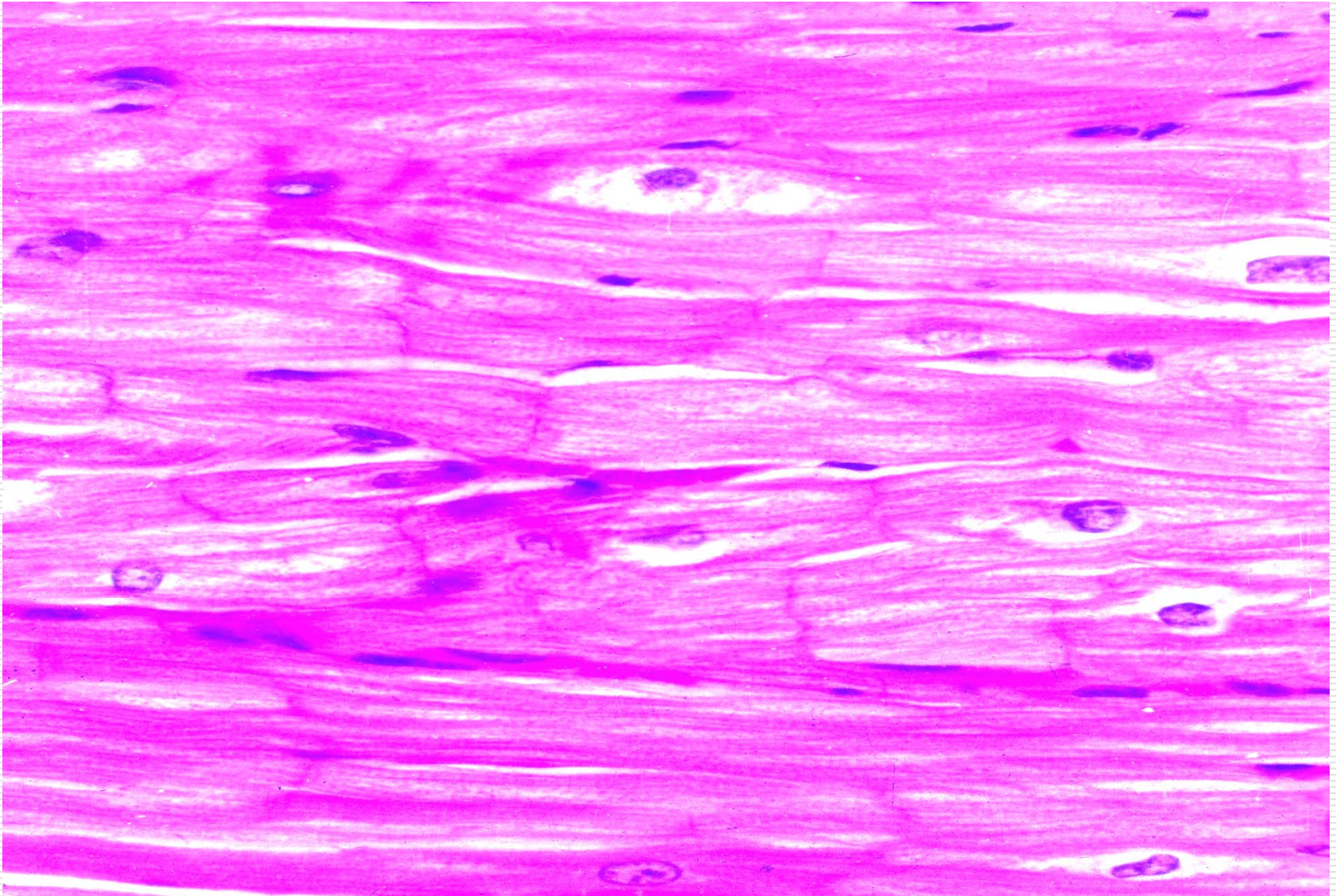
■ Structural components

- Sinoatrial node (SA node)
- Atrioventricular node (AV node)
- AV bundle or bundle of His
- Purkinje fibers



V Heart

Purkinje fiber



Summary

- **Master the classification, structure and functions of capillaries.**
 - **Master the structure and functions of large artery, medium-sized artery, small artery and arteriole .**
 - **Master the structure of heart wall and impulse-conducting system.**
 - **Know the distinction between arteries and veins.**
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