



Arteries

Classification of Arteries

Elastic (conducting) arteries: Aorta, Brachiocephalic, Common carotid, Subclavian, Common iliac and pulmonary trunk.

Muscular: femoral, brachial, radial.....

Arterioles

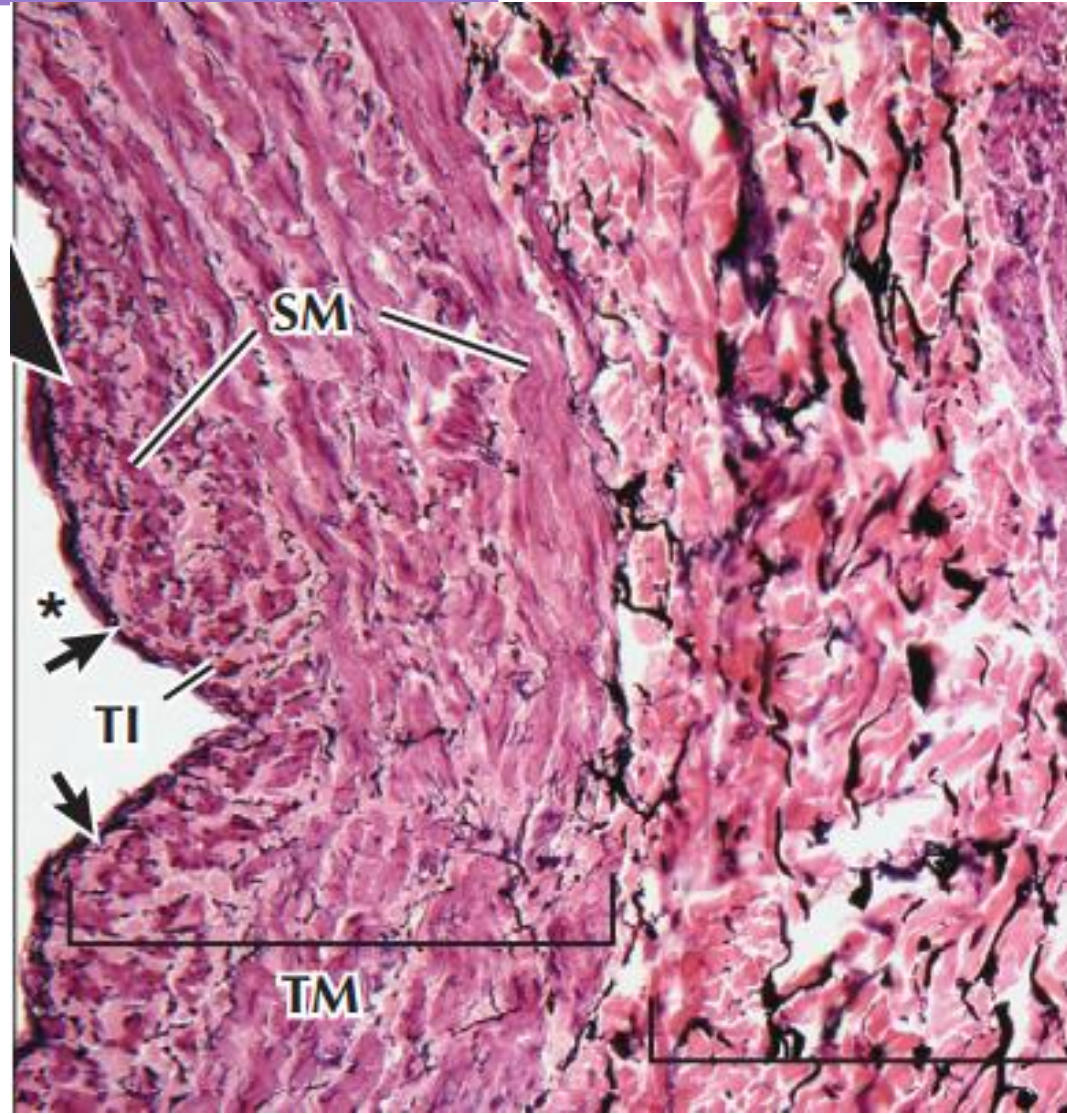


The transition
from one type
of arteries to
another is
gradual.

Elastic Arteries

Tunica intima

- **Simple squamous epithelium**, made of one layer of endothelial cells. The endothelium rests on a basal lamina
- **The subendothelial layer** of connective tissue consists of a delicate, interlacing network of collagen and elastic fibers.
- **The internal elastic lamina** is **indistinct** because the innermost elastic lamina of the media blends with adjacent laminae, without clear distinction between them



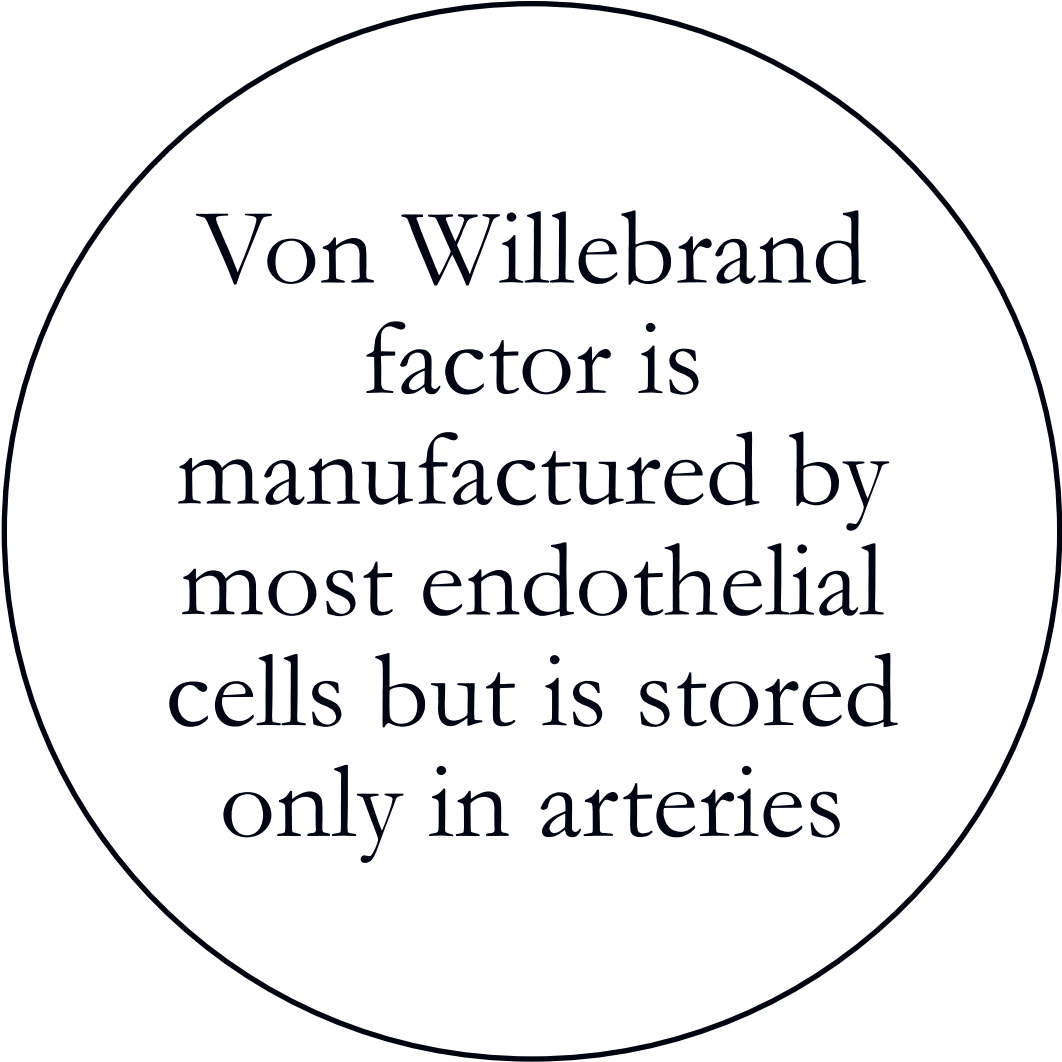
Elastic Arteries ... Tunica media

Tunica media consists of many fenestrated lamella of elastin.

The number of elastic lamella increase with age (35-70).

The extracellular matrix is secreted by smooth muscles.

A fenestrated external elastic lamina is present; it allow diffusion of nutrient from the adventitia to the media.



Von Willebrand
factor is
manufactured by
most endothelial
cells but is stored
only in arteries

Elastic Arteries Tunica adventitia

It is relatively thin.

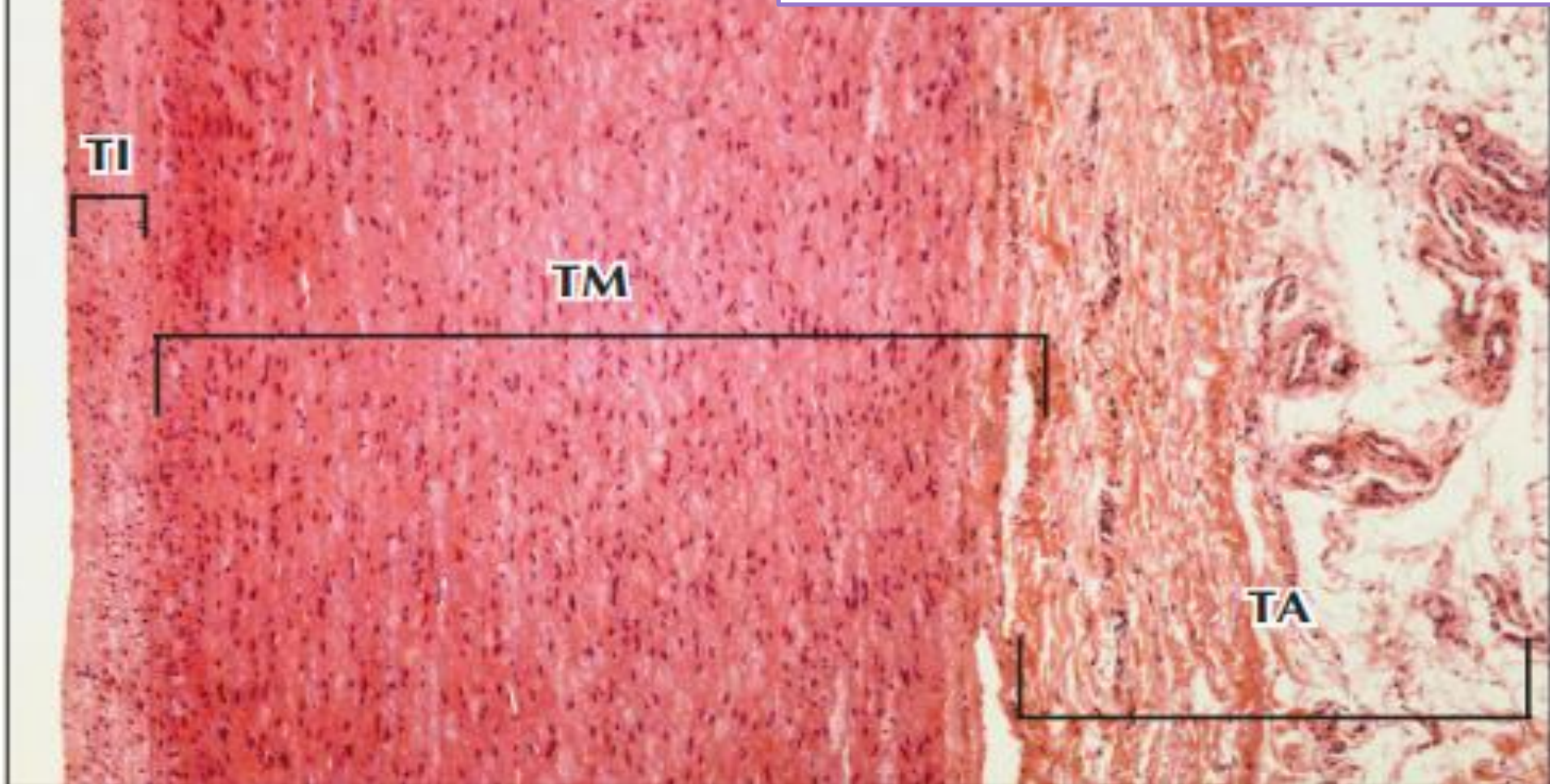
Composed of loose connective tissue.

Contains few scattered smooth muscles.

Vasa vasorum are abundant and may extend to the media.

H&E

Elastic laminae are not easily seen with this stain (H&E) and need special preparative and staining methods for elucidation



LM of part of the **aortic wall**. The **intima (TI)** abuts the lumen (Left). A thick **media (TM)** and an outer **adventitia (TA)** are also shown. Nuclei in the media at this magnification are mostly those of smooth muscle cells. 60×. H&E

Look at the next slide where,

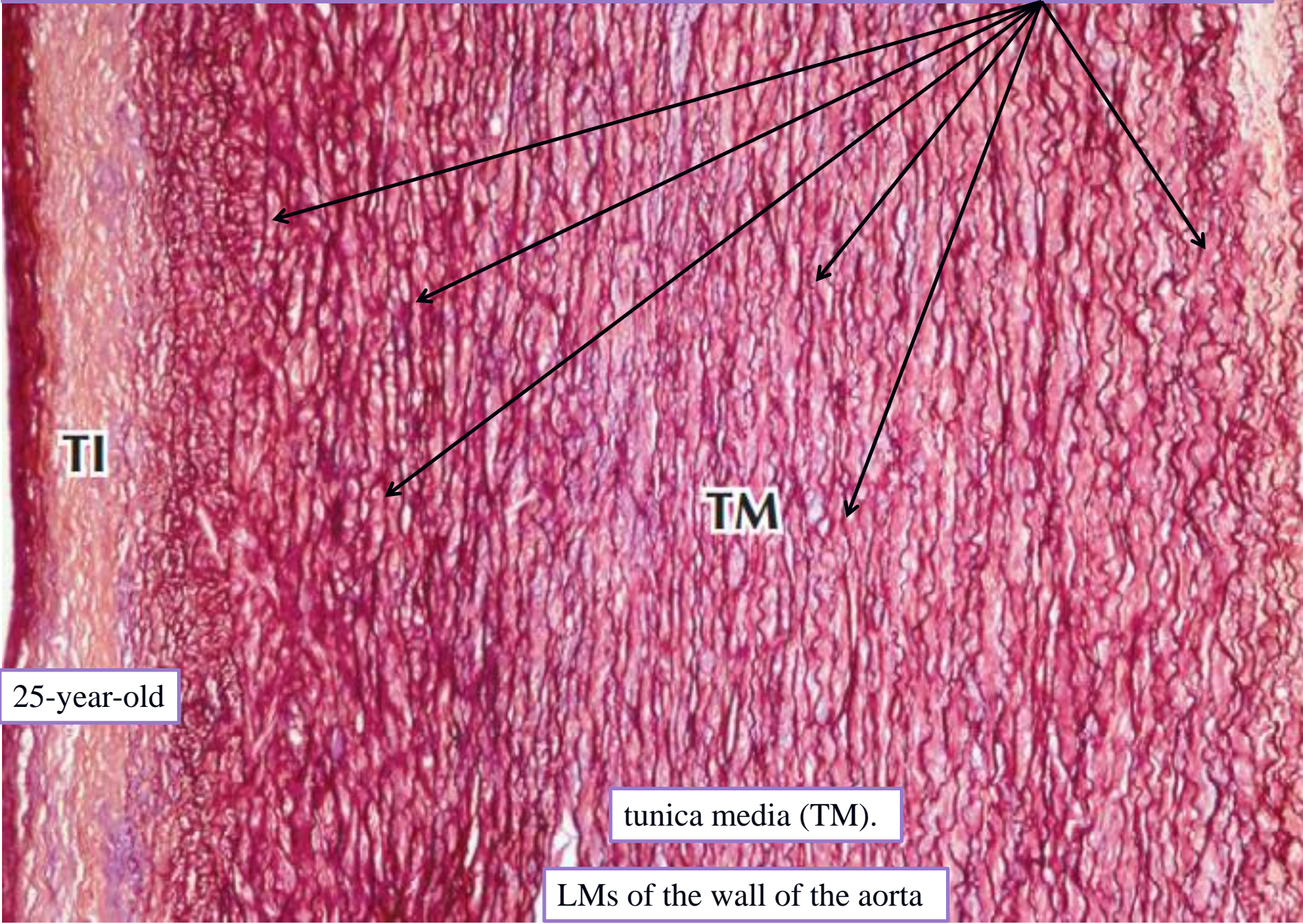


Gomori aldehyde fuchsin a special preparative and **staining methods** have been used
for elucidation of

Elastic fibers



60×. Gomori aldehyde fuchsin. special preparative and staining methods for elucidation of elastic fibers



TI

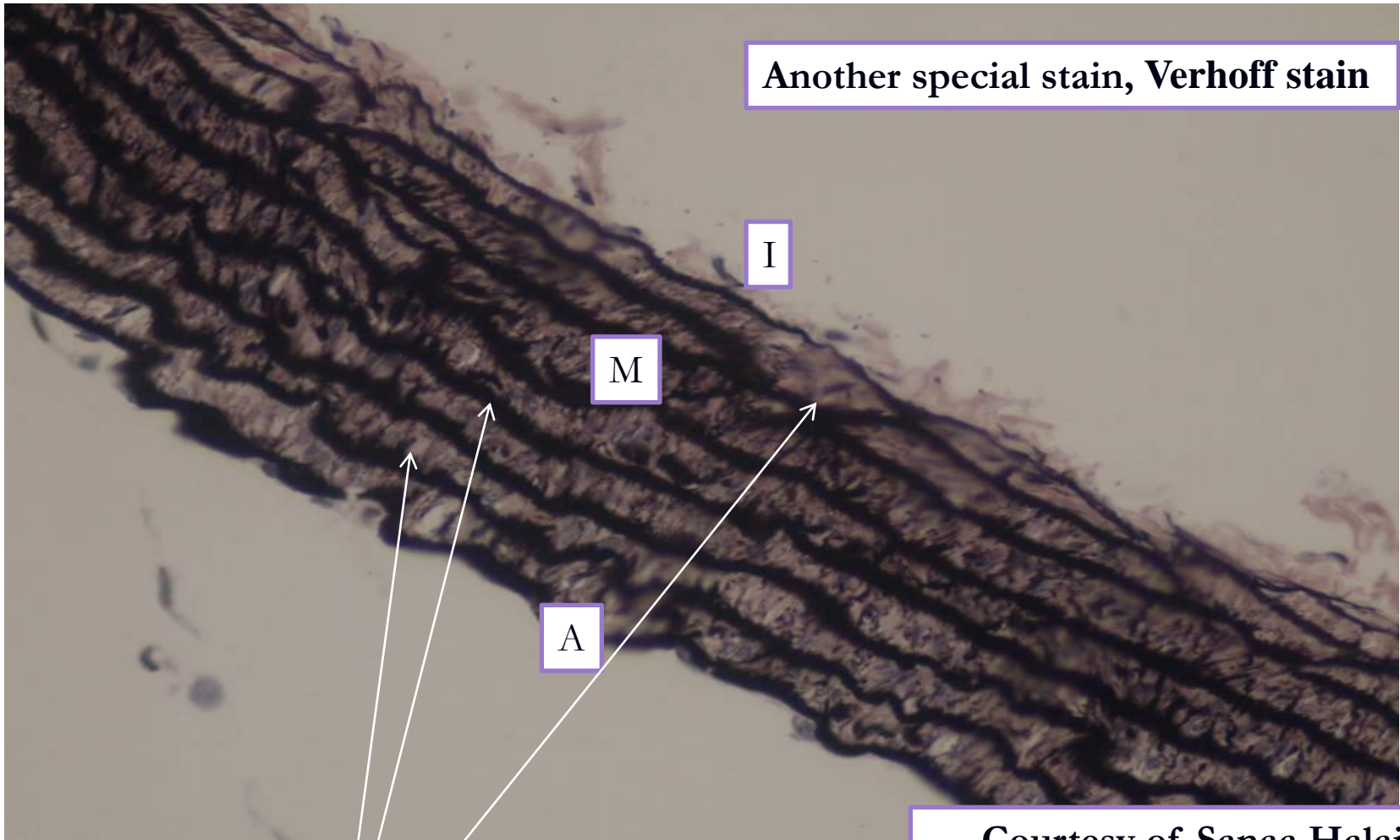
TM

25-year-old

tunica media (TM).

LMs of the wall of the aorta

Another special stain, Verhoff stain



**Transverse section of rat thoracic aorta
stained with Verhoff stain.**

**The darker elastic fibers are prominent
tunica intima(I), tunica media (M), and
tunica adventitia(A). X 400**

Courtesy of Sanaa Halaiqah.
Thesis material
supervised by Dr. Shatarat & Dr.
Badran, 2017.
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In the next slide you would see a comparison between a section of the aorta taken from a newborn and 25 -year-old

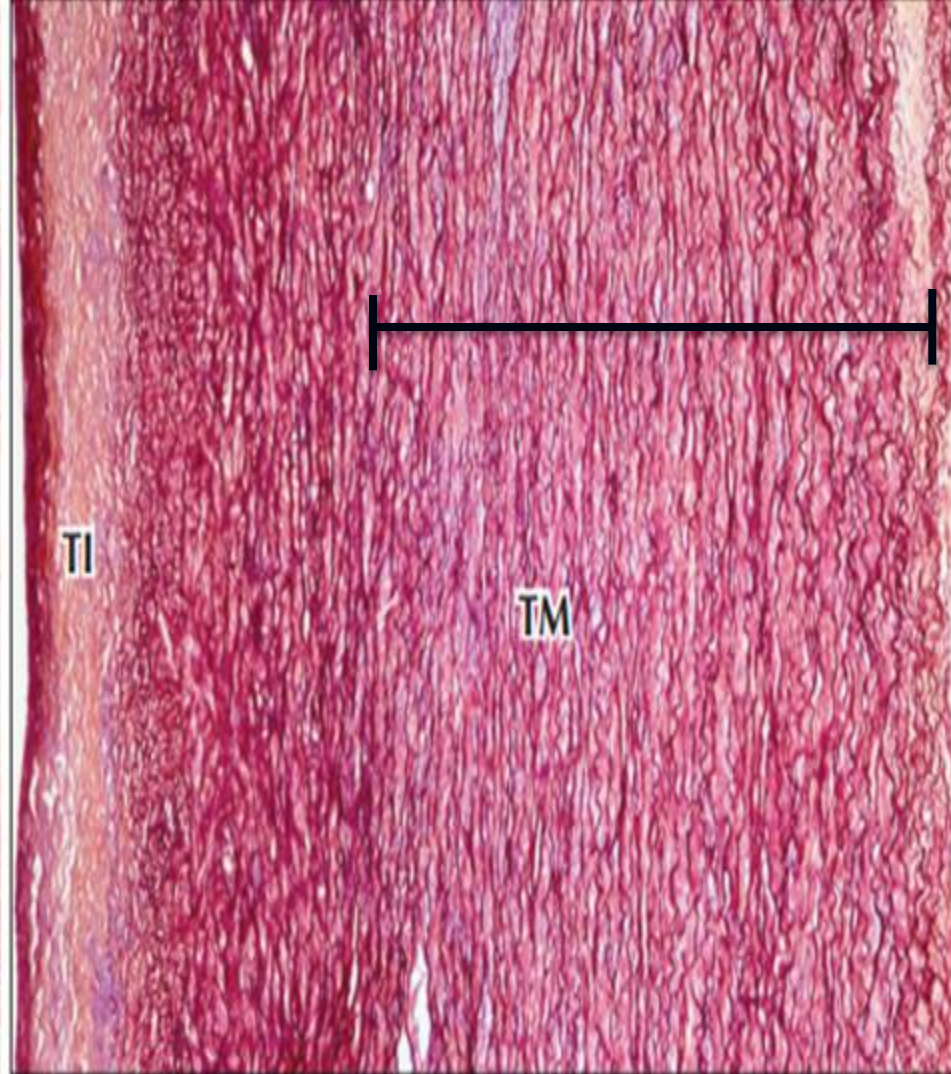
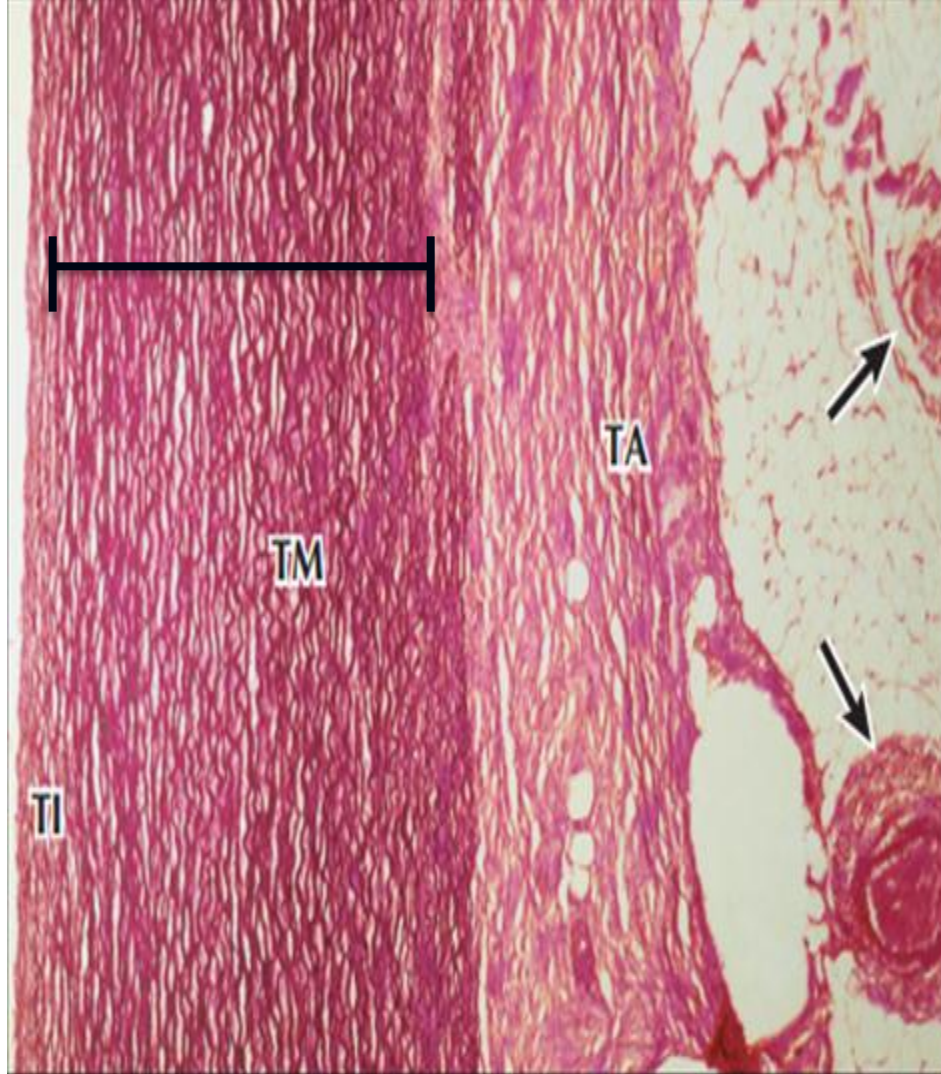


You can see that

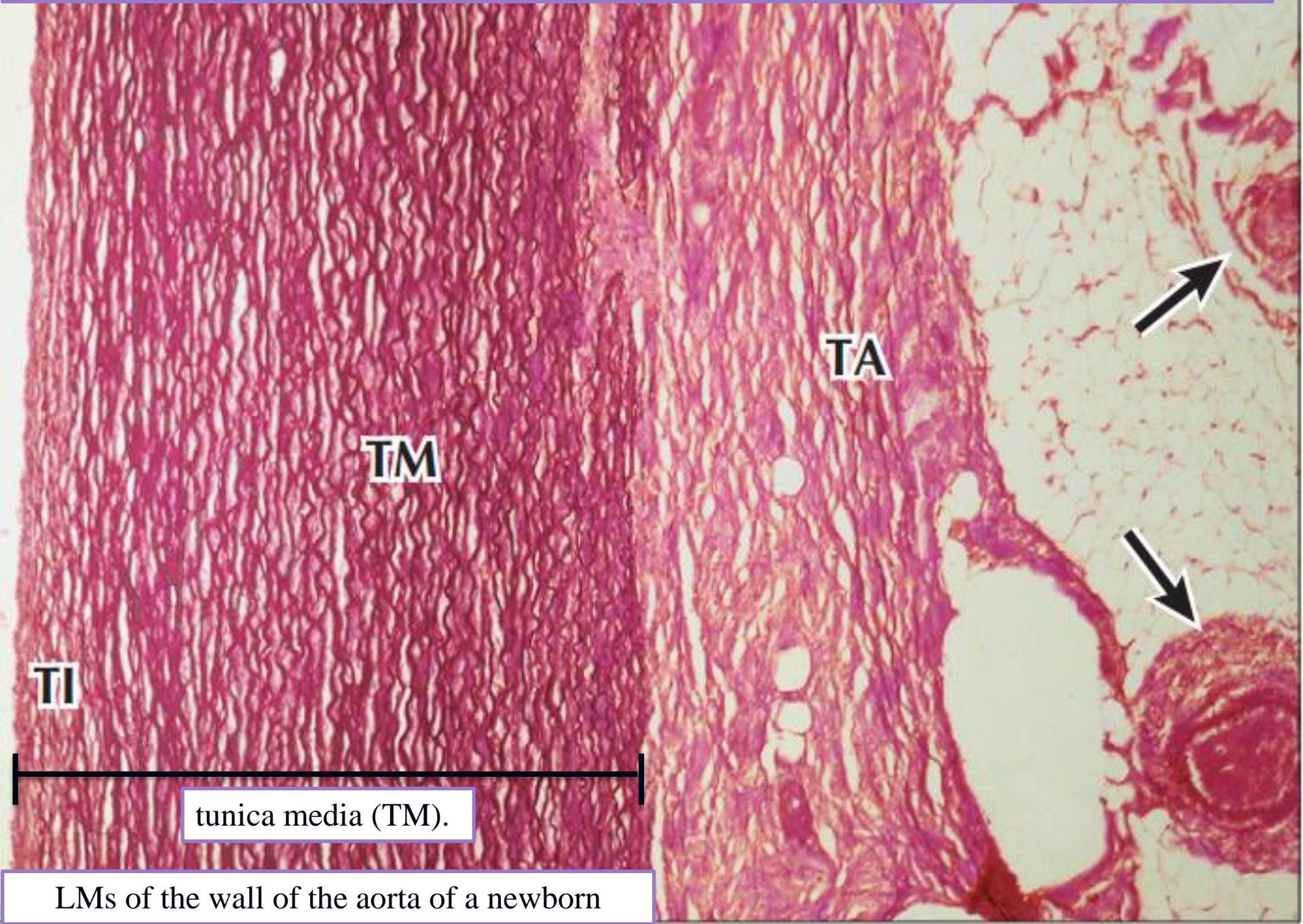


The number of elastic laminae —the dark, wavy bands—increases with age

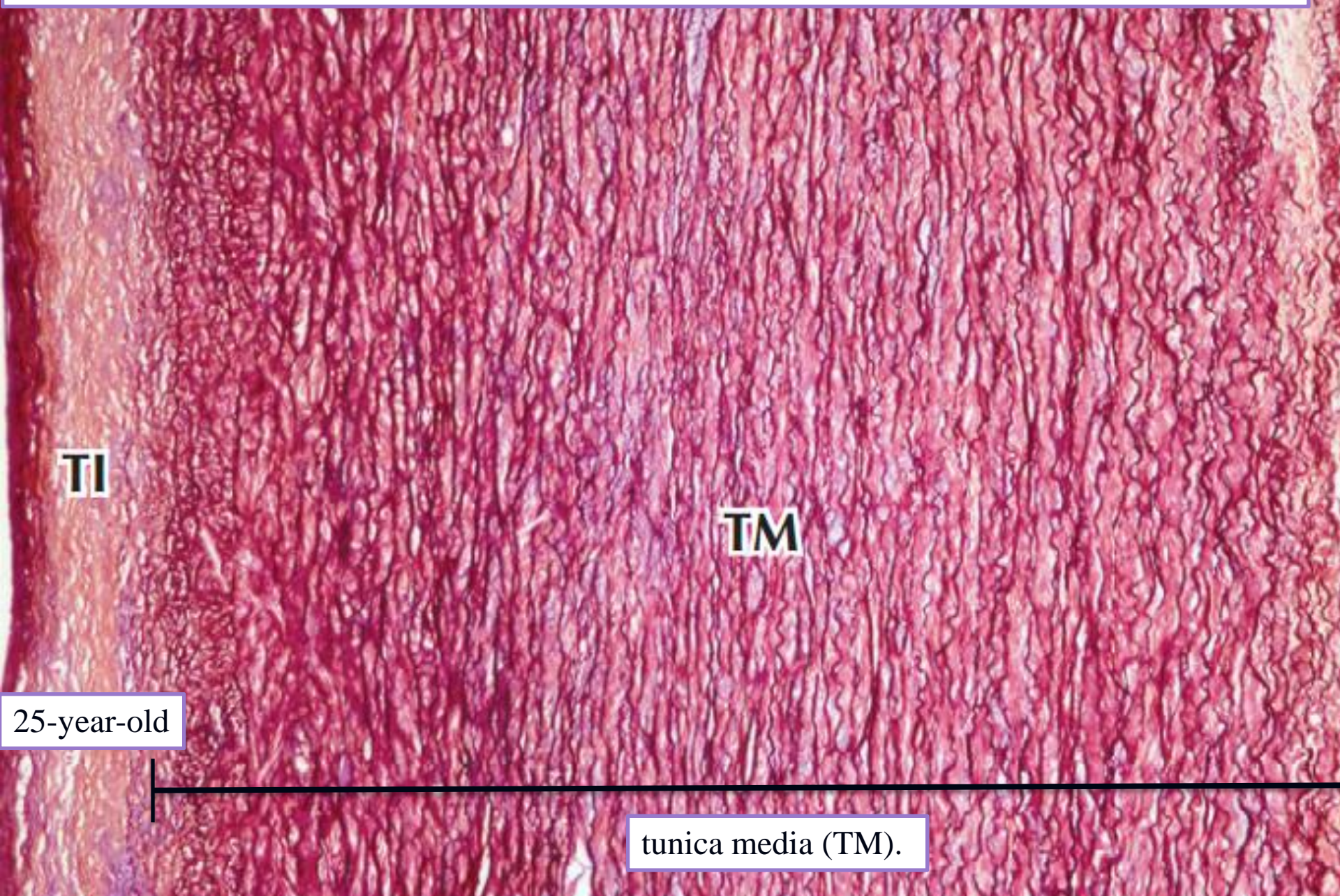




Comparative LMs of the wall of the aorta of a newborn (Left) and 25-year-old (Right). In both vessels, a relatively thin tunica intima (TI) merges with a prominent tunica media (TM). This stain specifically demonstrates elastic tissue, a prominent feature of these arteries. **The number of elastic laminae —the dark, wavy bands—increases with age.** Vasa vasorum (arrows) occupy loose connective tissue of the adventitia (TA). 60×. Gomori aldehyde fuchsin.



60×. Gomori aldehyde fuchsin. special preparative and staining methods for elucidation of elastic fibers



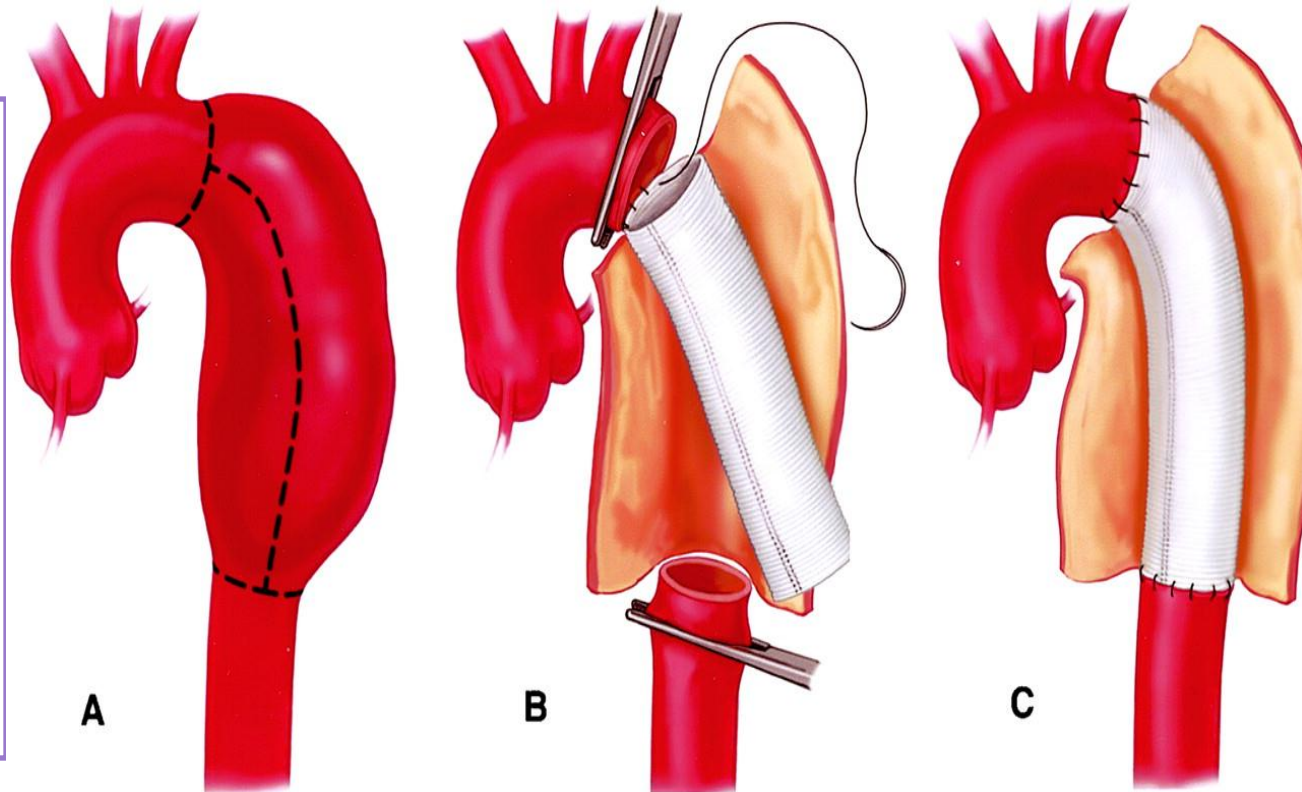
The number of elastic laminae —the dark, wavy bands—increases with age

An aneurysm

- is an abnormal localized dilation in the weakened wall of an artery.
- An aortic aneurysm occurs when the diameter of part of the aorta increases by 50% or more.
- A true aneurysm is a large bulge in the wall that consists of all three tunics.
 - Rupture may lead to fatal bleeding in only a few minutes.
 - Atherosclerosis is a major cause of most aortic aneurysms.

Read only

Infection, inflammation, syphilis, and the genetic connective tissue disorder Marfan syndrome also weaken arterial walls, and chronic hypertension induces susceptibility to aneurysms because elevated arterial pressures place undue stress on vessel walls



Muscular Arteries

Muscular Arteries, Tunica intima

thinner than in elastic arteries.

Sub endothelial CT contains few smooth muscles.

Prominent internal elastic lamina, which might be duplicated.

Processes from endothelium pass through fenestrae in IEL and form gap junction with smooth muscles in the media.

Muscular Arteries Tunica media

Tunica media is composed mostly of smooth muscles.

Smooth muscles are circularly arranged.

The number of layers of smooth muscles is 4-40.

Each smooth muscle has a basal lamina.

Other components: type III collagen and chondroitin sulfate.

External elastic lamina is seen in large muscular arteries.

Muscular Arteries, Tunica adventitia

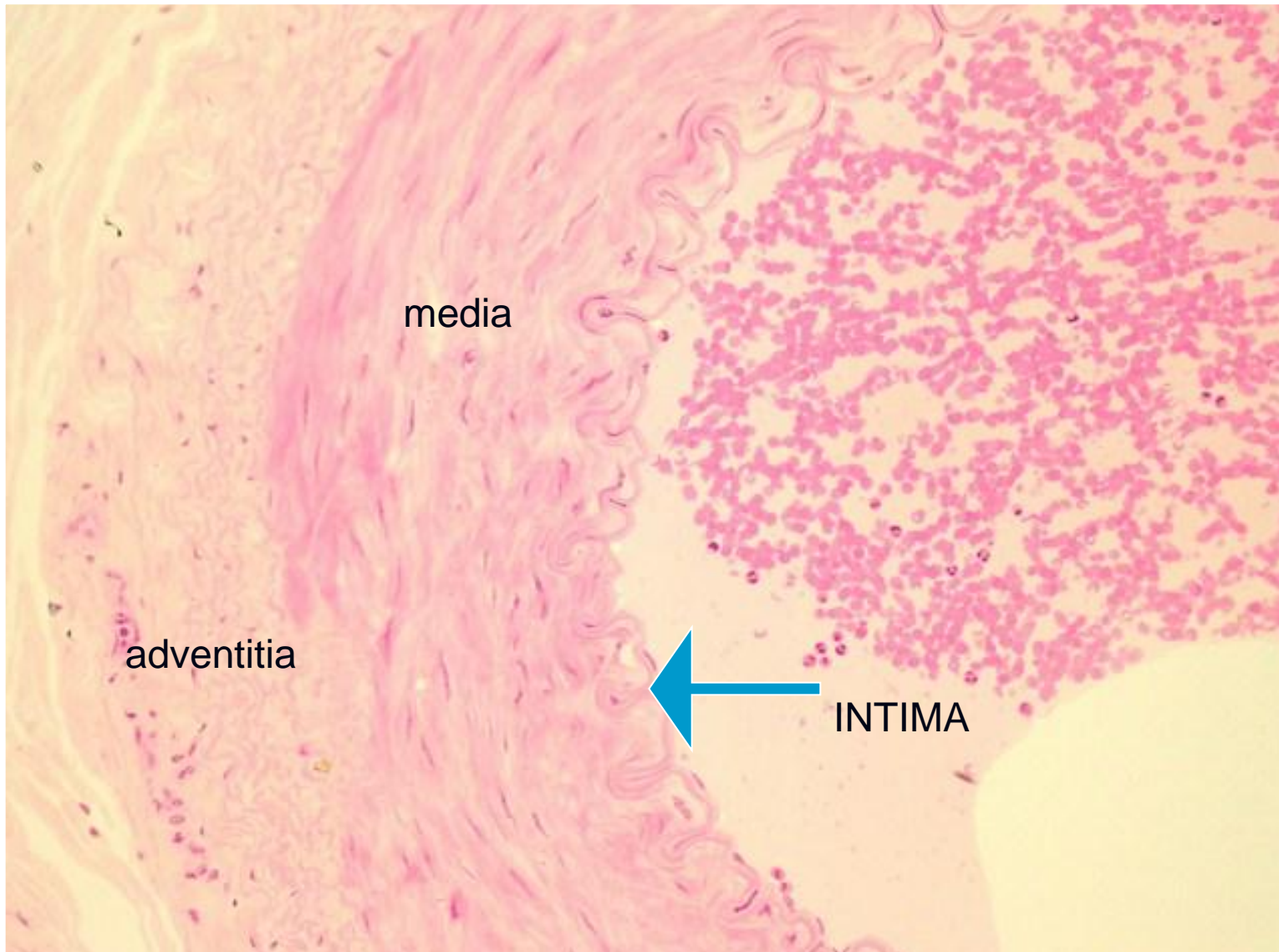
Tunica adventitia contains elastic and collagen fibres.

Ground substance contains dermatan sulfate and heparan sulfate.

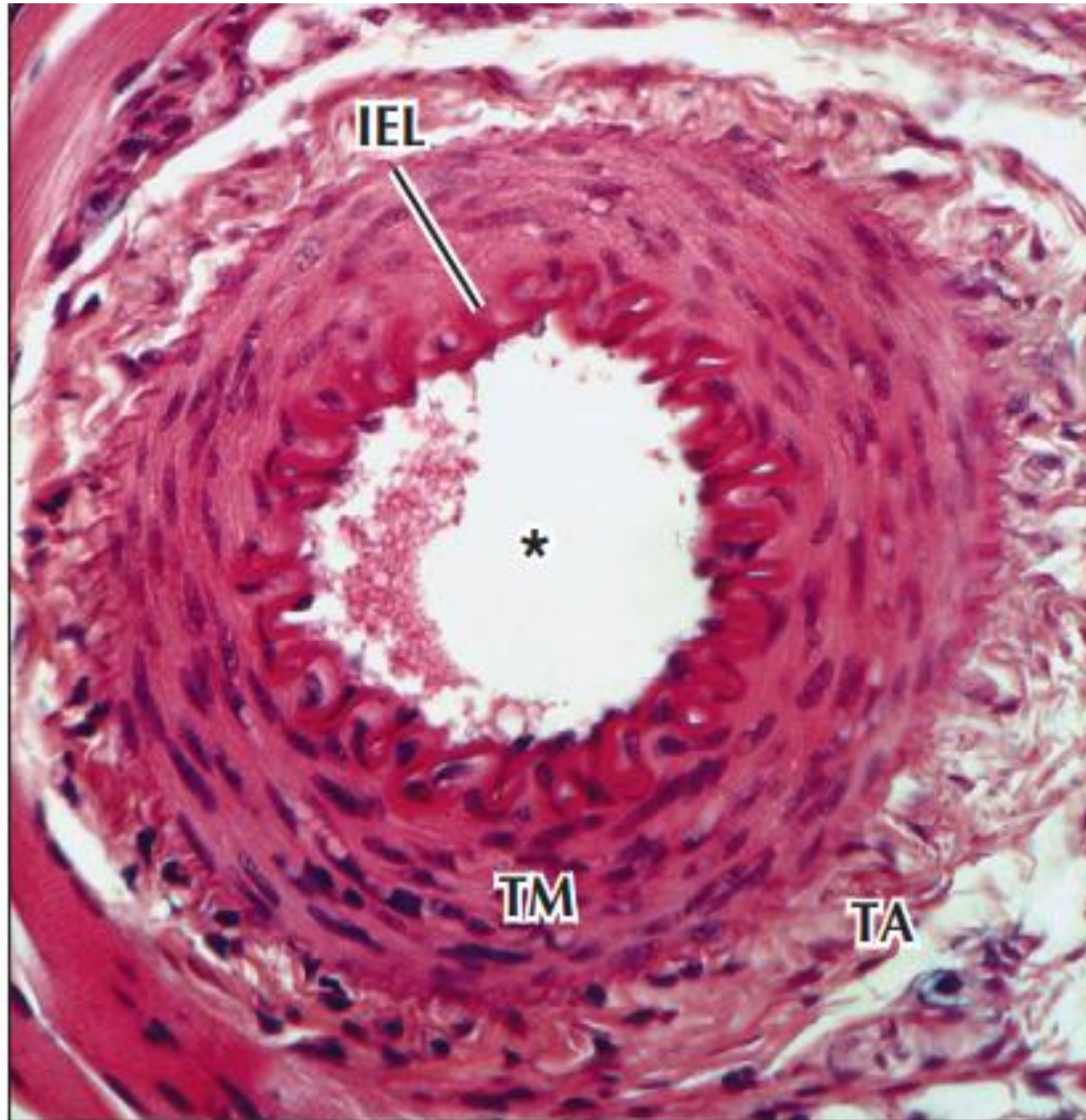
Occasional longitudinal smooth muscles are seen.

Contains vasa vasorum and unmyelinated nerve fibres.

muscular artery



H& E



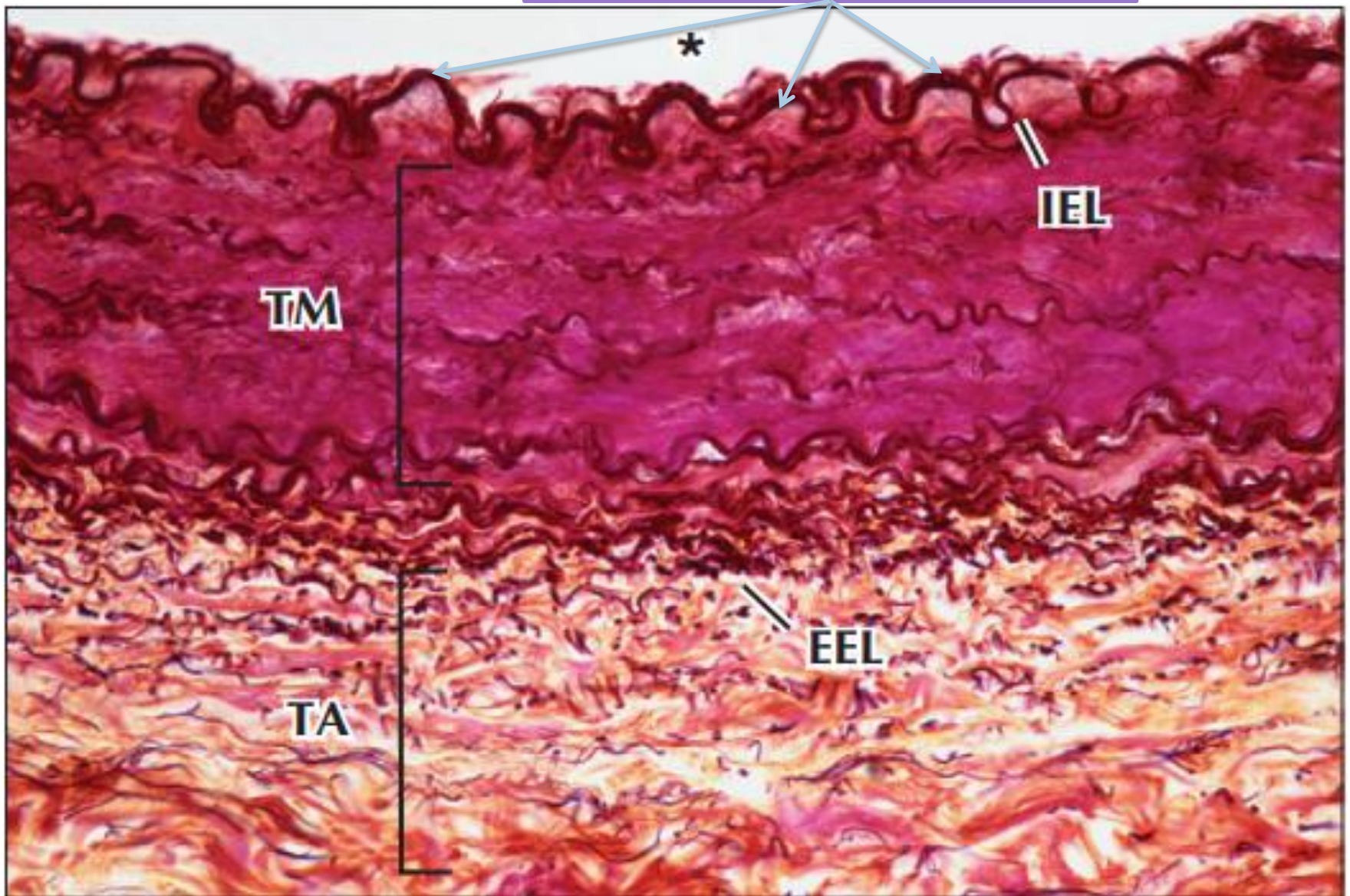
LM of the wall of a muscular artery.

In **this partly constricted artery**, the lumen (*) caliber is small relative to the muscular wall thickness.

A prominent internal elastic lamina (IEL) looks corrugated. Several layers of circular smooth muscle occupy the media (TM); loose connective tissue, the adventitia (TA). 240×.

H&E.

Prominent internal elastic lamina



LMs of the wall of a muscular artery

320×. Gomori aldehyde fuchsin

Specialized Arteries

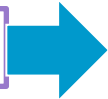
Pulmonary arteries: thin wall due to reduction of muscles and elastic tissue.

Intracranial arteries: thin walls with prominent internal elastic lamina.

Umbilical arteries: media composed of 2 thick muscular layers; inner longitudinal and outer circular.

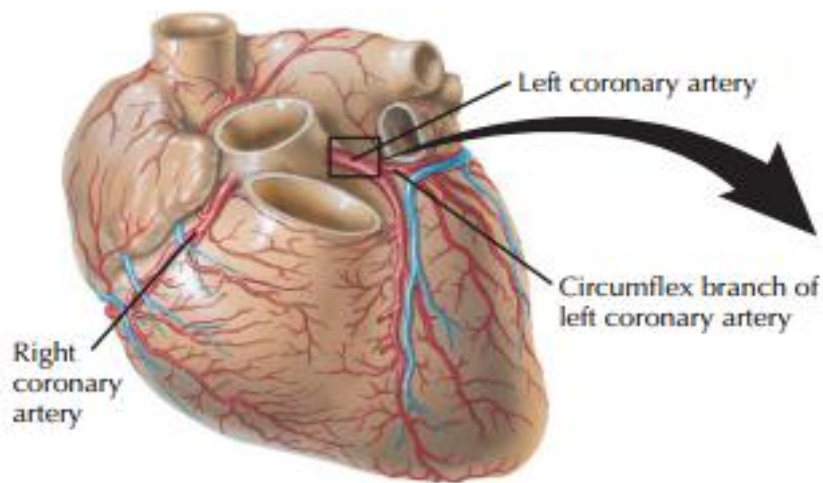
Penile arteries: thick intima with many longitudinal muscle fibres.

Roots of aorta and pulmonary arteries: cardiac muscle in the media.



Unique features

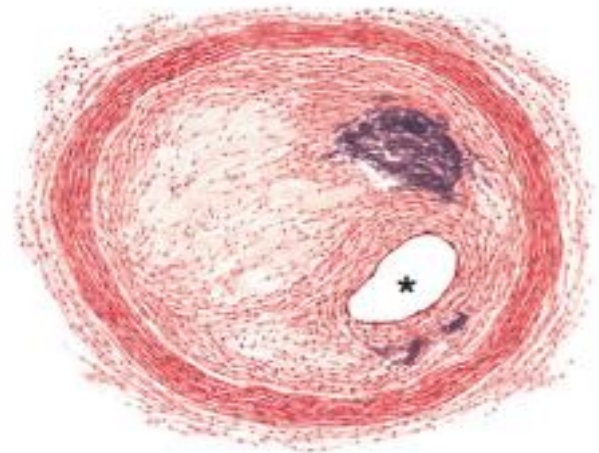
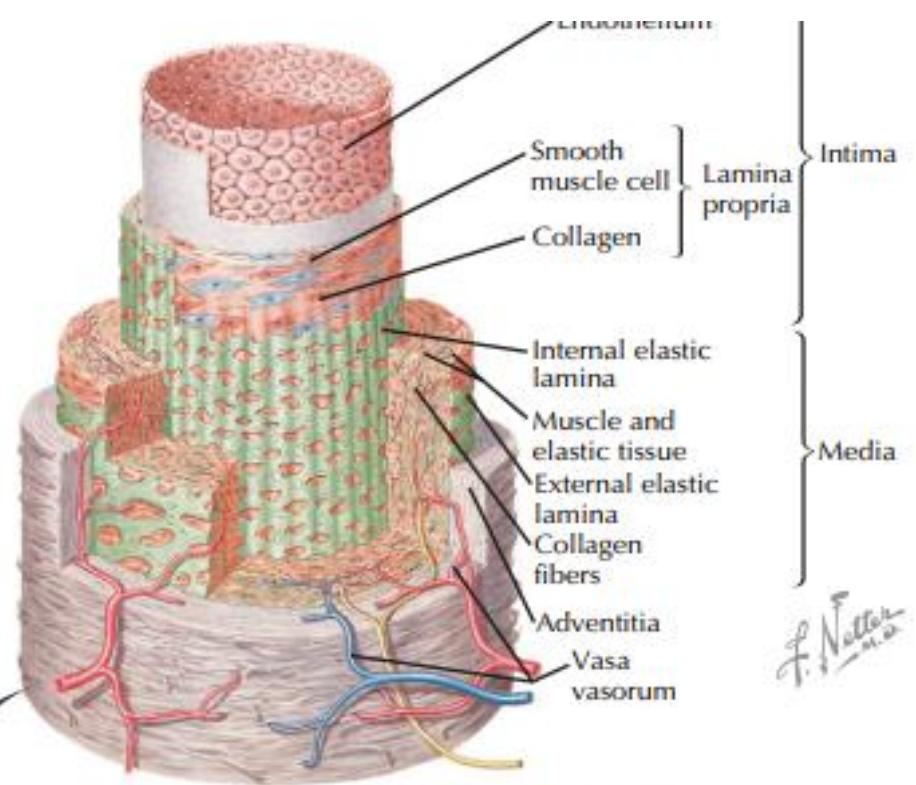
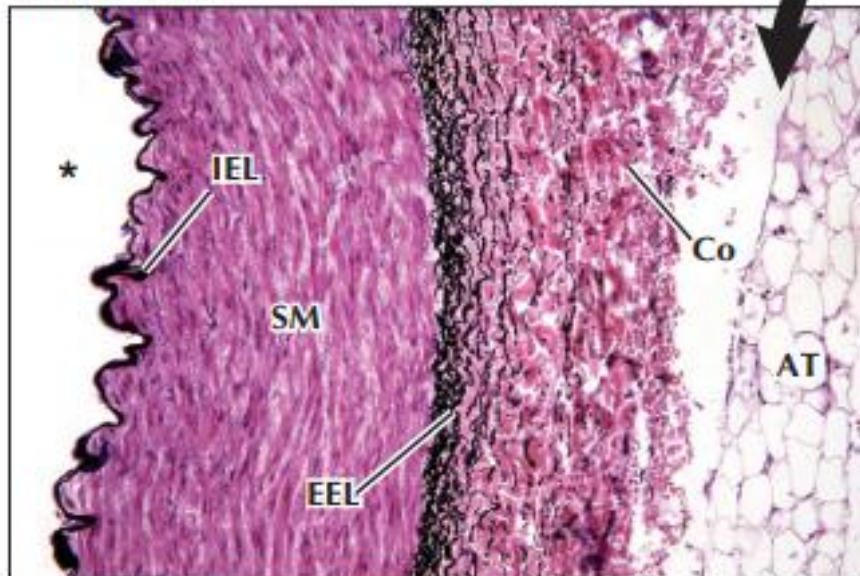
- The adventitia is **quite thick relative to that of other muscular arteries** it consists of loosely packed collagen, adipose tissue, and some elastic fibers.
- Bundles of smooth muscle cells in the media have exceptionally **rich innervation**.
- Because coronary arteries bend repeatedly during systole and diastole, both media and adventitia contain **bundles of longitudinally oriented smooth muscle** as well as circularly arranged bundles.
- Coronary arteries are also unique in their high **collagen to-elastic fiber ratio**, which reflects high tensile strength and relatively low stretchability.
- Branching sites of these arteries show normal, periodic thickenings of the intima, called musculoelastic cushions.
- **These focal areas may contribute to development of atherosclerosis (via accumulation of low-density lipoproteins and rapid lesion formation).** From their epicardial location, coronary arteries give rise to arterioles that supply blood to a large network of myocardial capillaries.
- Collateral connections between arterioles form in response to disease-induced obstruction of a coronary artery.
- Compared **with men, women** usually have coronary arteries with smaller diameters, so coronary artery surgery is often **more difficult and may contribute to a poorer outcome**.



▼ **LM of the wall of a coronary artery in transverse section.**

Dark-staining elastic fibers are seen mainly in internal (IEL) and external (EEL) elastic laminae. Many layers of smooth muscle (SM) occupy the media; collagen (Co) and adipose tissue (AT) are in the adventitia. The vessel lumen is indicated (*). 75 \times .

Verhoeff-van Gieson.



△ **Cross section of coronary artery showing atherosclerotic narrowing.** Note almost complete occlusion of lumen (*) by intimal atherosclerosis with fatty accumulation and calcium deposition.

Arterioles

Arterioles

Their diameter is < 0.1 mm.

They control the peripheral resistance and regulate flow to capillaries.

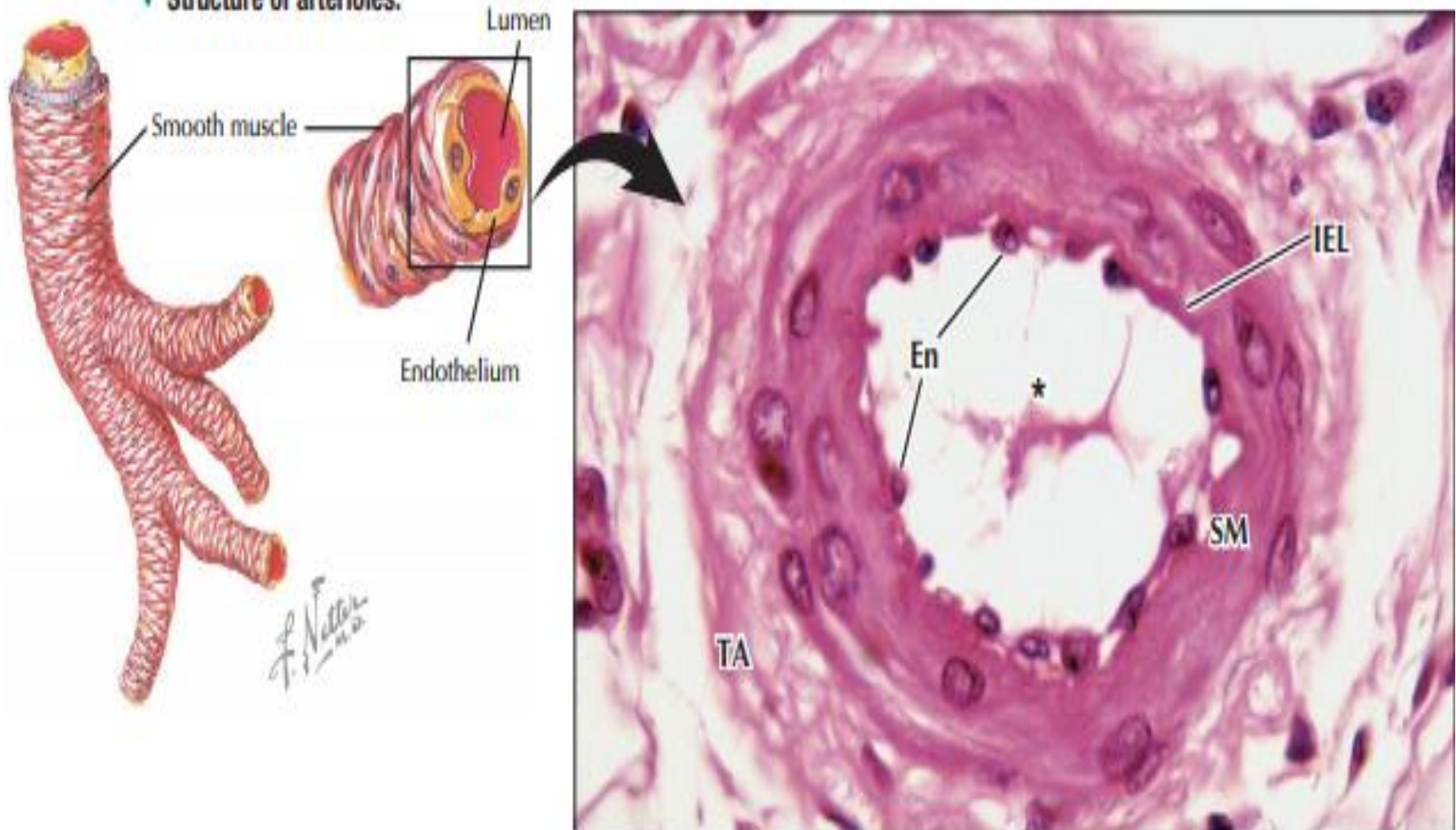
IEL may be present.

Tunica media is 1-3 layers of smooth muscles.

No EEL.

Tunica adventitia is small.

▼ Structure of arterioles.



LM of an arteriole in transverse section. Tightly arranged smooth muscle cells (SM) are oriented more or less circularly relative to the lumen (*). Their contraction causes the internal elastic lamina (IEL) to appear corrugated and endothelial cell (En) nuclei to bulge into the lumen. The adventitia (TA) contains connective tissue cells (mostly fibroblasts) and collagen fibers. 720 \times . H&E.

Metarterioles

They directly supply capillary beds.

The smooth muscle layer in the media is incomplete.

Each smooth muscle encircles the endothelium.

They act as sphincters.



Capillaries

Types of Capillaries

The smallest blood vessels composed of one endothelial cell.

They are present in three types:

Continuous

Fenestrated

Sinusoidal

Capillary Endothelium

Their long axis lies in the same direction of blood flow.

Their ends are tapering.

The nucleus bulges into the capillary lumen .

Cytoplasm contains: Golgi complex, few mitochondria, few rER, free ribosomes.

Structural support is provided by desmin and/or vimentin.

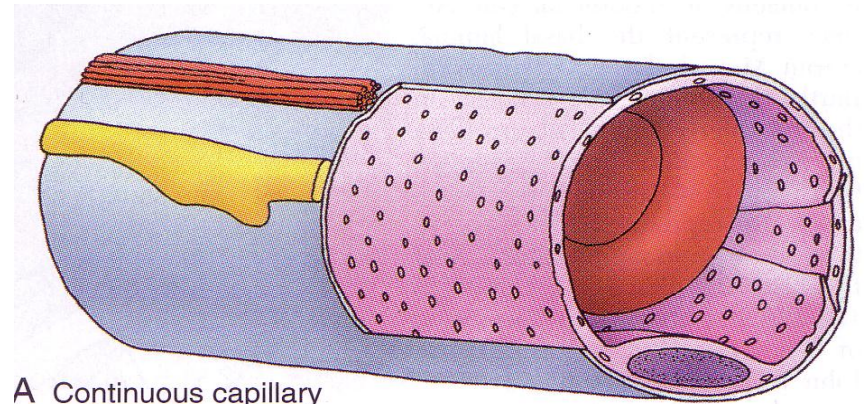
Continuous Capillaries

Present in muscles,
connective tissue and CNS.

Known as somatic
capillaries.

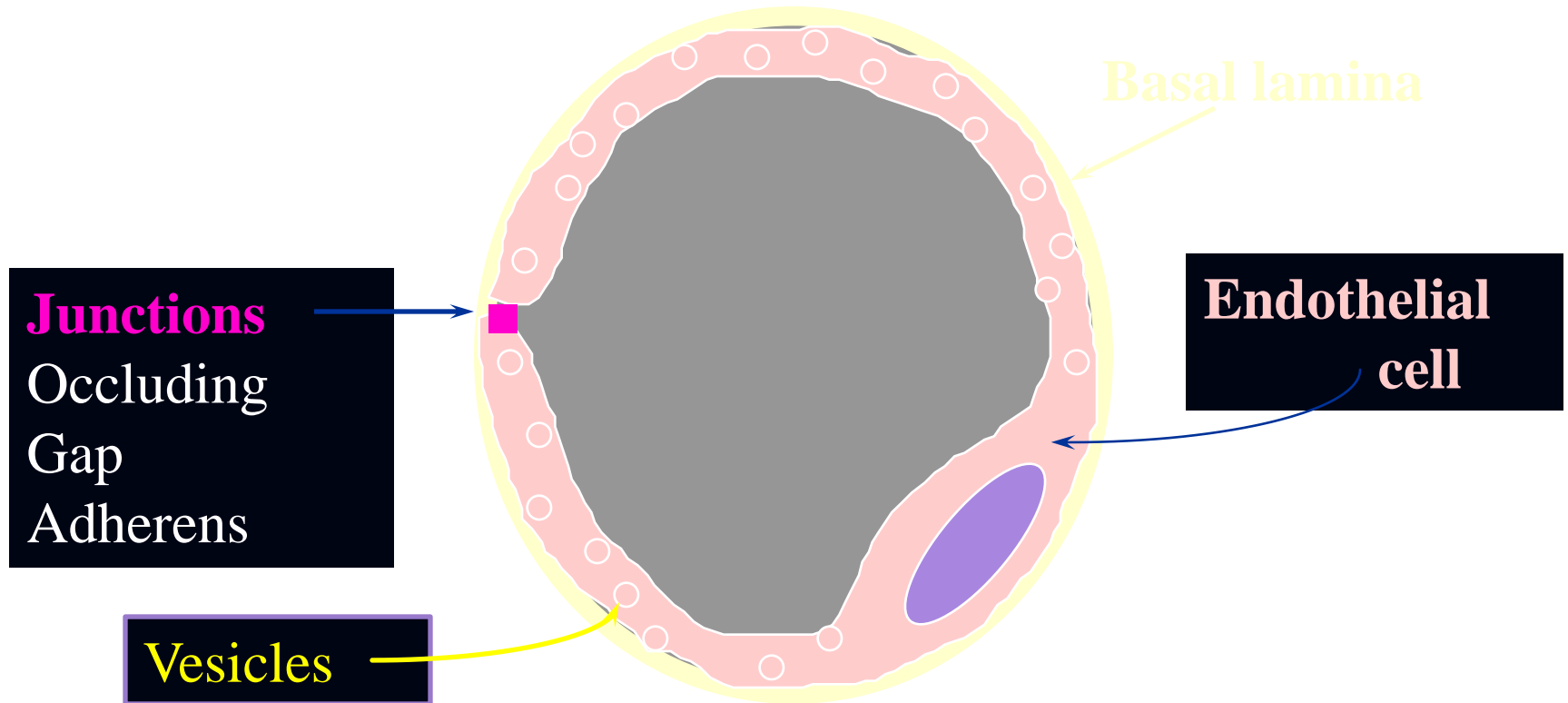
Cells are connected by
fasciae occludentes.

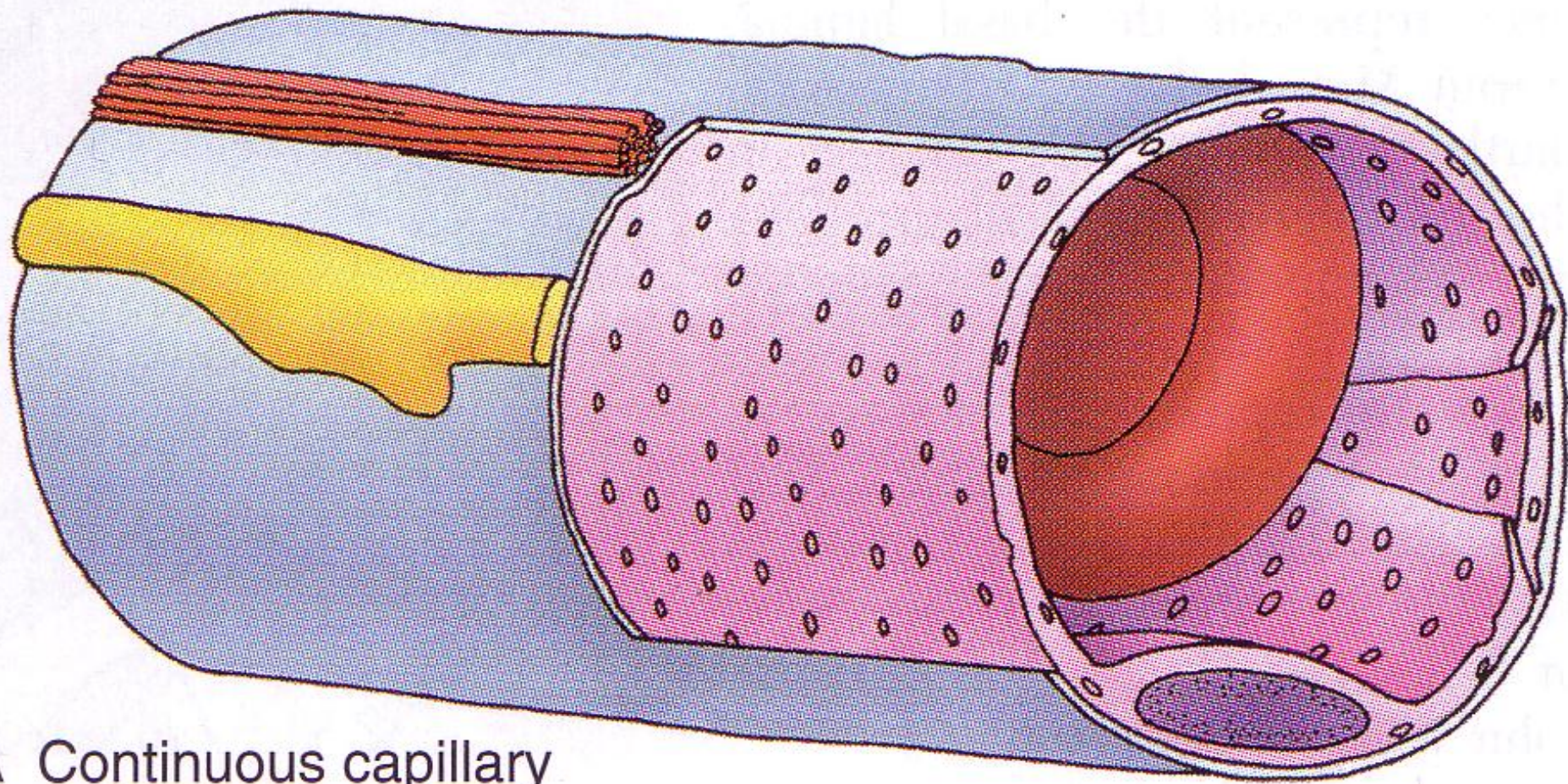
Cells are polarized.



CAPILLARIES 1 Continuous

CONTINUOUS = UNFENESTRATED

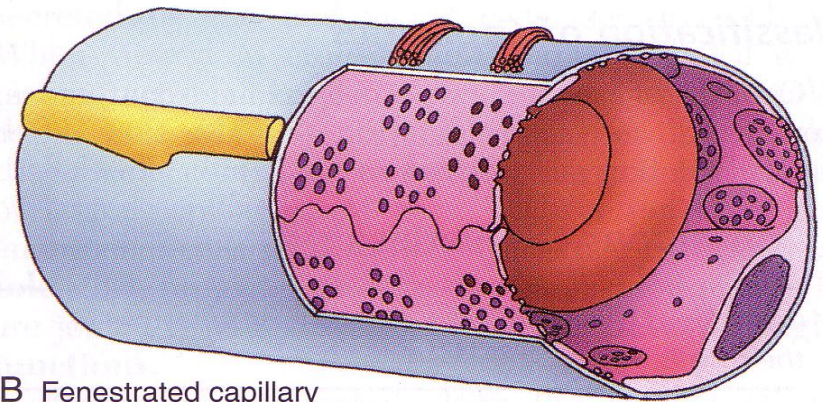




A Continuous capillary

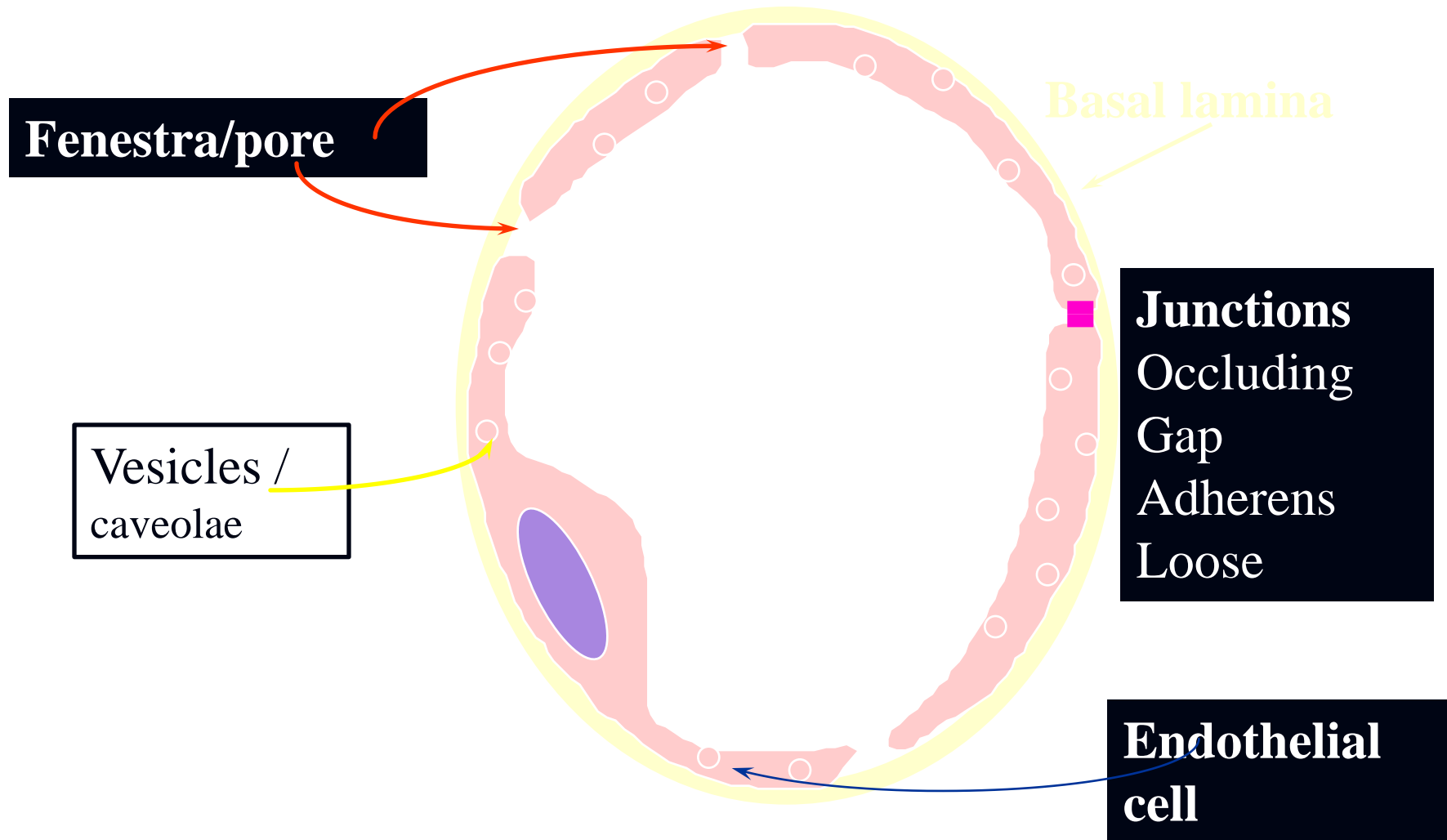
Fenestrated Capillaries

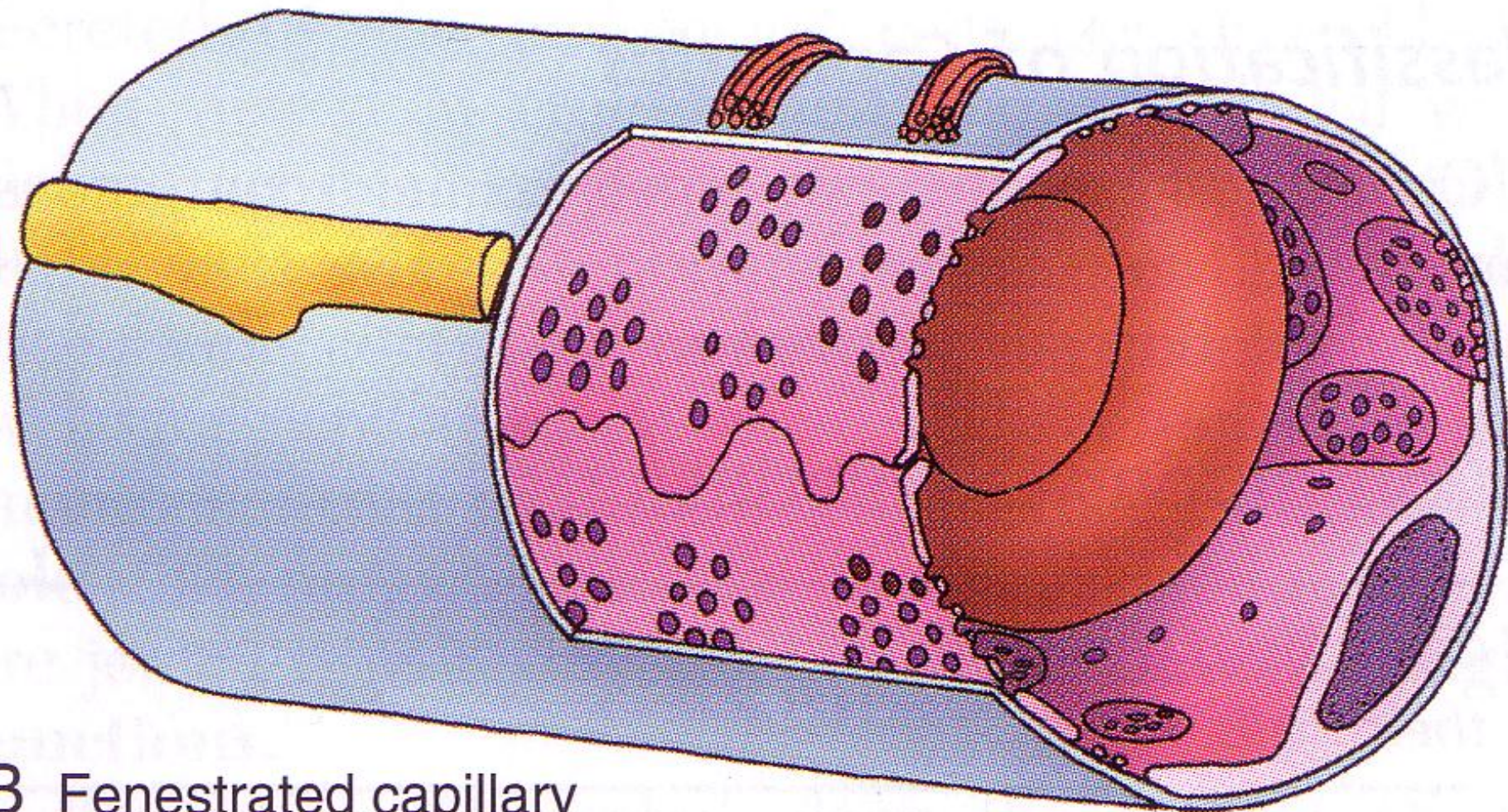
- Present in the pancreas, intestine and endocrine glands.
- Known as visceral capillaries.
- The pores are covered by thin diaphragm.
- Renal glomeruli, have fenestrated capillaries without diaphragm.



B Fenestrated capillary

CAPILLARIES 2 Fenestrated

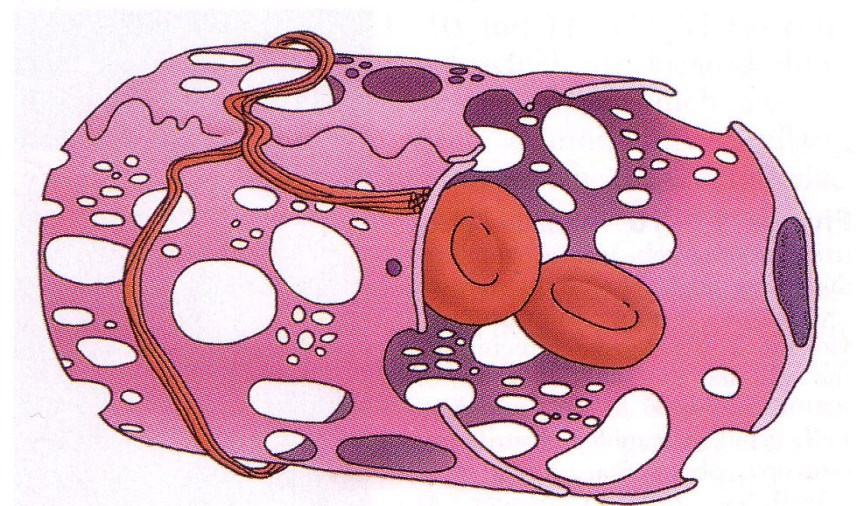




B Fenestrated capillary

Sinusoidal Capillaries

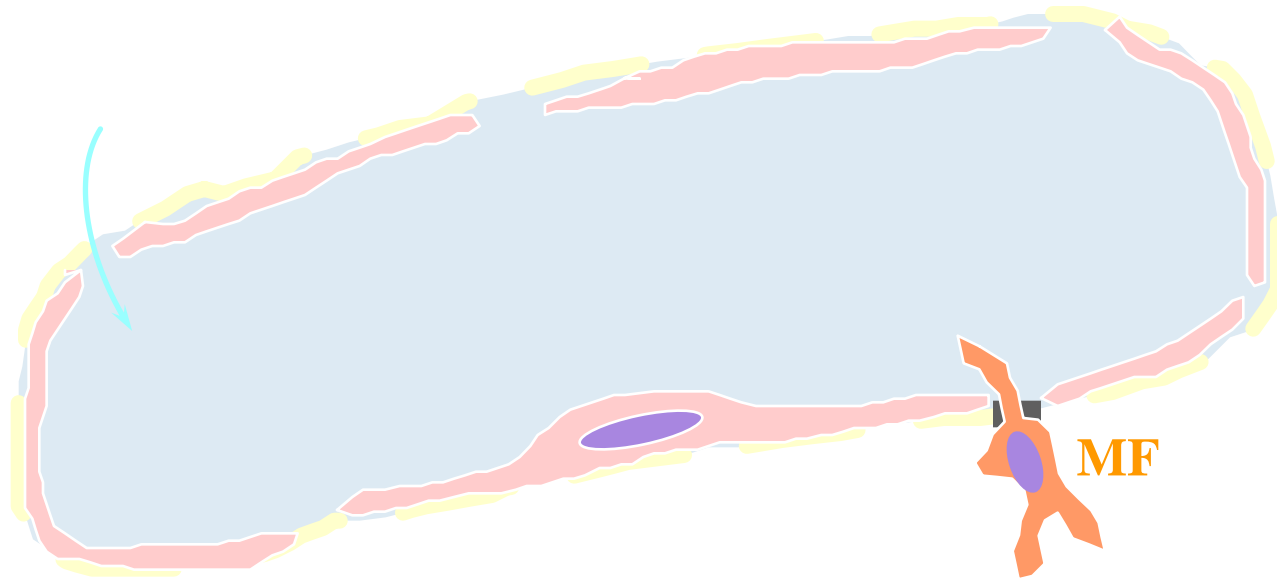
- Present in the liver, spleen, bone marrow.
- The fenestare lack diaphragm.
- Basal lamina may be absent in many places.



C Sinusoidal (discontinuous) capillary

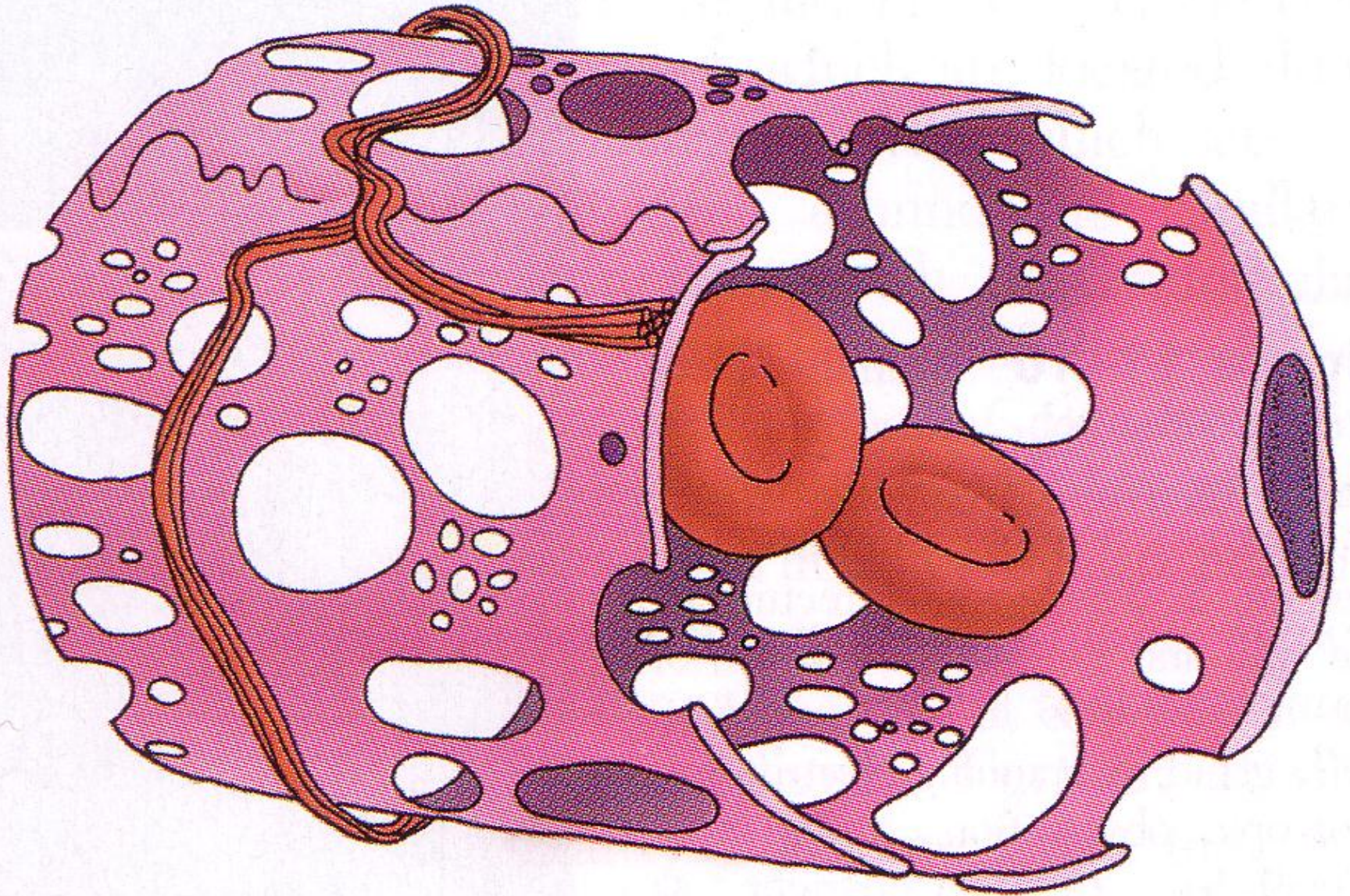
SINUSOID

Sinusoids are like wide meandering fenestrated capillaries, but are associated with macrophages, and have breaks in the basal lamina (in the liver, the basal lamina is not truly present)

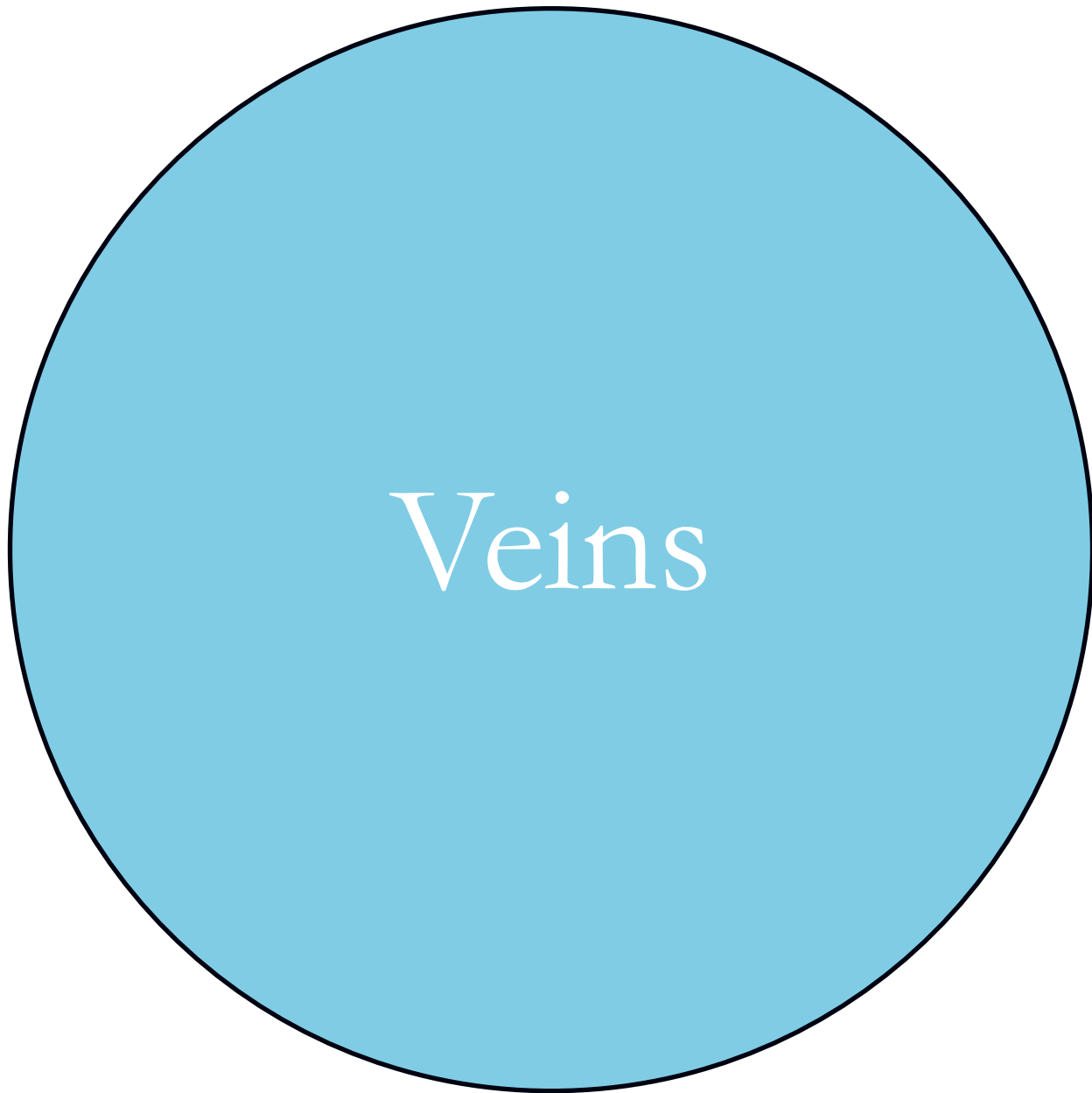


Typical of liver,
spleen, & marrow

If one were to call the sinusoids of the liver “discontinuous capillaries”, the pathological process of “capillarization” would lose its meaning.



C Sinusoidal (discontinuous) capillary



Venules and Small Veins

Read only

Their walls are similar to capillaries.

Venules (post capillary) have thin endothelium surrounded by pericyte and reticular fibres.

In larger venules, pericytes are replaced by scattered smooth muscles.

In small veins, smooth muscles form a continuous layer.

The endothelium in venules of lymphoid organs is rather cuboidal (HEV) and functions in lymphocyte segregation and recognition.

Medium Veins

Read only

Less than 1 cm in diameter.

Drain most of the body.

Occasionally the endothelium is surrounded by elastic fibres but **no** IEL.

Tunica media: Smooth muscles are loosely organized with collagen fibres and fibroblasts in between.

Tunica adventitia: collagen and elastic bundles are longitudinally arranged with few smooth muscles.

Large Veins

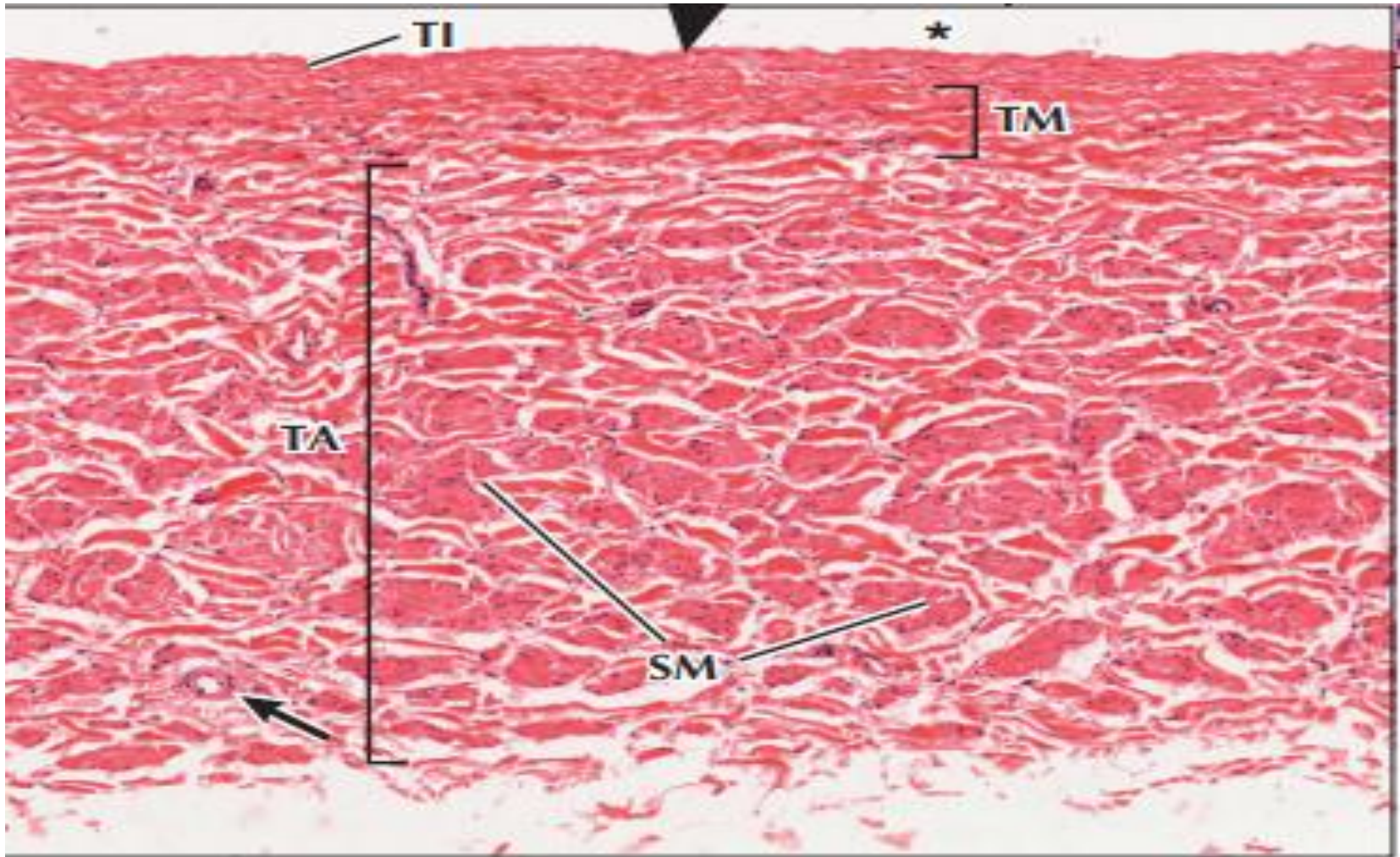
Include: SVC, IVC and veins forming them and their major tributaries, pulmonary and portal veins

Tunica intima: similar to medium veins but with thick subendothelial tissue.

Tunica media: poorly develop in most of the large veins.

Tunica adventitia: well developed.

Tunica adventitia: well developed



LM of the wall of the inferior vena cava. The lumen (*) is lined by an attenuated intima (TI). A few layers of circular smooth muscle cells occupy the thin media (TM). The adventitia (TA), the thickest layer, contains longitudinal bundles of smooth muscle (SM) interspersed with collagen fibers, as well as vasa vasorum (arrow). 55 \times . H&E

Special Features of Certain Veins

Cerebral, meningeal veins, dural venous sinuses, retinal veins, penile erectile tissue and veins of the bones: **have no definite media.**

Veins of the gravid uterus, umbilical vein, some mesenteric veins and limbs are **rich in smooth muscles.**

Adventitia of SVC, IVC and pulmonary veins contain cardiac muscle close to the heart.

THE END

انتهى بحمد الله

Thanks to Dr. Darwaish Badran for his valuable
Contribution to this lecture