بسم الله الرحمن الرحيم

THE VASCULAR SYSTEM 1

CVS MODULE

Semester 1, Year 3

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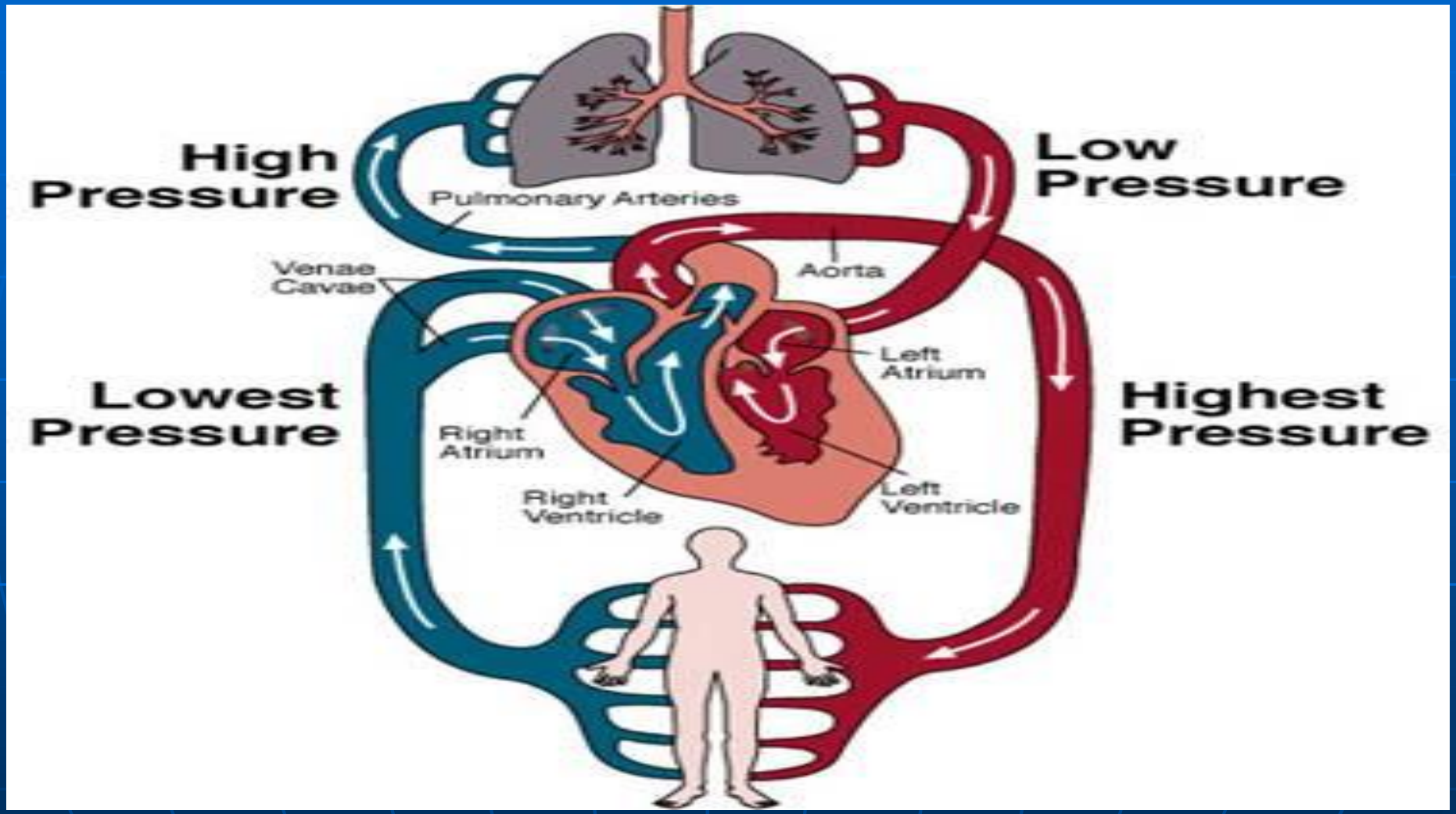
Circulatory system



1. The Cardiovascular System

2. The Lymphatic system

The Blood Vessels

They include:

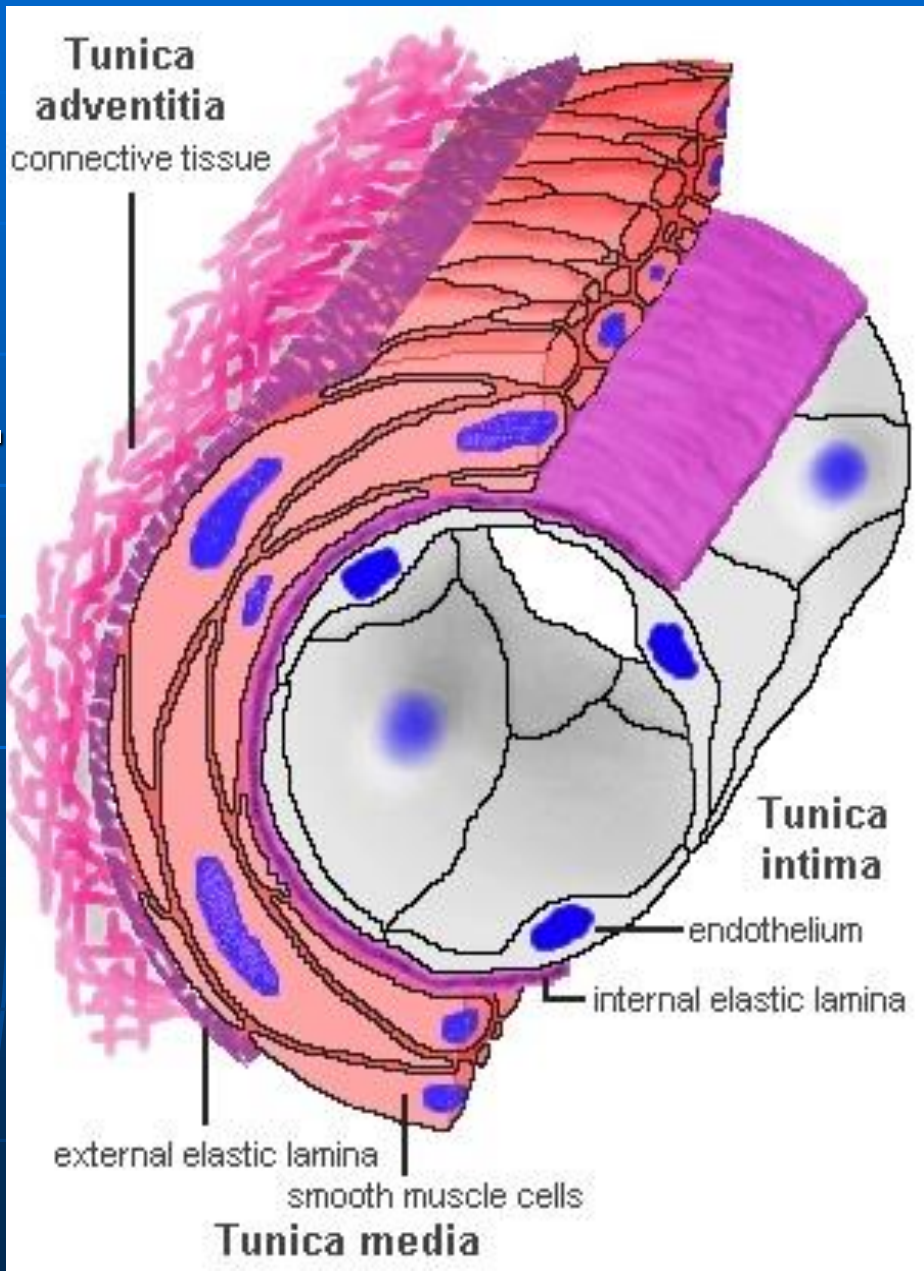
- **Arteries:** Large arteries, medium sized arteries & arterioles.
- **Veins:** Large veins, medium sized veins & venules.
- **Arterio-venous connections:** Blood capillaries, sinusoids & arterio-venous anastomosis.

General structure of blood vessels

1-Tunica Intima: Innermost layer, contact with blood.

2- Tunica Media: The middle layer of blood vessels.

3- Tunica Adventitia: The outermost layer.



1- Tunica Intima: formed of

endothelium
subendothelium
internal elastic

a- Endothelium:

Simple squamous epithelium, lies on basal lamina. It provides a smooth surface for blood flow, and easy exchange.

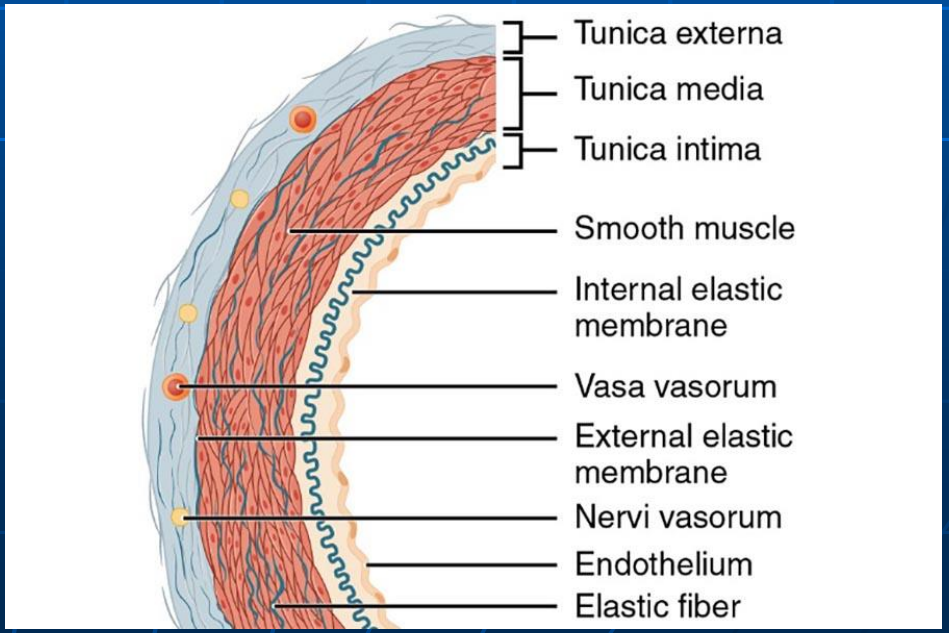
b- Subendothelium:

Loose areolar C.T. to support the endothelium

for nutrition

c- Internal elastic lamina:

Present in arteries. Made of dense elastic fibers forming fenestrated membrane. Well developed in muscular arteries and absent in small arterioles. Prevent occlusion of arteries.

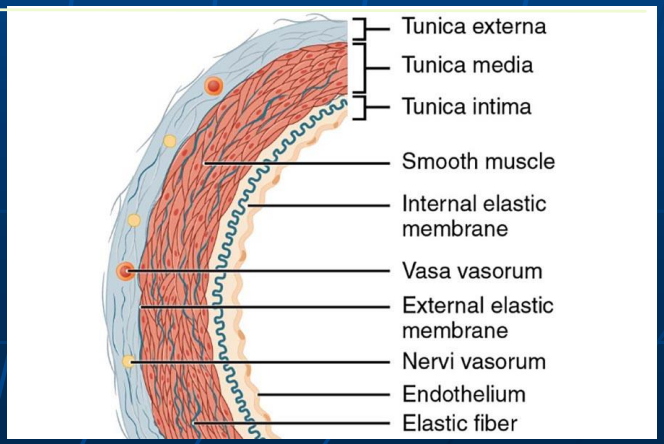


2- Tunica Media: formed of:

- Circularly arranged smooth muscle f
- Variable amounts of elastic fibers. Fine collagen fibers.
- Ground substance in between.
- Its outer layer is limited with elastic membrane in some arteries, which forms (External elastic lamina).
- Regulates blood flow by contraction of its smooth m.

3- Tunica Adventitia:

- Formed of loose C.T. in which collagen f. are predominant, with some elastic f. and some C.T. cells.
- Contains nerves, lymphatics and vasa vasorum.
- It connects blood vessels to the surrounding tissues and prevents over-distension of the vessel.

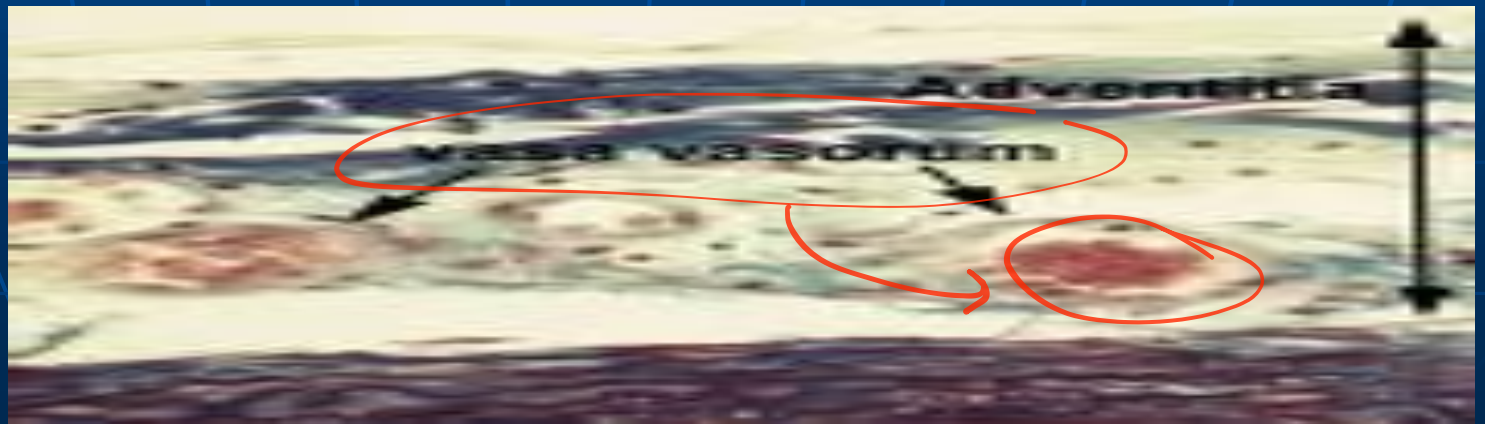


- **Vasa Vasorum:**

(blood vessel of the blood vessel).

– Small arteries that branch in adventitia and outer part of media, in large vessels to nourish them.

– Small blood vessels are nourished from the blood passing inside their lumina.



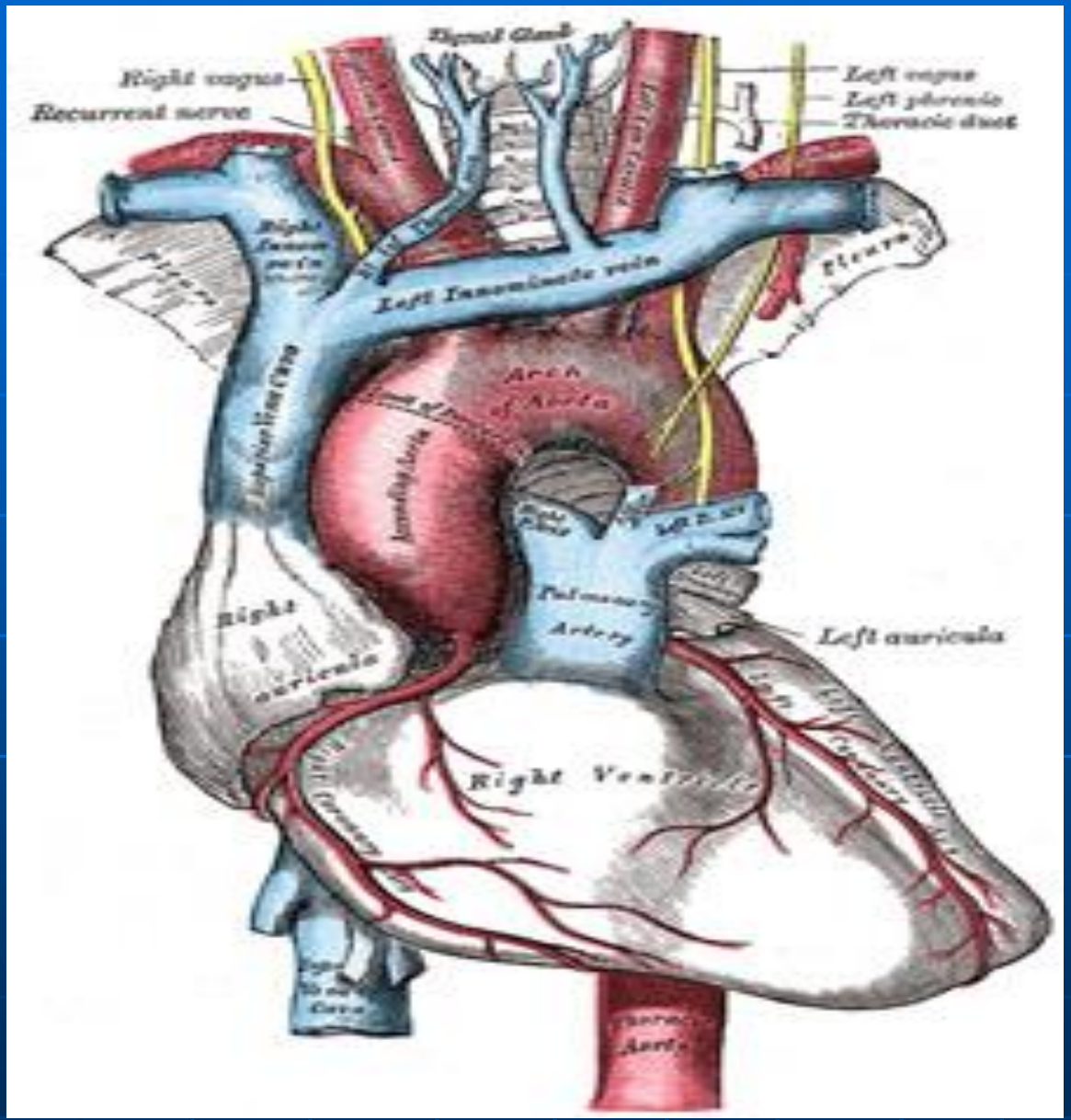
Arteries

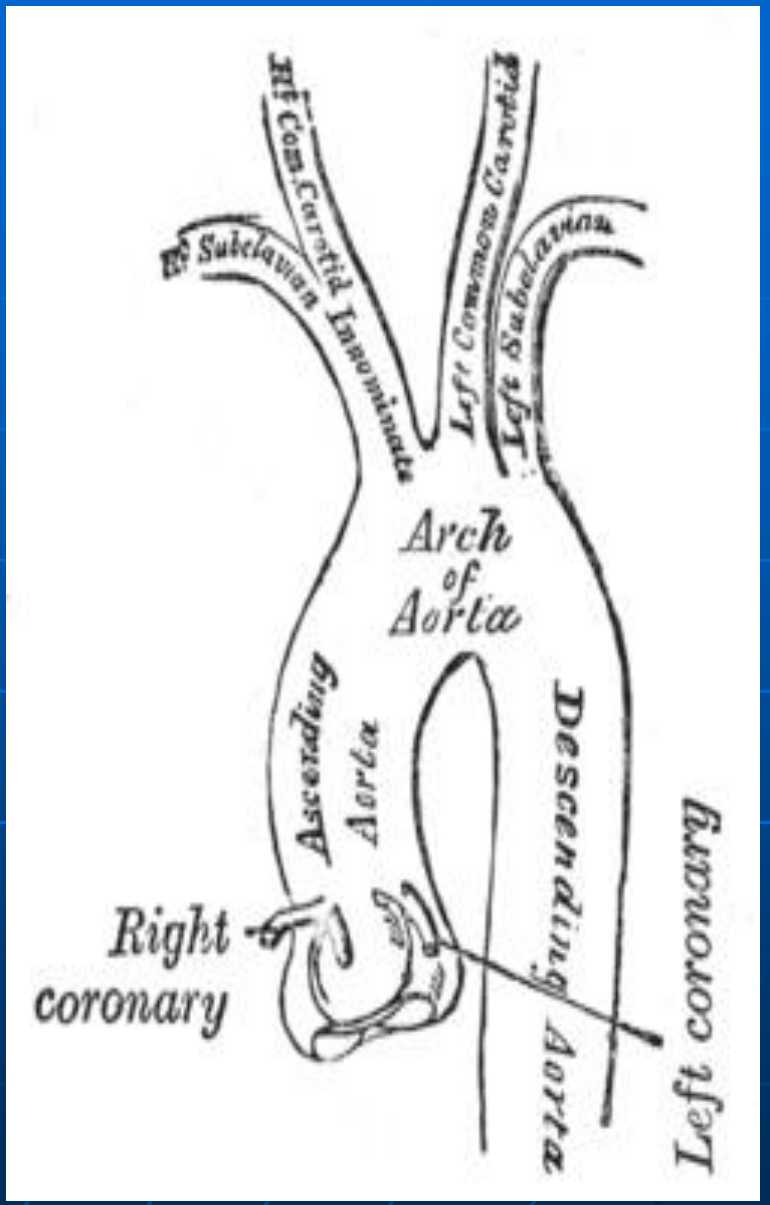
- Classified according to their size & main tissue in their media into:

1- **Large elastic arteries:** which carry blood from the heart.

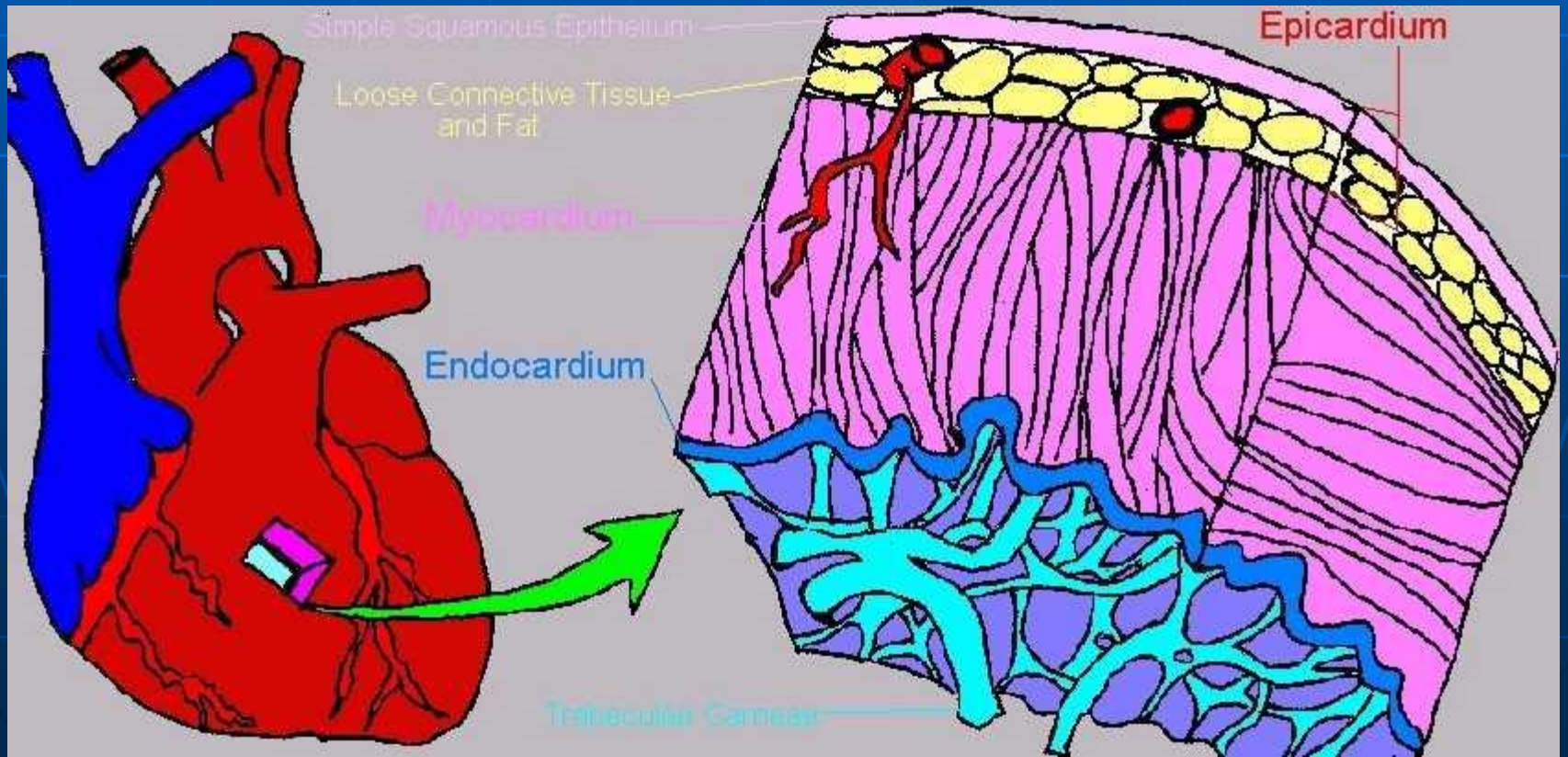
2- **Medium-sized muscular arteries:** distribute blood to organs.

3- **Small arteries (arterioles):** regulate blood flow to capillaries


Thyroid Gland
Right vagus
Recurrent nerve
Left vagus
Left phrenic
Thoracic duct
Left Innominate vein
Pleura
Arch of Aorta
Right auricula
Pulmonary Artery
Left auricula
Right Ventricle


Rt Com. Carotid
Rt Subclavian
Innominate
Left Common Carotid
Left Subclavian
Arch of Aorta
Ascending Aorta
Descending Aorta
Right coronary
Left coronary

The basic structure of arteries is similar in having the three concentric layers.



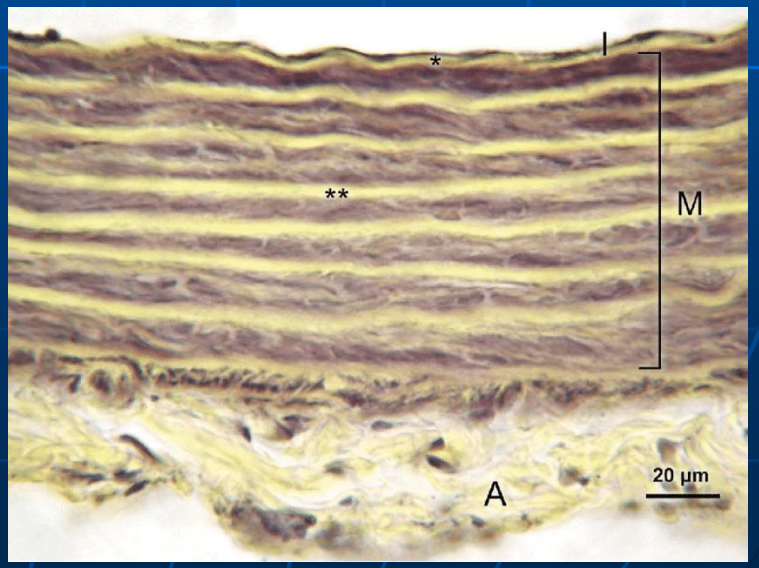
I- Large Elastic Arteries:

→ Elastic fiber ↑↑↑ / اصفر
→ lumen واسع
→ Resist

- Resist changes in blood pressure in their initial parts by their elastic recoil.

by Elastic Fiber

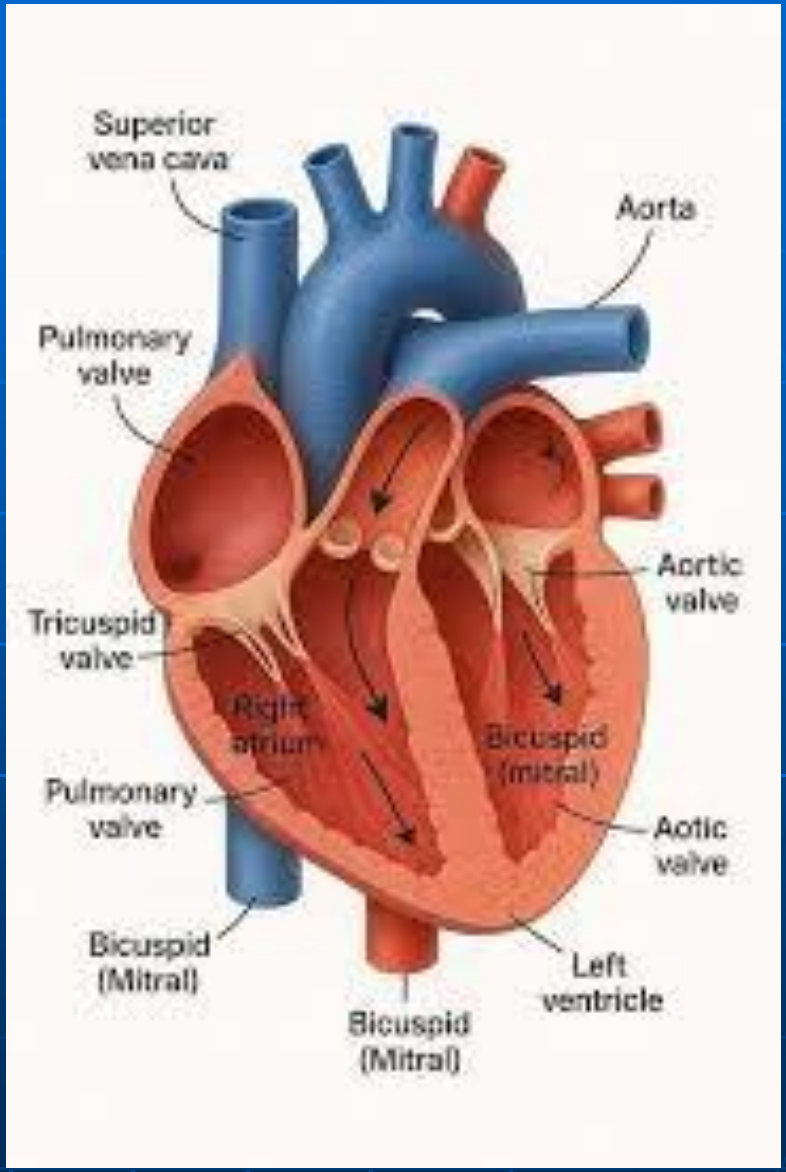
- They have thick walls which appear yellowish in fresh conditions as they are mainly formed of elastic f. They also have very wide lumina.



The large elastic arteries in the body are:

pulmonary, aorta and its large branches.

Aorta will be studied as an example.



The Aorta

1- Tunica Intima:

a. Endothelium: simple sq. epithelium

b. Subendothelium: thick loose C.T. rich in elastic fibers, collagen fibers which are longitudinally arranged.

c. Internal elastic lamina: non-clear, as it is similar to the underlying elastic laminae of the media.

2- Tunica Media:

The thickest layer, (70% of the wall), made of:

- **Concentrically arranged fenestrated elastic membranes, increase with age**

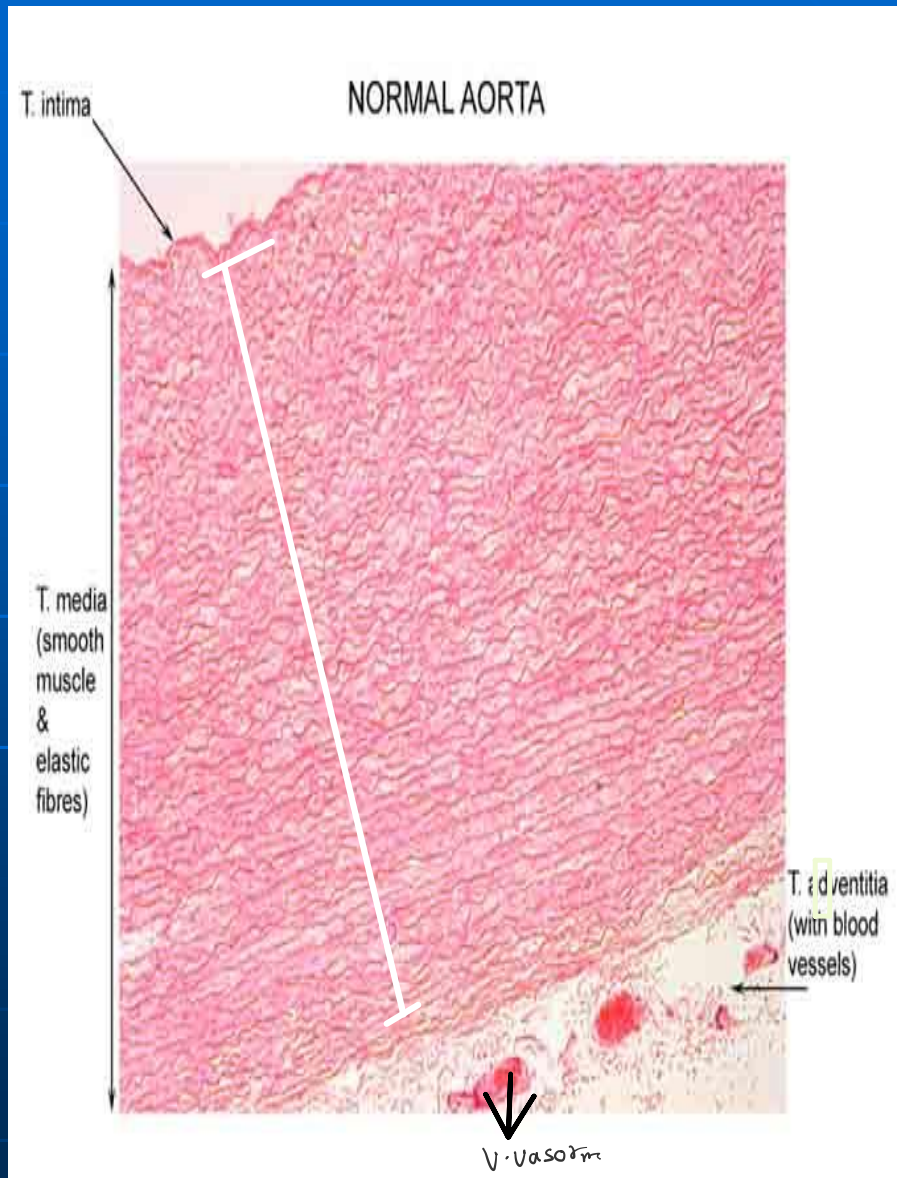
N.B.: the fenestrae in the elastic laminae are important to facilitate the diffusion of substances through the arterial wall.

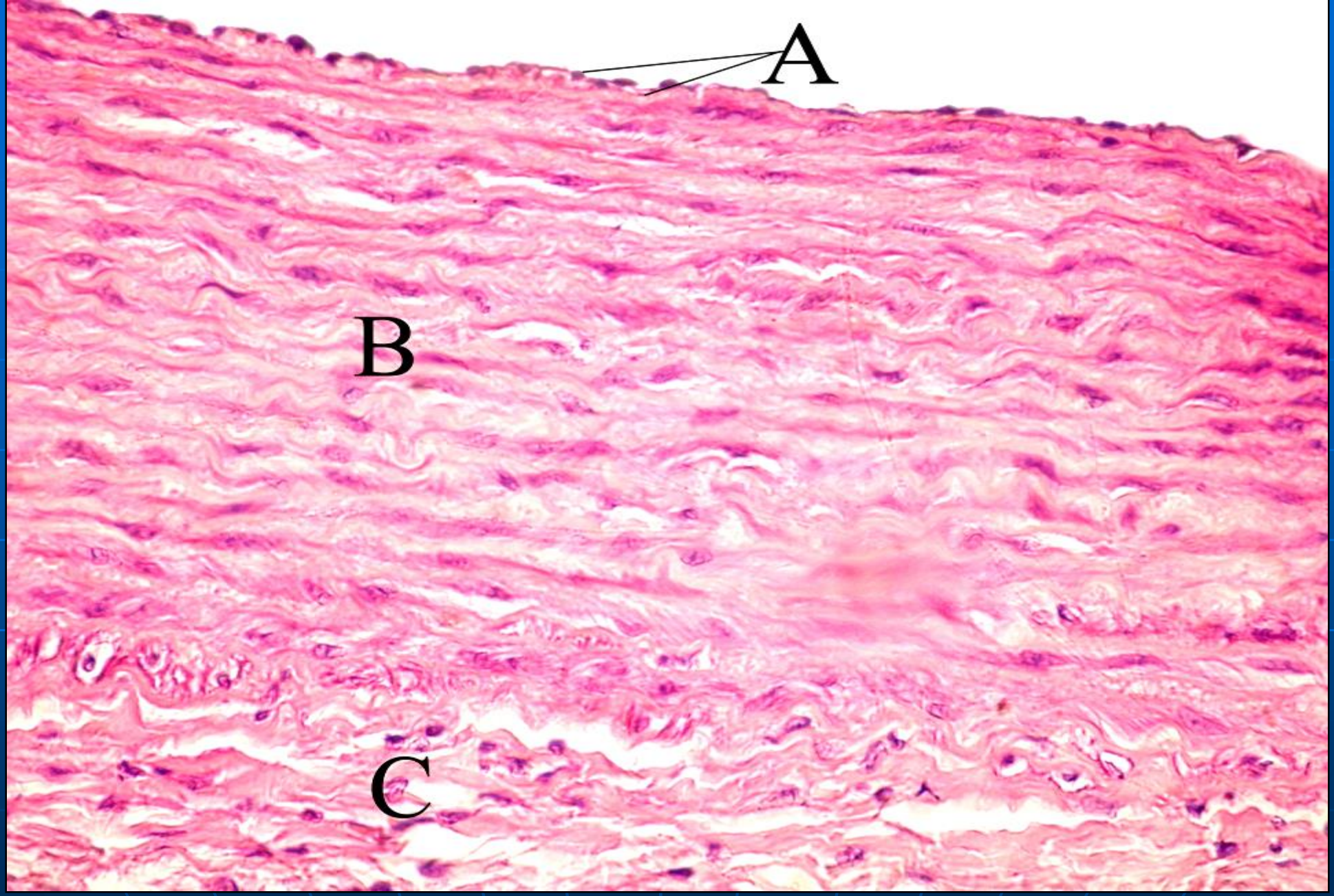
- **Smooth muscle fibers, alternating with the elastic membranes (which is responsible for production of elastic f. and ground substance**
- **Collagen fibers are found between elastic f.**
- **External elastic lamina cannot be differentiated from those of the media.**

3-Tunica Adventitia:

Thin coat, formed of loose C.T., in which:

- longitudinally arranged Collagen & elastic f. are found,
- Containing vasa v.
- Lymphatics and nerves
- are present.

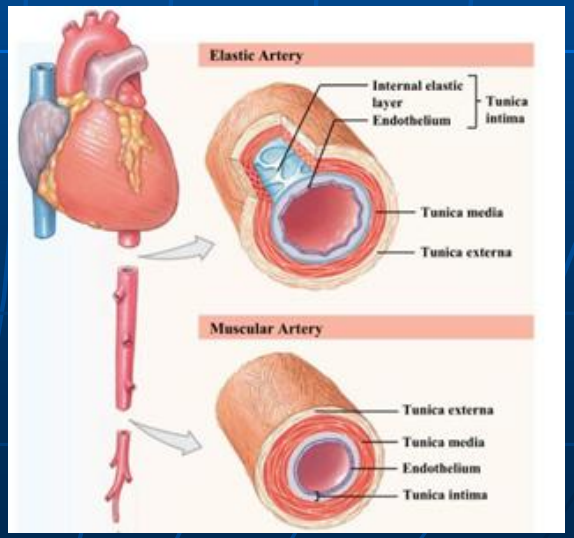




Large elastic (aorta) artery

II-Medium-Sized (Muscular) Arteries:

- The most common type
- Their wall is formed mainly of smooth muscles regulate blood flow to organs.
- Transition from elastic to muscular arteries is not abrupt; there is gradual reduction in elastic f. and increase in smooth muscles.



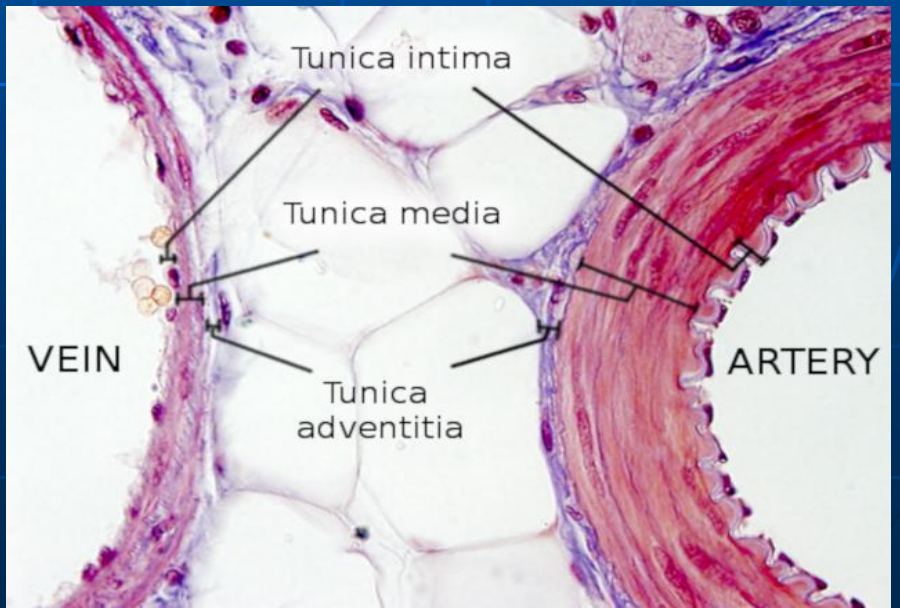
1-Tunica Intima:

thinner than in elastic arteries.

a. **Endothelium.**

b. **Subendothelium:** thin layer of C.T., may contain smooth muscle fib.

c. **Internal elastic lamina:** is very prominent, well developed and appears as a wavy pink line in H & E sections.



2- Tunica Media:

- Thick layer of concentrically arranged smooth muscle fibers (from 4 layers in small arteries, up to 40 layers in large muscular arteries).
- Elastic and fine collagen fibers (reticular) are found scattered between the muscle fibers.

- **External elastic lamina:**

Present in large muscular arteries between media and adventitia as condensed elastic fibers.

3- Tunica Adventitia:

- **Its thickness is less than the media.**
- **Formed of longitudinal collagen and elastic fibers and fibroblasts.**
- **Nerves, lymphatic and vasa vasorum in large ones.**

تتكون صوصوة أحياناً.

Type	Large Elastic Arteries	Medium-Sized Muscular arteries
site	Aorta & its large branches, pulmonary	Most muscular and organ arteries.
Tunica intima	Thicker. IEL is not prominent	Thinner. Prominent IEL.

All-3-layers thick is more in large

Tunica media 	**Mainly elastic lam.** **Smooth muscle.** **Ill defined external elastic lamina**	**Mainly smooth M. Elastic and collagen fibers in-between.** **External elastic lamina is defined.**
Tunica adventit	**Presence of vasa vasoru**	**No vasa vasorum**

Veins

- Carry bl. from tissues and return it to heart.
- Veins start as post capillary venules, muscular, then large veins.

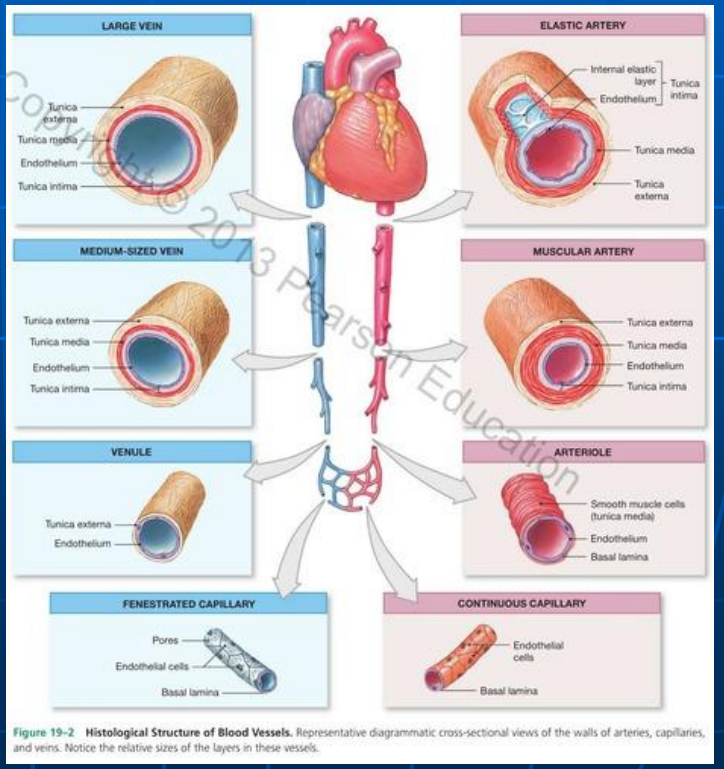


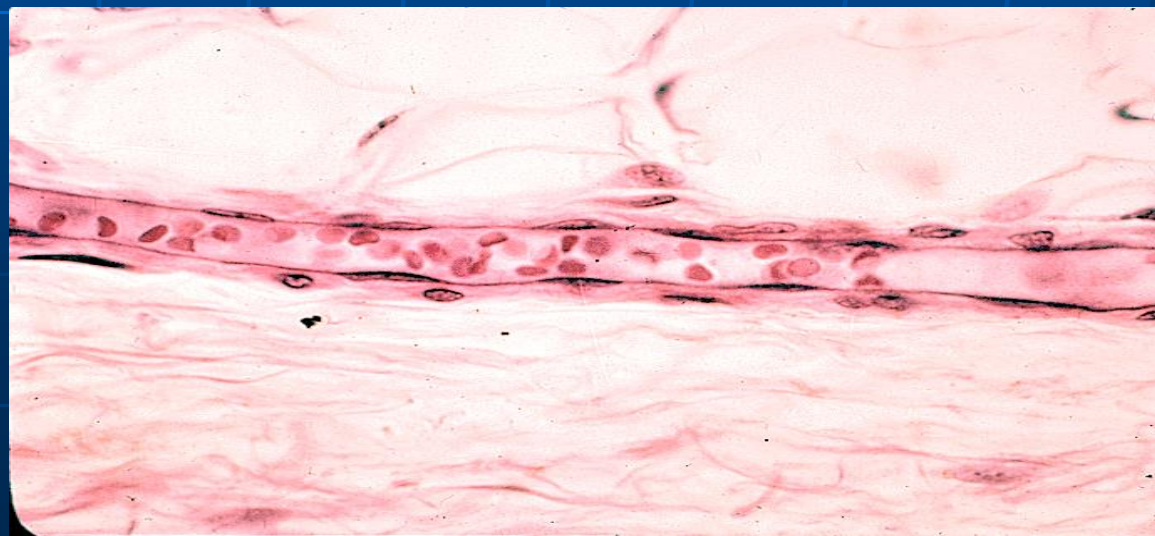
Figure 19–2 **Histological Structure of Blood Vessels.** Representative diagrammatic cross-sectional views of the walls of arteries, capillaries, and veins. Notice the relative sizes of the layers in these vessels.

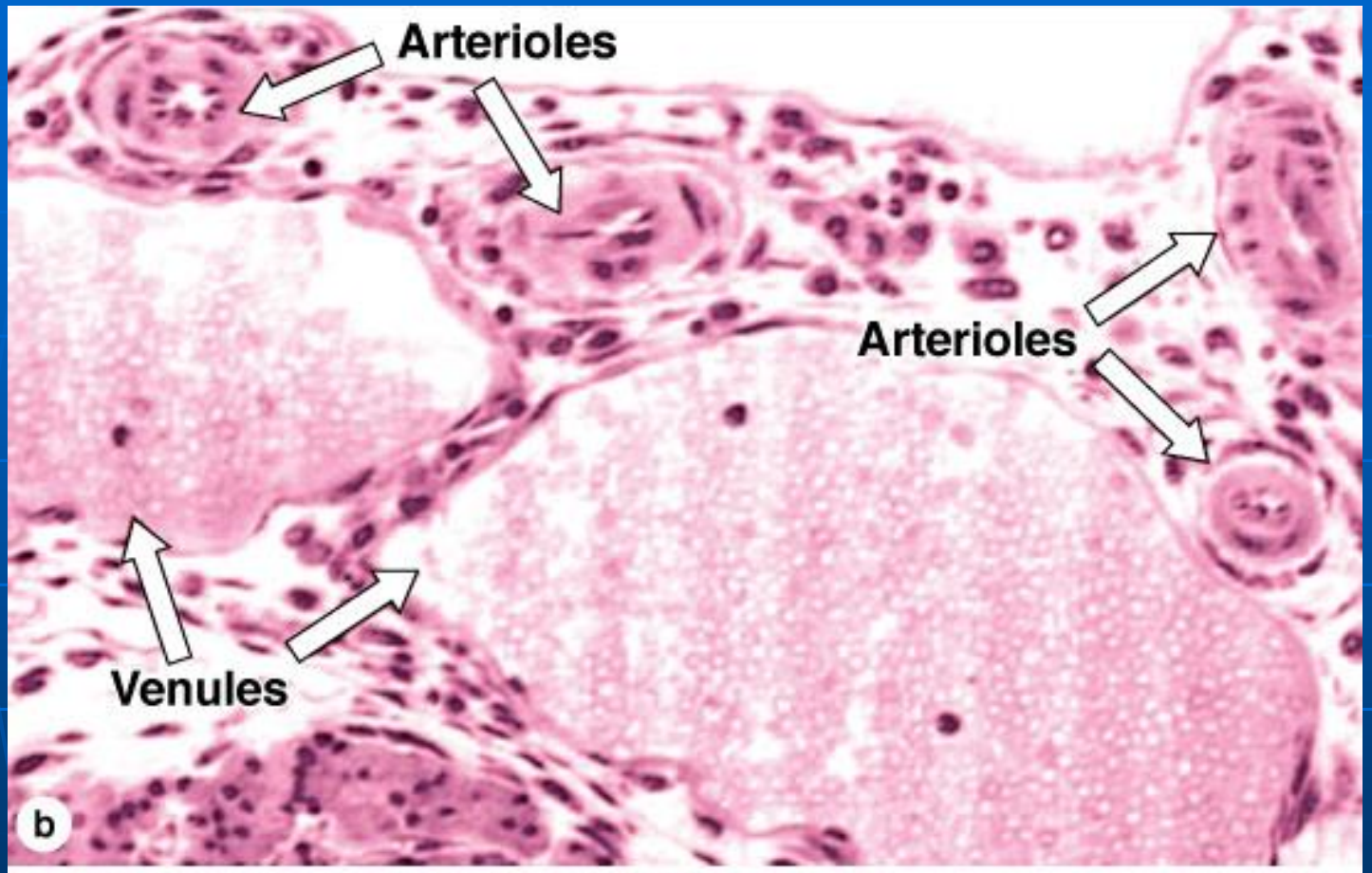
1- Small veins (venules): Smallest veins into which capillaries drain

- **They have very thin walls.**
- **T. Intima: endothelium rich in actin filaments, rests on thin basal lamina**
- **T. Media: contains pericytes and reticular fibres. Few smooth m. differentiate from pericytes start to appear as diameter increases, then called muscular venules.**

- **T. Adventitia:**
- relatively thick

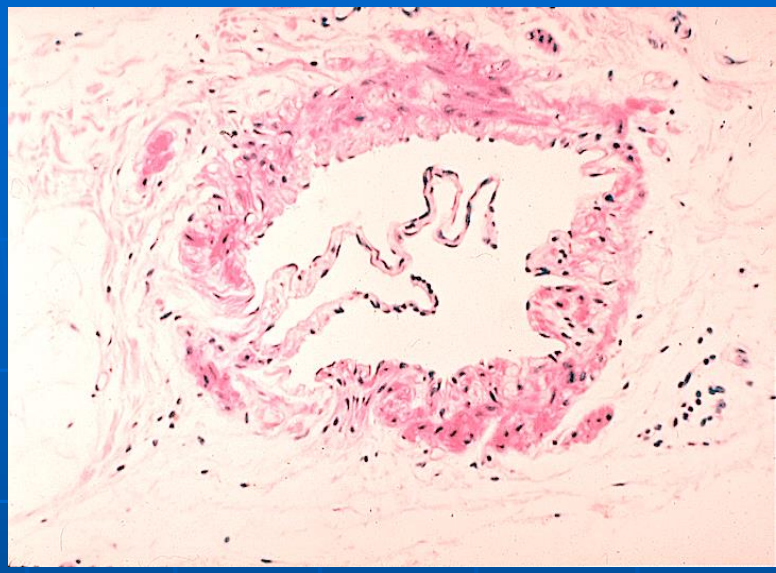
N.B. Exchange of materials between blood and tissues occurs in capillaries and in postcapillary venules





Source: Mescher AL: *Junqueira's Basic Histology: Text and Atlas, 12th Edition:* http://www.accessmedicine.com

2- Medium-sized (muscular) veins:



T. Intima:

- Endothelium.
- Thin subendothelium:

C.T.

with no elastic fibers.

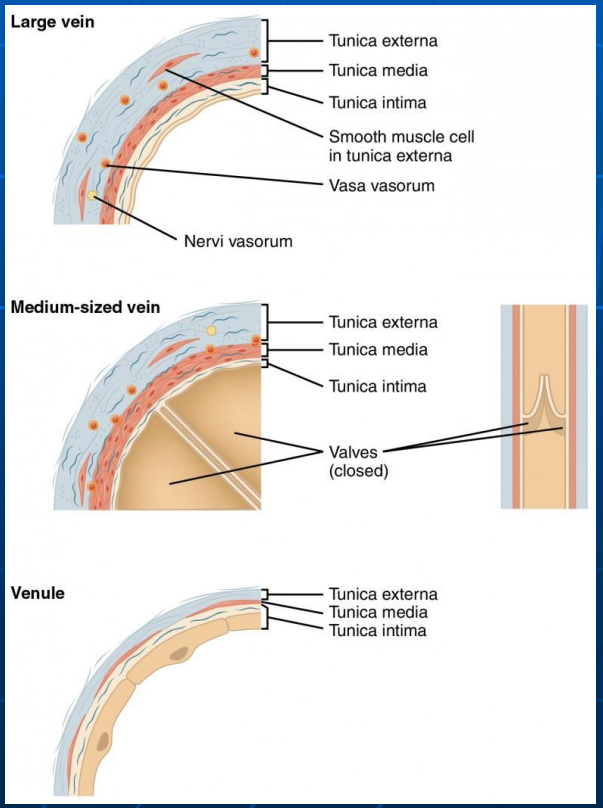
No IEL.

- Endothelium projects into the lumina to form valves. Valves are semilunar folds that project from the intima into the lumina, lined from both sides by endothelium. Their core is formed of elastic tissue.

- Valves are absent in small veins, and large veins.
- T. Media: Thin, formed mainly of small bundles of smooth muscles, circularly arranged, separated by longitudinally arranged collagen fibers and fibroblast in-between, but poor in elastic fibers.

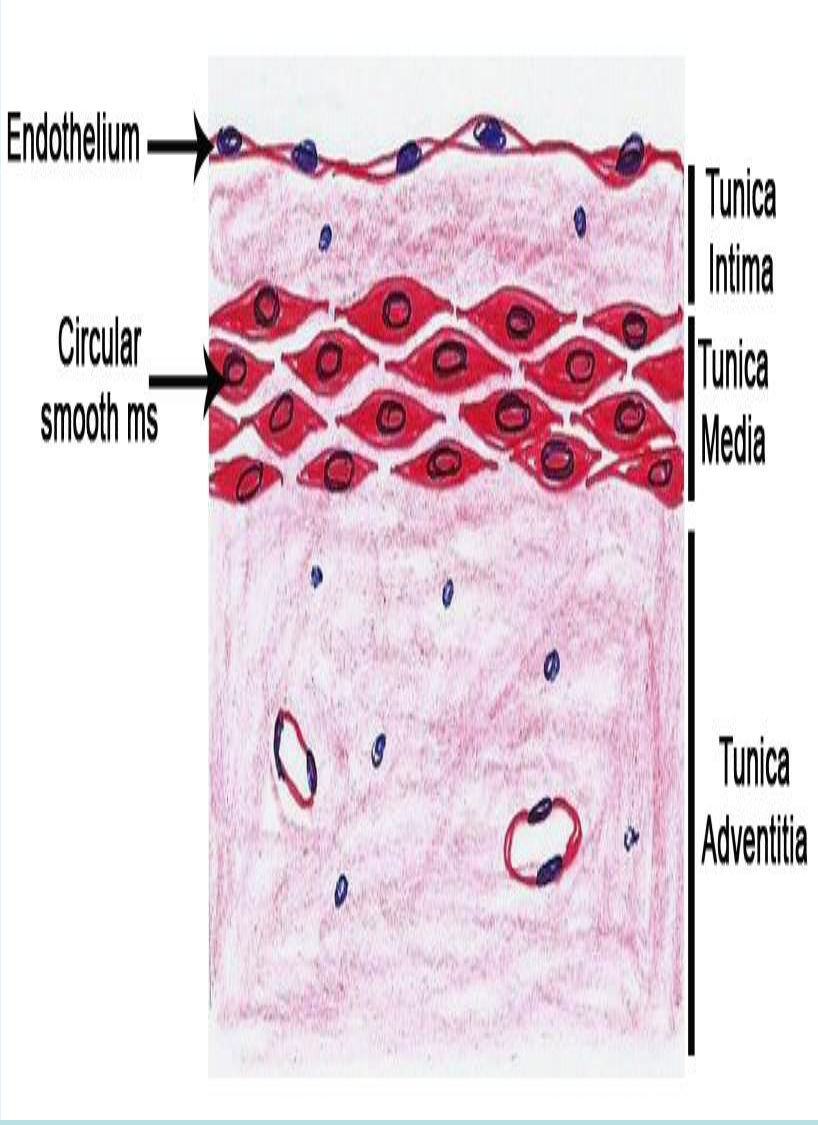
T. Adventitia: the thickest layer, loose C.T., rich in collagen fibers which are mostly longitudinally arranged. In large ones vasa vasorum are found, as the blood passing in these veins has a low O2 tension.

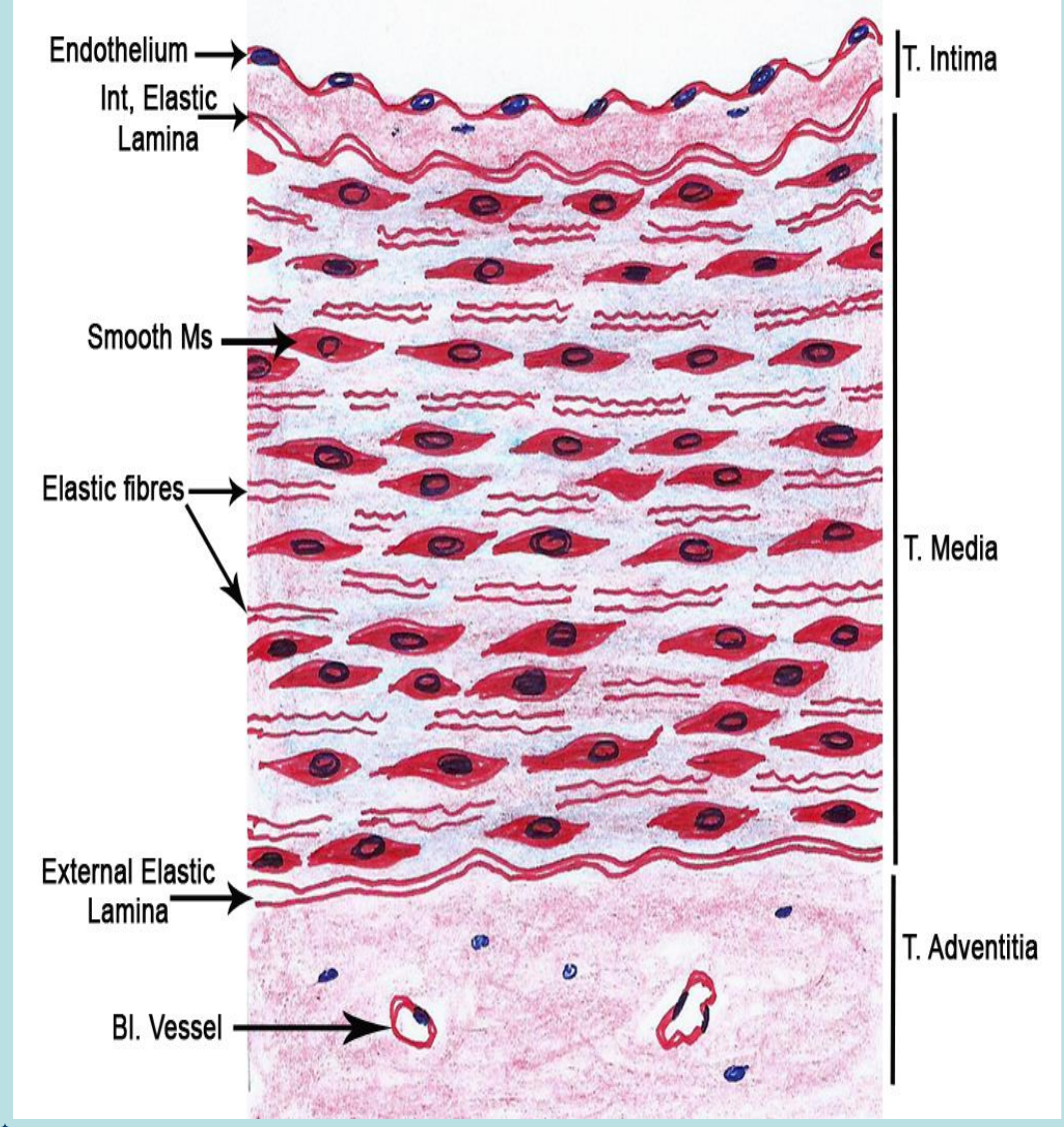
Large + Medium size vein



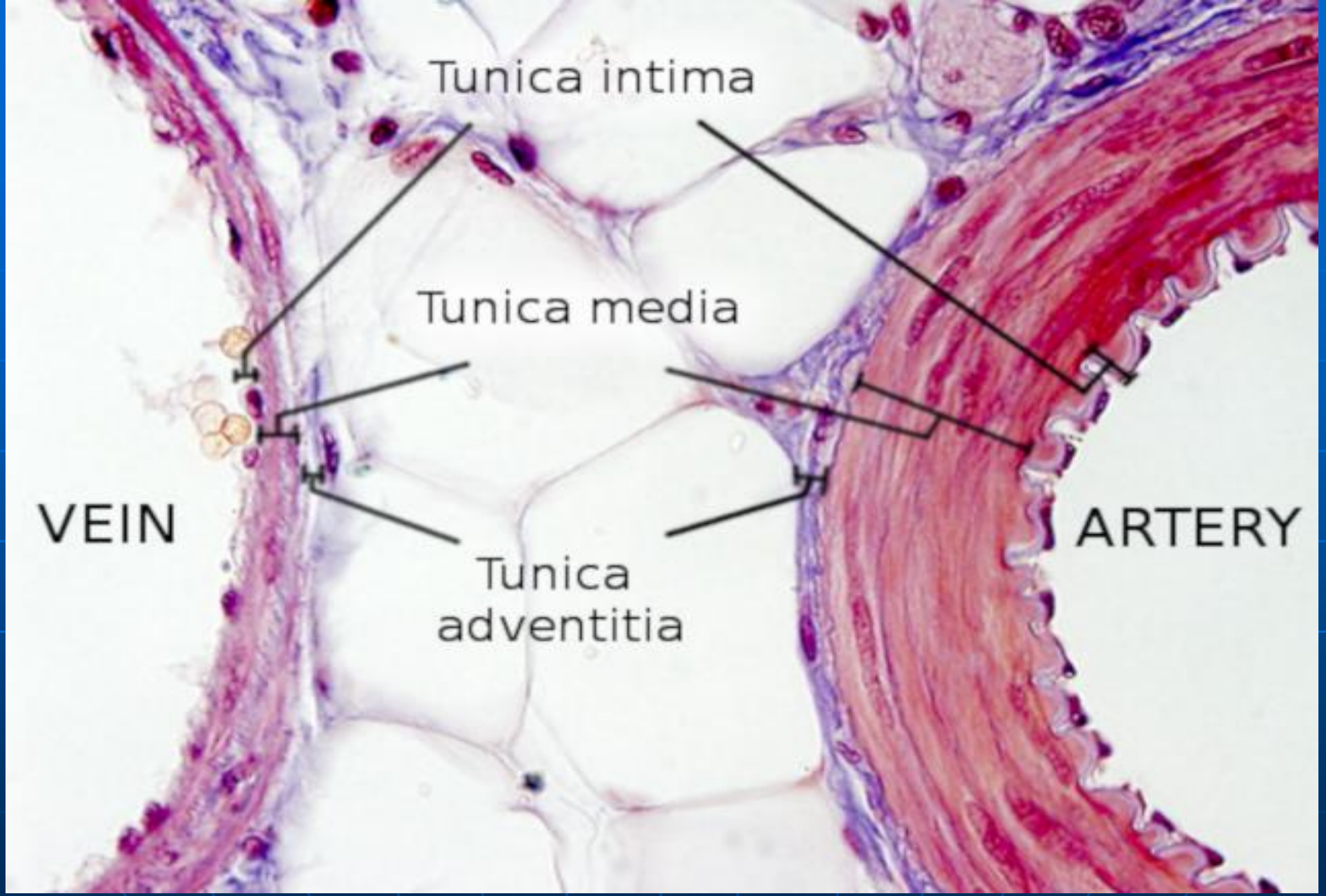
Medium-sized Artery	Medium-sized Vein
Thick wall and narrow lu	Thin wall and wide L
The lumen is rounded, doesn't collapse	The lumen collapses after death
It has no valves	It has valves
The lumen contains no blood after death	The lumen contains blood after death
T. Intima is thick, folded, rich in elastic fibers, has a clear internal elastic l.	thin, not folded, poor in elastic fibers, has no internal elastic lamina

Medium-sized Artery	Medium-sized Vein
T. Media is thick, made of smooth muscles and elastic fibers	T. media is thin, made of smooth muscles poor in elastic fibers
External elastic lamina may be present in between the media & adventitia or absent	It has no external elastic lamina
T. Adventitia is thin, rich in elastic fiber	T. Adventitia is thick, rich in collagen fibers
It has a rapid flow of arterial blood	It has a slow flow of venous blood

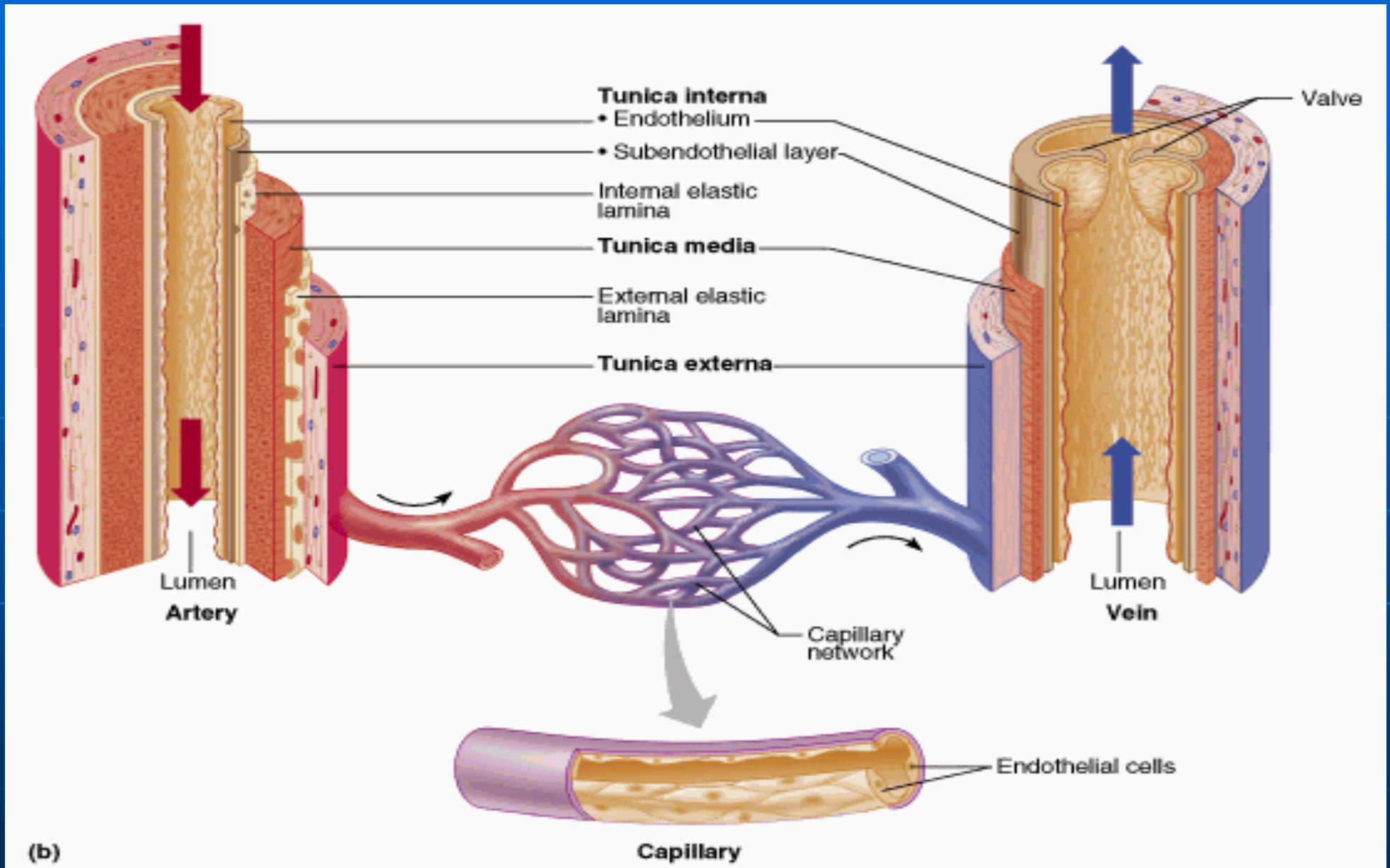


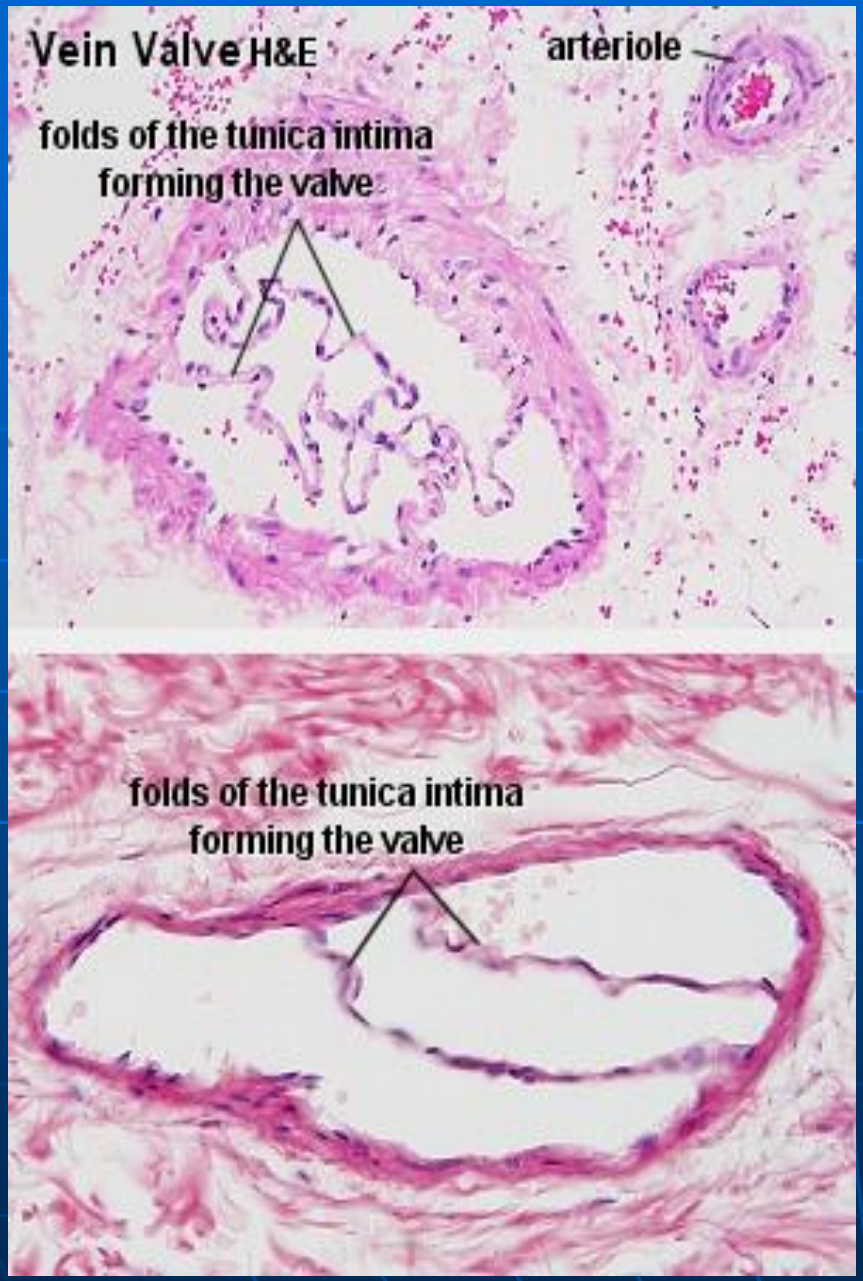


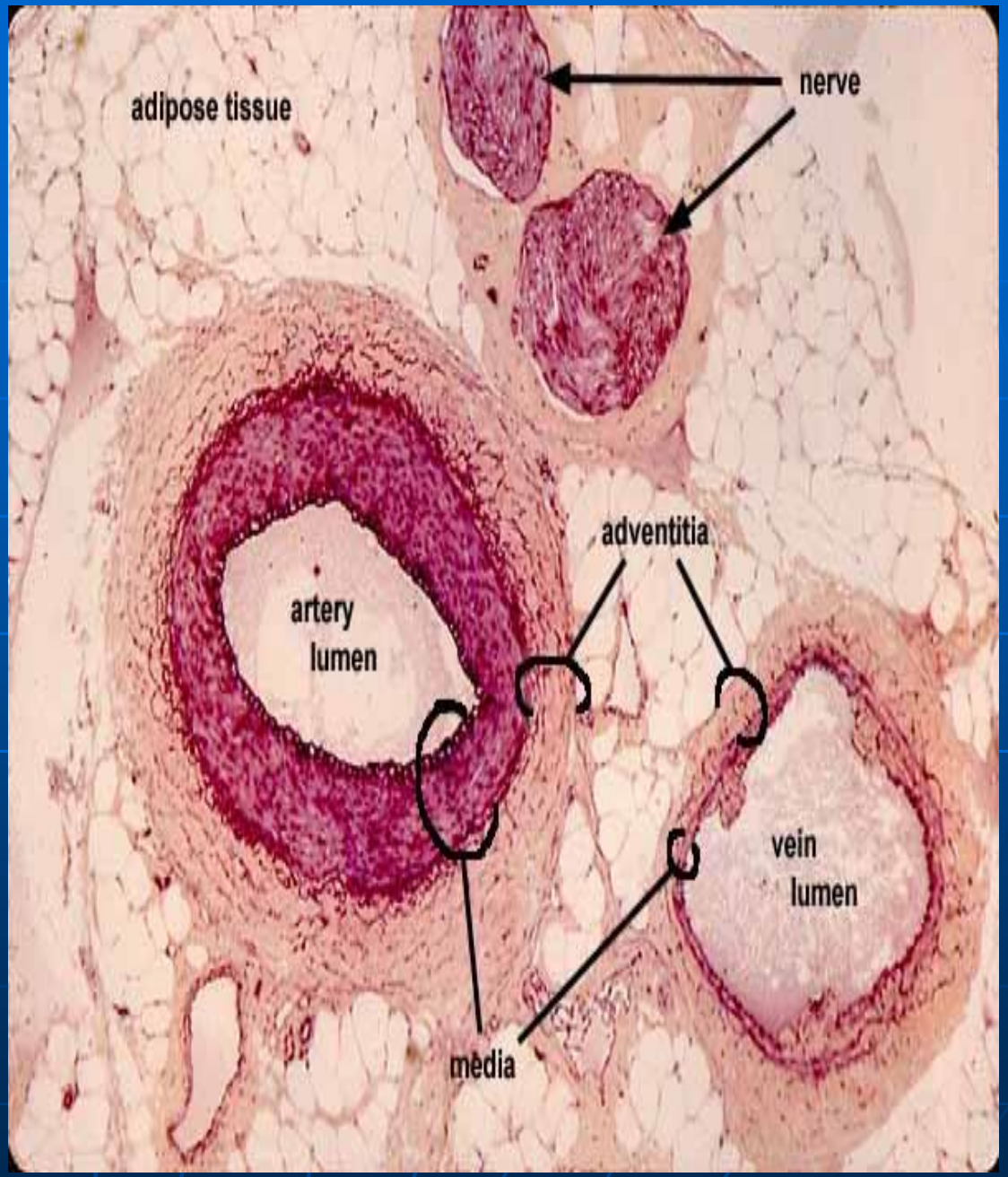
Medium sized vein Medium sized arter



Medium sized artery and vein




Vein Valve H&E
arteriole
folds of the tunica intima
forming the valve
folds of the tunica intima
forming the valve


adipose tissue
nerve
adventitia
artery
lumen
vein
lumen
media

3- Large veins

Has a thick wall and a wide lumen.

Inferior vena cava is the best example.

- **T. Intima:** well developed, no IEL, no valves

- **T. Media:** thinner than arteries, few smooth m. and abundant C.T., poor in elastic fibers.

T. Adventitia: thickest layer, it is formed of loose C.T. that contains longitudinal bundles of smooth muscle fibers and elastic fibers. These fibers facilitate elongation and shortening of the vena cava with respiration.