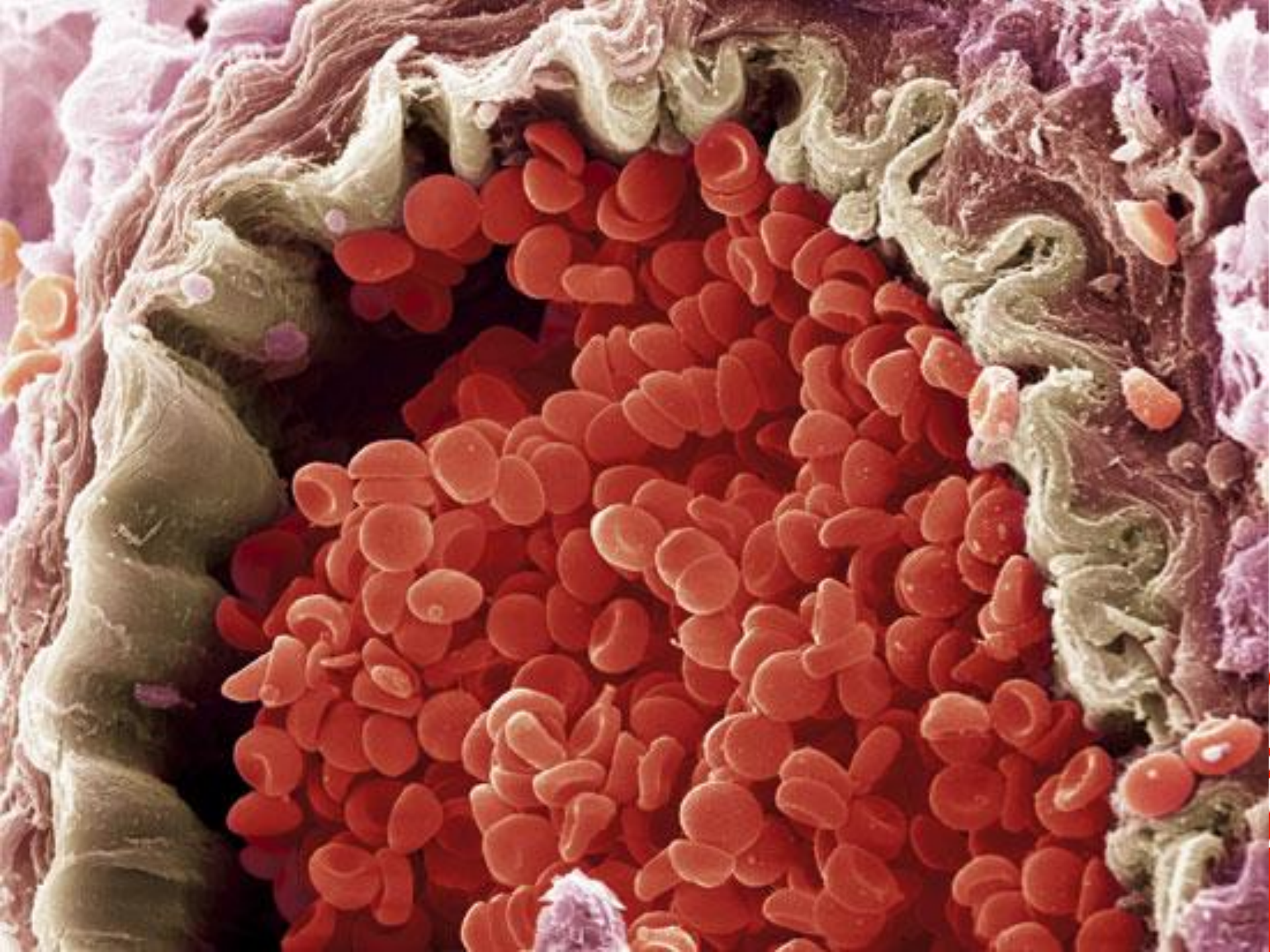




Cévy

Histologie





Obecná stavba

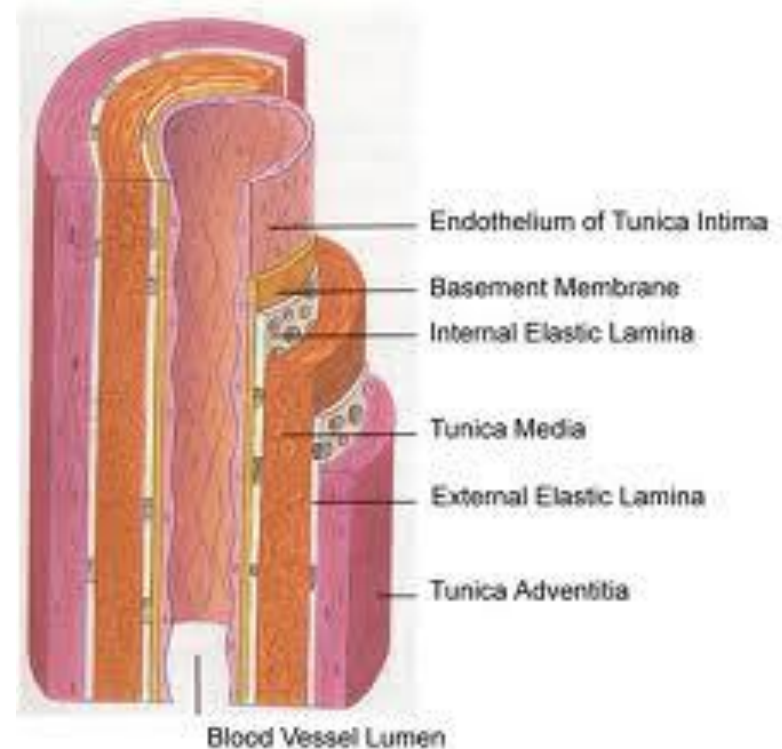
- **Tunica intima**

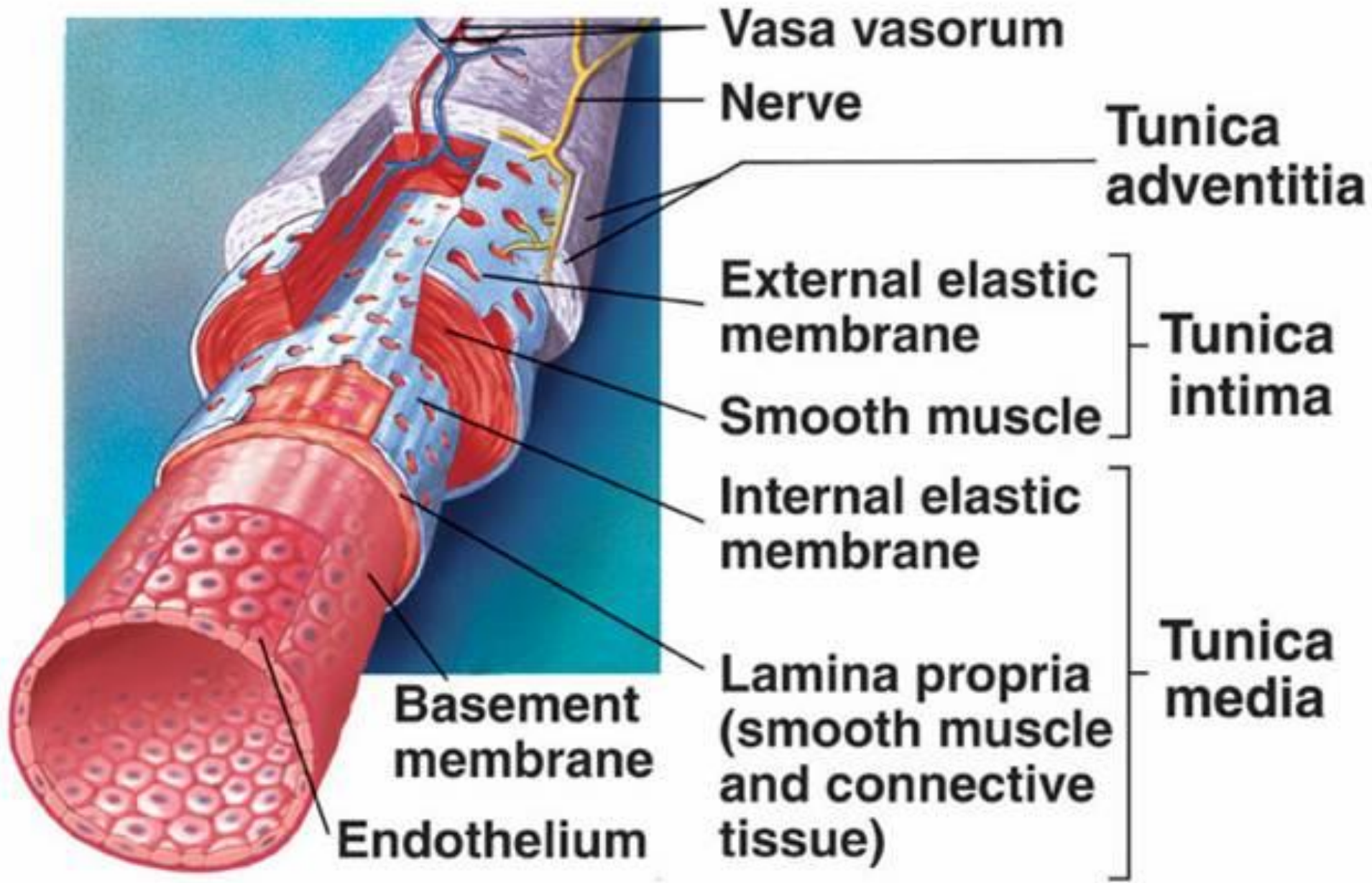
- Endotel
- Bazální lamina
- Subendotelová vrstva
- Membrana elastica interna

- **Tunica media**

- Hladký sval
- Membrana elastica externa

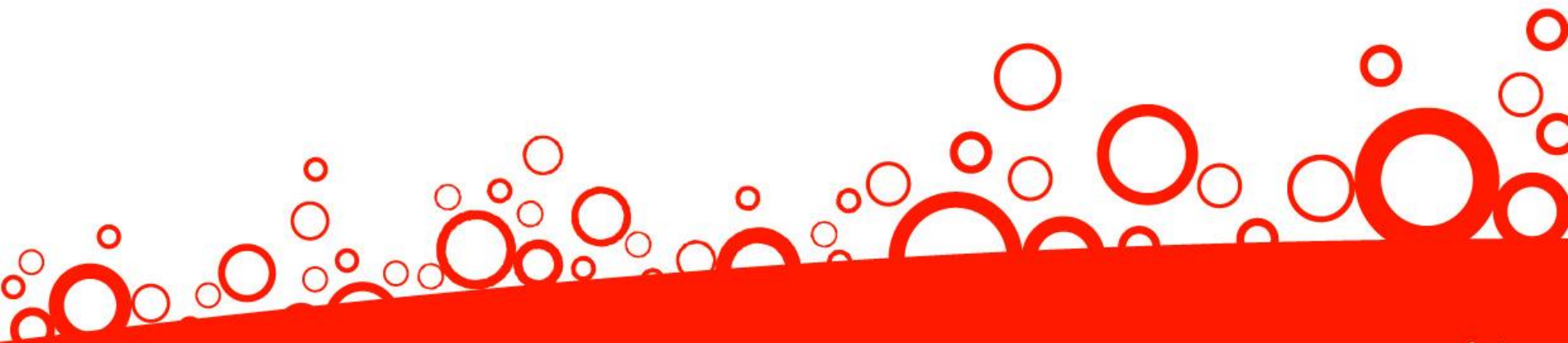
- **Tunica adventitia**





Tunica intima

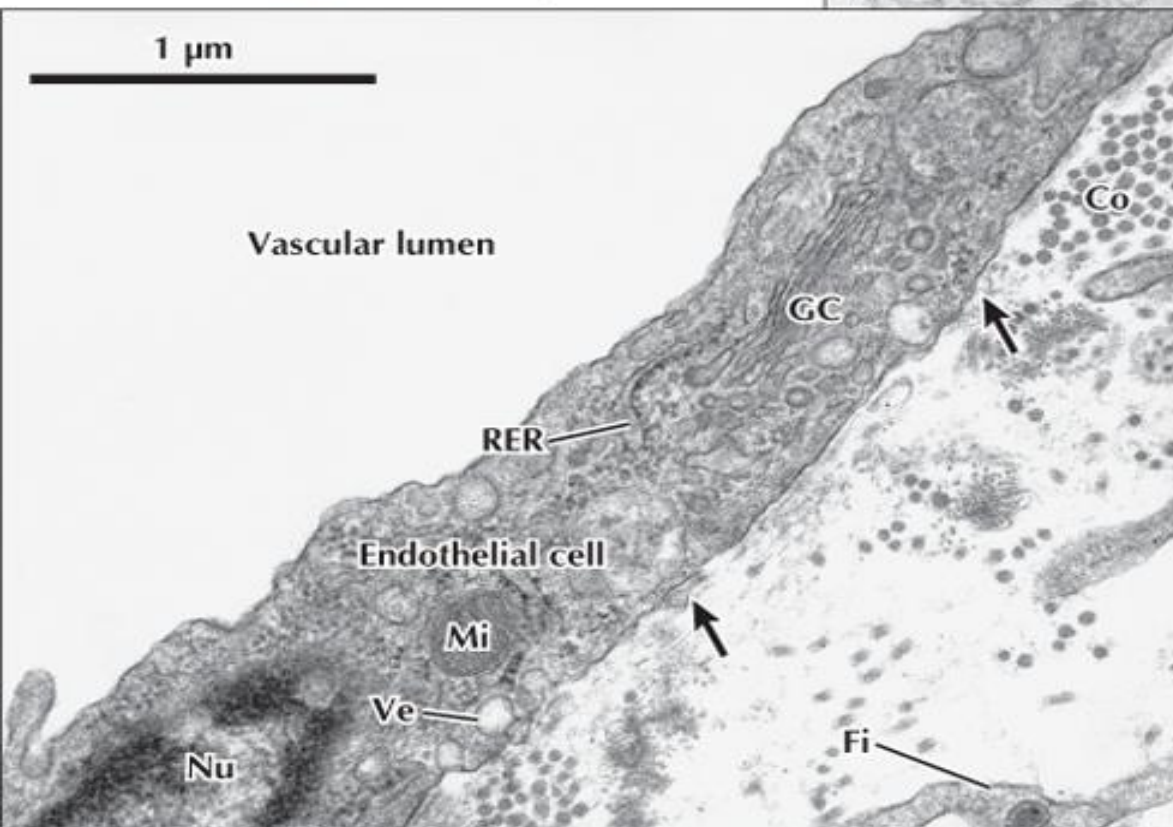
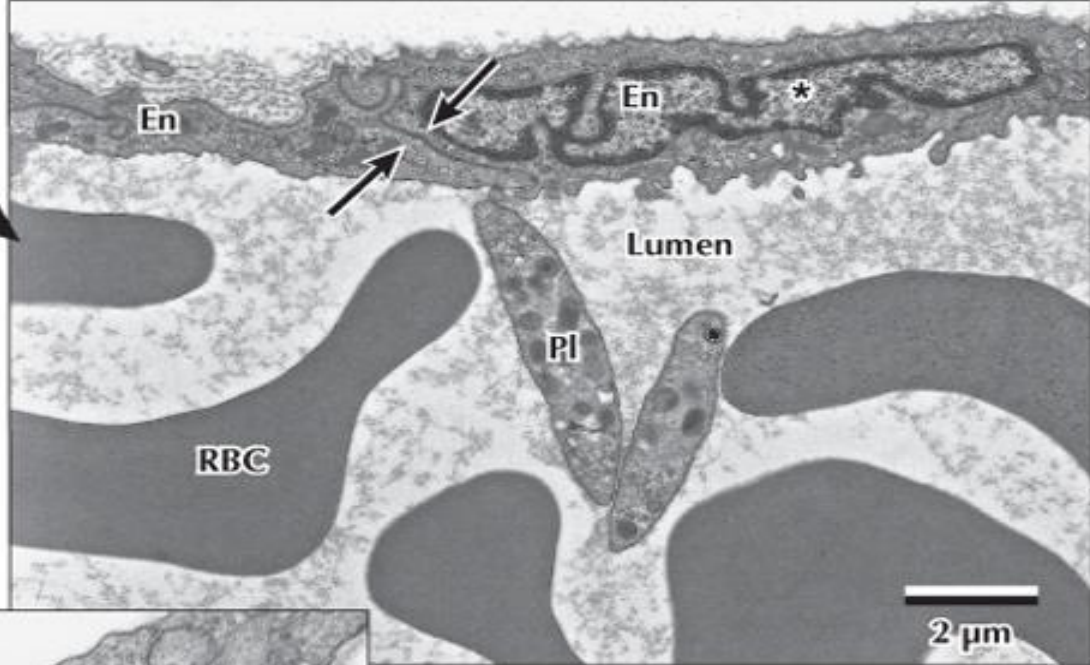
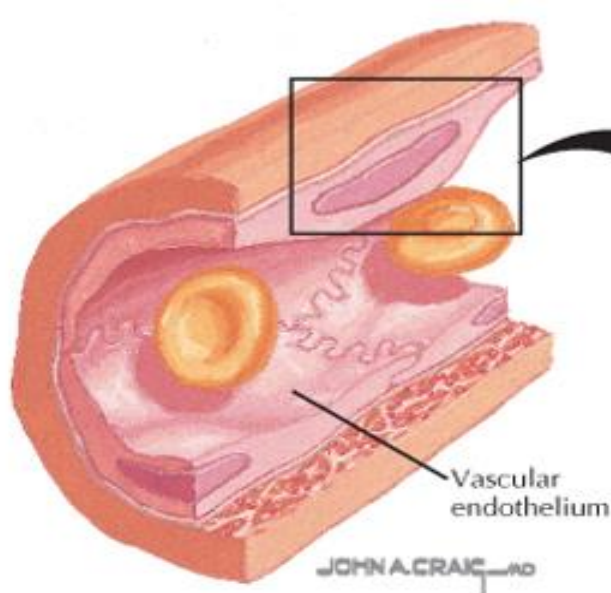
- Endotel
- Bazální lamina
- Subendotelové vazivo
- Membrana elastica interna



Endotel

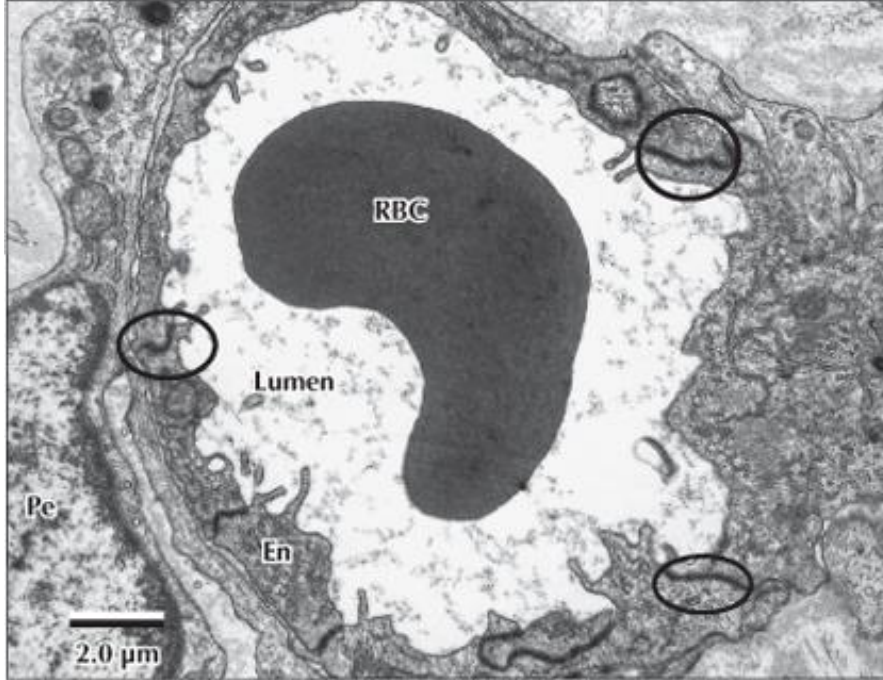
- Jedna vrstva plochých buněk
- Mezibuněčné spoje
- Glykokalyx
 - Nesmáčivost
 - Negativní náboj

» Weibelova-Paladeho granula



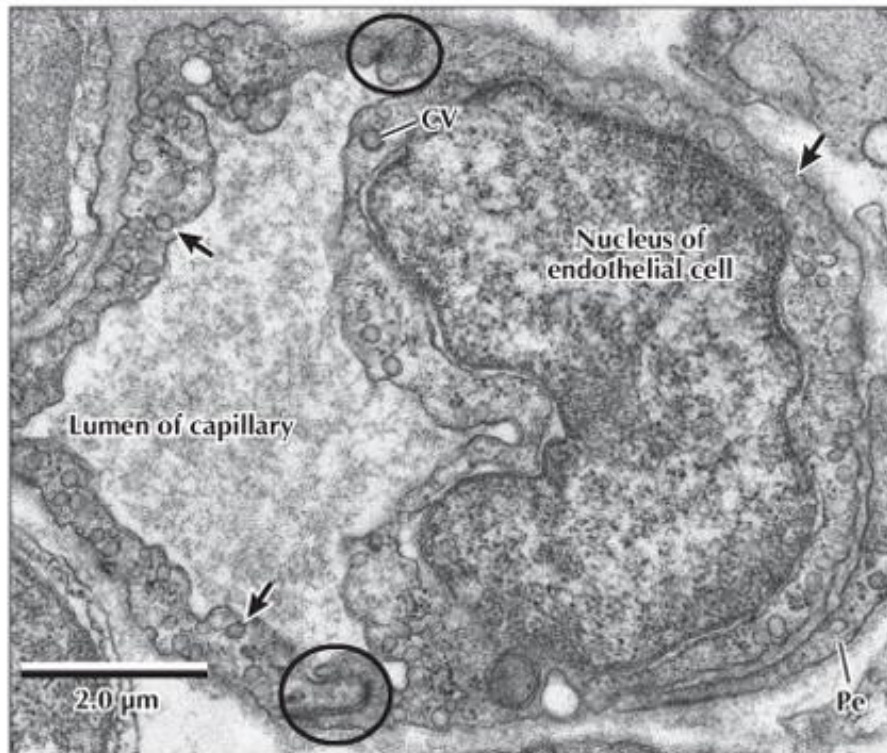
▲ **EM of part of an arteriole.** The lumen, lined by endothelial cells (En), contains erythrocytes (RBC) and platelets (PI). The nucleus (★) of one endothelial cell looks corrugated because of cell contraction. Ends of two closely apposed endothelial cells (arrows) are joined by intercellular junctions. 6000×.

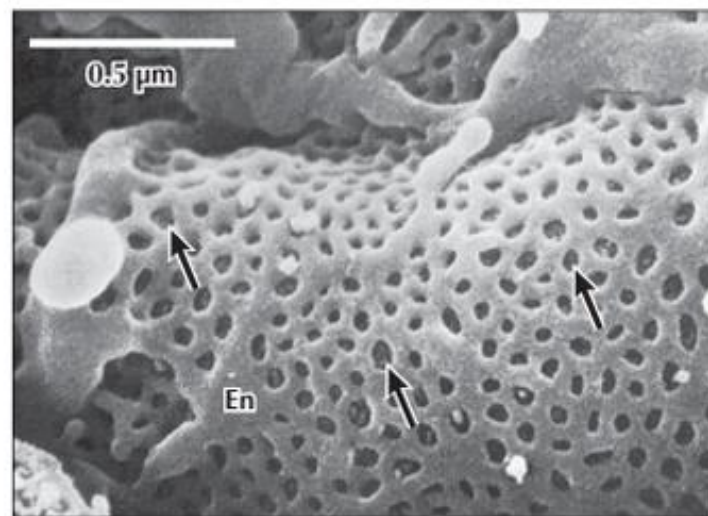
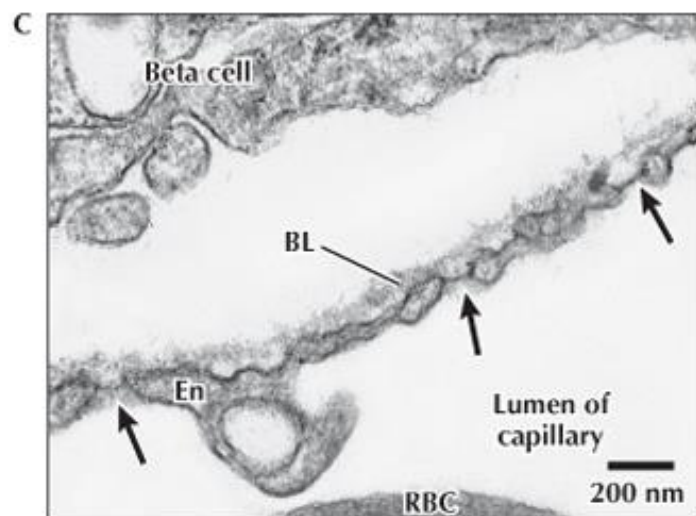
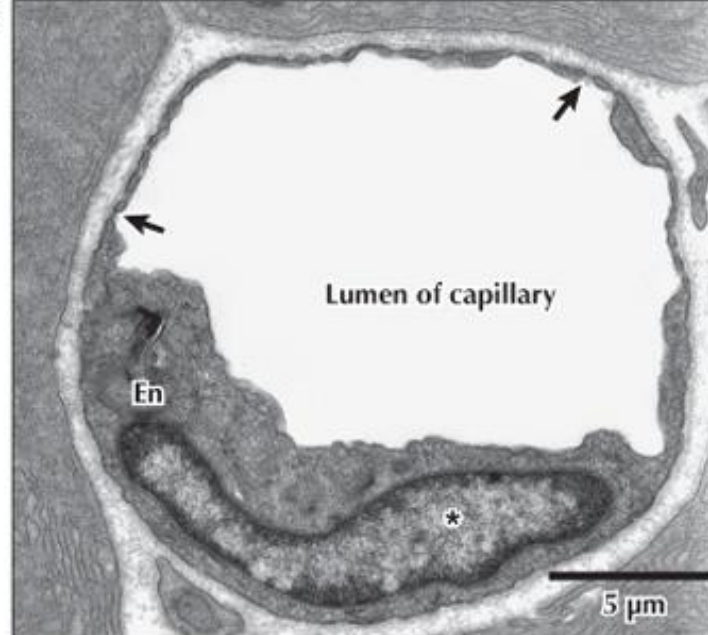
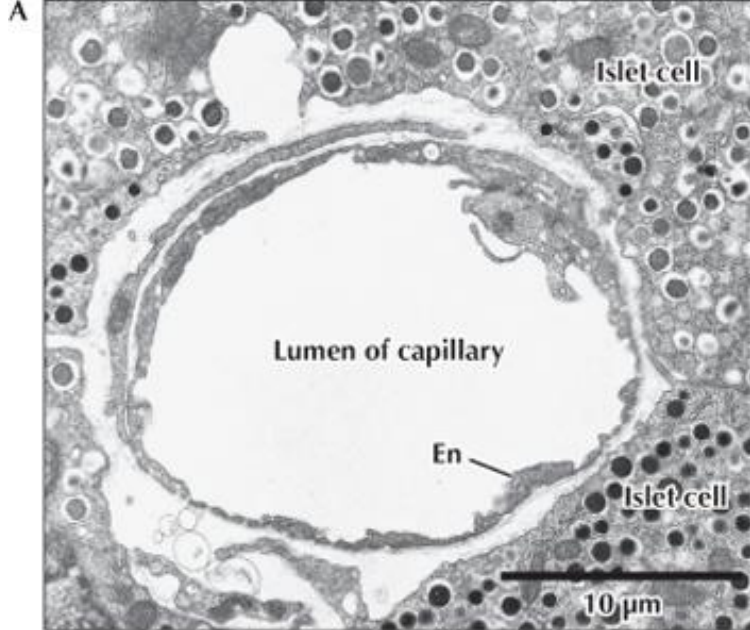
◀ **EM of part of a vascular endothelial cell.** The elongated cell rests on a thin basal lamina (arrows) and contains many transcytotic vesicles (Ve), which are especially numerous in the abluminal part of the cell. Part of the nucleus (Nu) can be seen. A Golgi complex (GC), rough endoplasmic reticulum (RER), and mitochondria (Mi) are also in the cytoplasm. Underlying connective tissue shows collagen fibrils (Co) and processes of fibroblasts (Fi). 33,000×.



◀ **EM of a tight capillary in the central nervous system.** The lumen contains an erythrocyte (RBC); endothelial cells (En) form an uninterrupted, complete lining (parts of several cells are seen). Endothelial cells are linked by intercellular junctions, most of which are tight junctions (circles) that are linear densities between adjacent cells. A grazing section through one endothelial cell (to the right) reveals abundant, tightly packed organelles in the cytoplasm. A pericyte (Pe) surrounds the endothelium on its abluminal aspect and shares the same basal lamina. Unlike endothelial cells, pericytes do not completely encircle the capillary lumen. 6000×

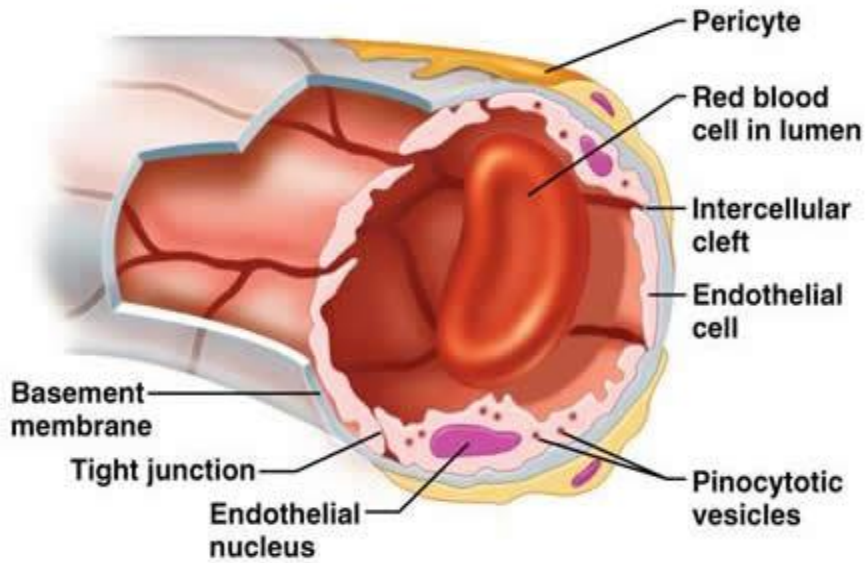
▶ **EM of a skeletal muscle tight capillary sectioned transversely.** The vessel has a signet ring appearance. Parts of two endothelial cells line the lumen and are held together by tight junctions (circles). One cell is sectioned at the level of its euchromatic nucleus, which has an irregular contour. Cytoplasm of both cells contains abundant organelles, including many spherical transcytotic vesicles (arrows). In contrast to more numerous transcytotic vesicles, the less common coated vesicles (CV) are usually on the luminal side of the endothelium. The process of a pericyte (Pe) adheres to the outer aspect of the endothelium, with which it shares a basal lamina. 12,000×



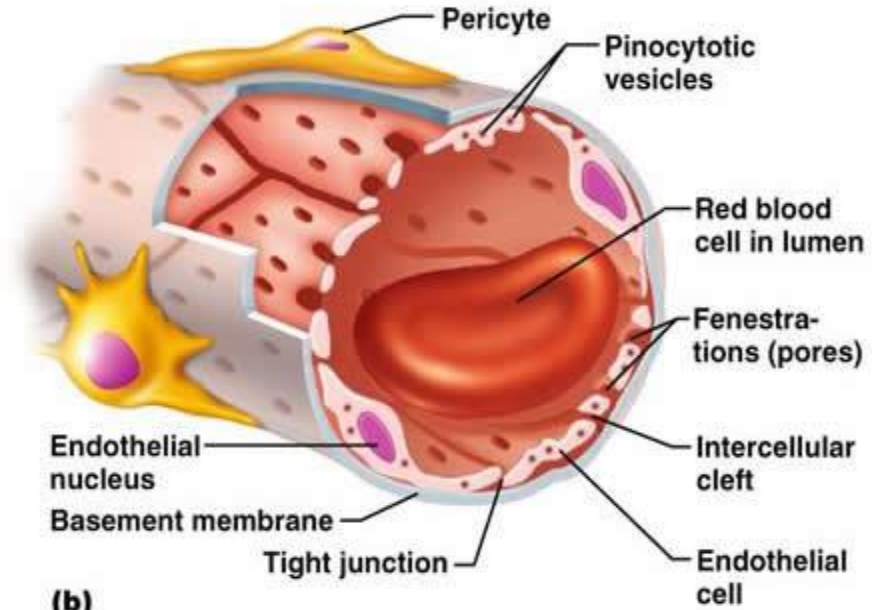


▲ EMs of fenestrated capillaries in the endocrine pancreas in transverse section. Thin endothelium (En) lines wide capillary lumina. The endothelium of one capillary is close to islet cells (A) and an endothelial cell nucleus (*) is in the plane of section of another (B). Higher magnification (C) better shows endothelium and several fenestrae (arrows), each spanned by a thin diaphragm. A surrounding basal lamina (BL) and a beta cell are also seen. A: 3000 \times ; B: 4000 \times ; C: 40,000 \times .

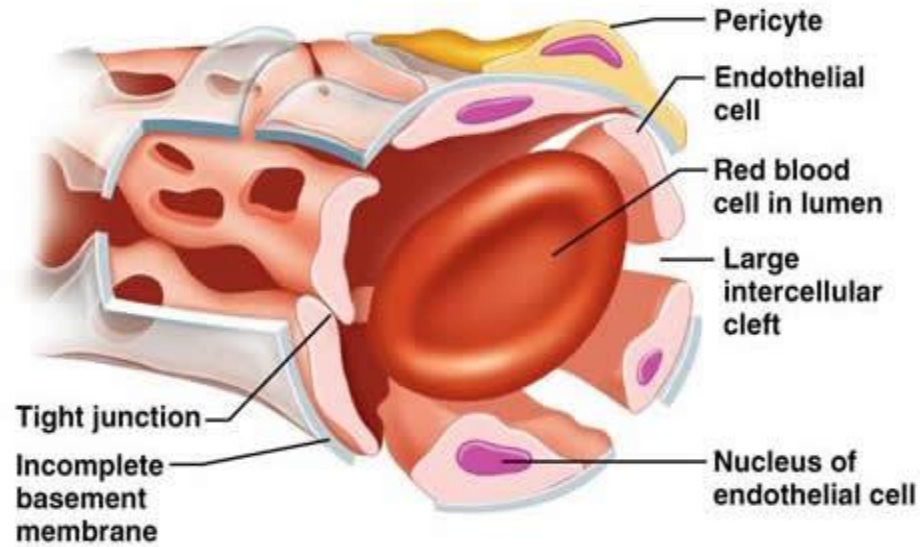
▲ High-resolution scanning EM of a glomerular capillary in the renal corpuscle. This surface view of endothelium (En), from inside the lumen, shows circular fenestrae (arrows). 50,000 \times . (Courtesy of Dr. M. J. Hallenberg)



(a)



(b)



(c)

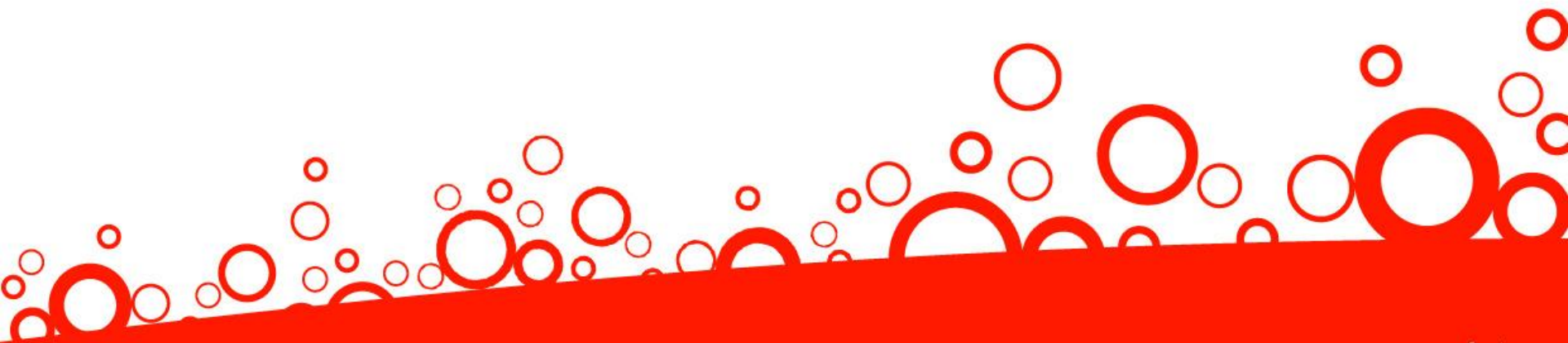
Subendotelová vrstva

- **ECM** (kolagenní, elastická vlákna, proteoglykany...)
- **Hladké svalové buňky**
- Silná u tepen elastického typu

- Změna poměru v závislosti na věku
 - U dětí tenká – převážně ECM bez bb
- Aterosklerotické změny

Membrana elastica

- Síť elastických vláken
- Externa – pouze u tepen velkého kalibru
- U tepen elastického typu – nejsou odlišitelné od ostatních vrstev elastiky





Internal elastic membrane

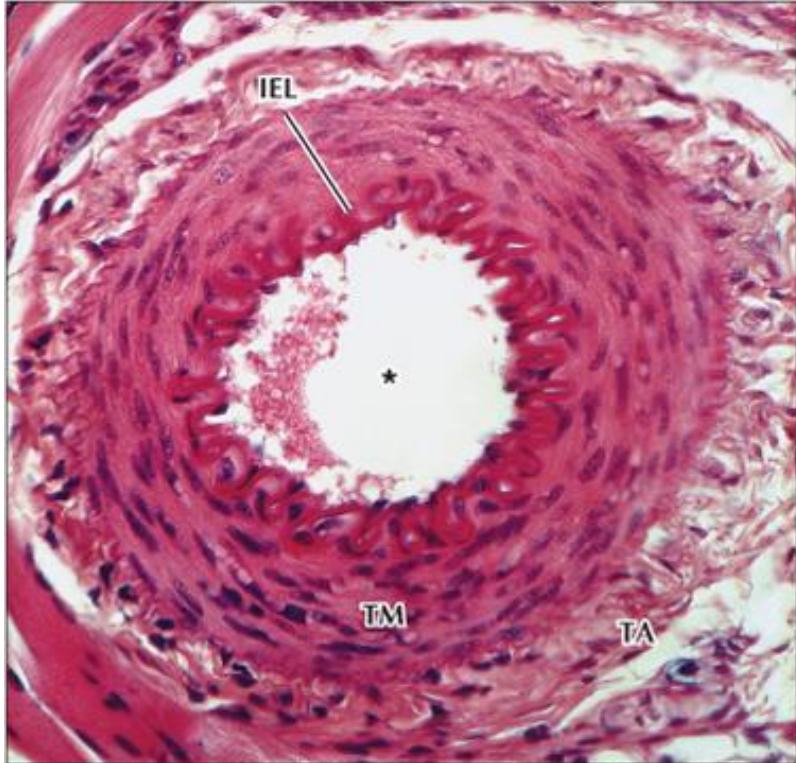


External elastic membrane

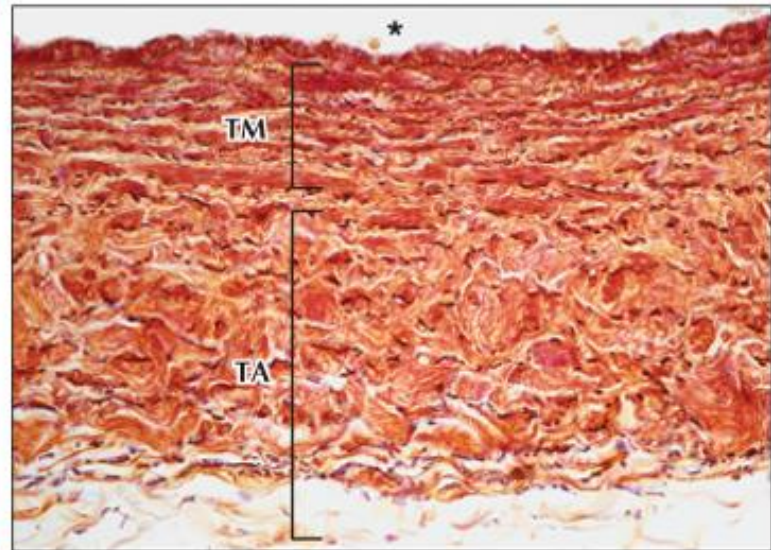
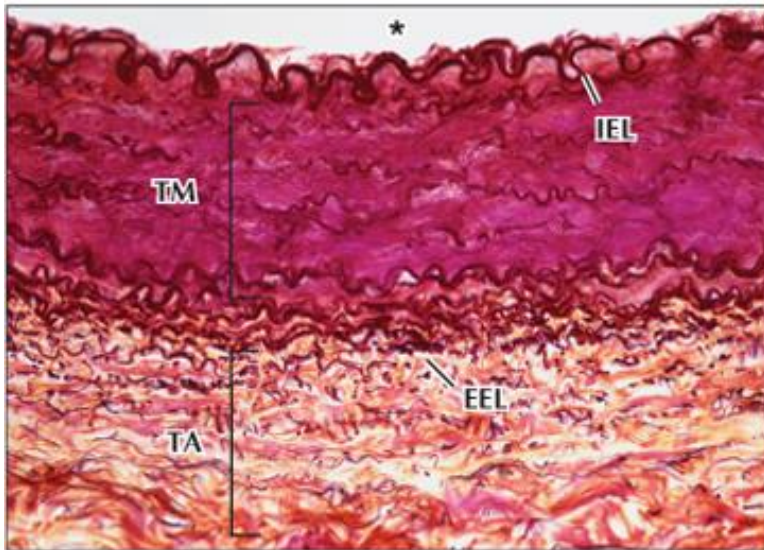


Tunica media - MA

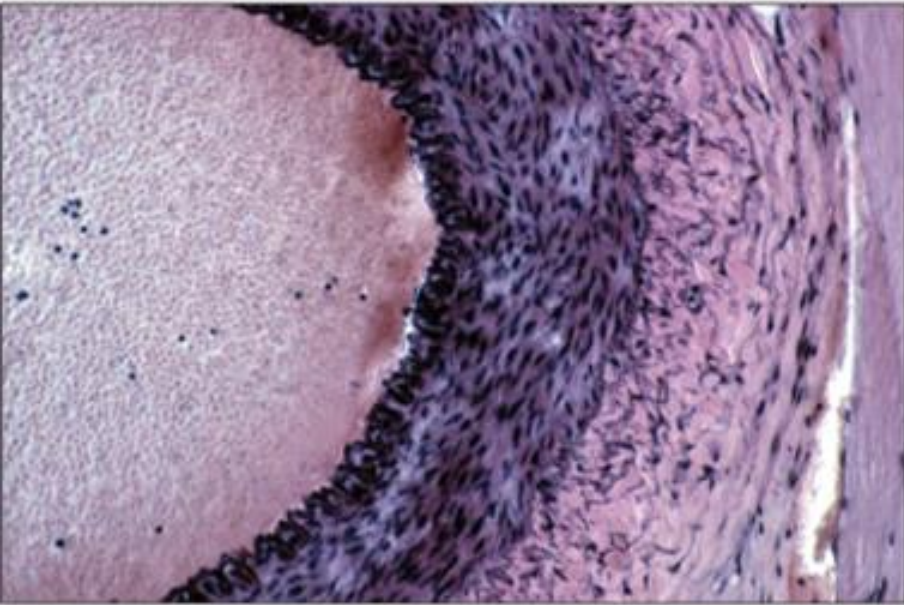
- **hladká svalovina** + ECM – elastická a kolagenní vlákna (III)
- Fibroblasty se zde **NENACHÁZEJÍ!!!**
- Svalové bb – gap junctions



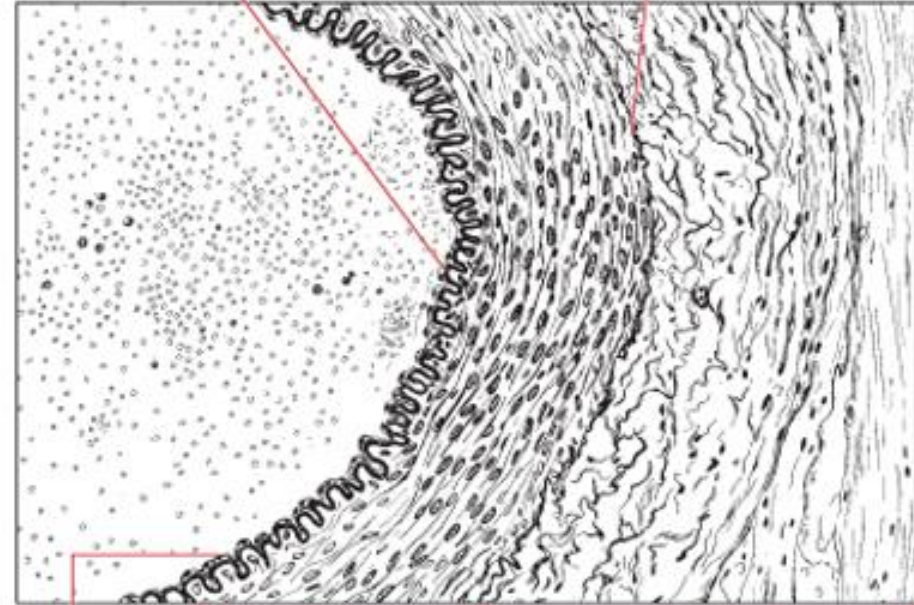
◀ **LM of the wall of a muscular artery.** In this partly constricted artery, the lumen (*) caliber is small relative to the muscular wall thickness. A prominent internal elastic lamina (IEL) looks corrugated. Several layers of circular smooth muscle occupy the media (TM); loose connective tissue, the adventitia (TA). 320×. H&E.



▲ **LMs of the wall of a muscular artery (Left) and muscular vein (Right).** The arterial wall has more elastic fibers (in black), whereas the vein has more collagen (in orange). Smooth muscle in the artery imparts an intense eosinophilia to the media (TM). Internal elastic lamina (IEL), external elastic lamina (EEL), adventitia (TA), and lumen (*) are indicated. 320×. Gomori aldehyde fuchsin.



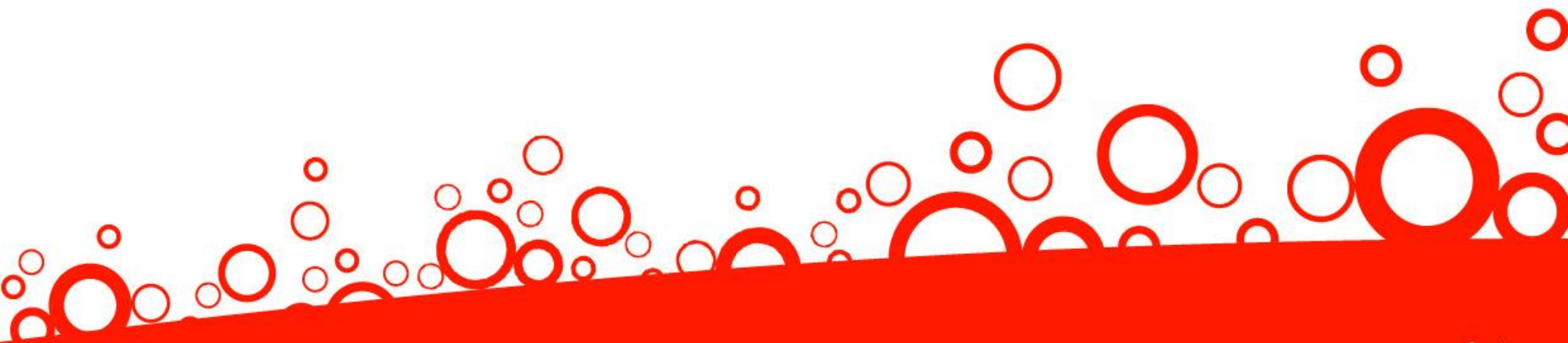
Internal elastic membrane External elastic membrane

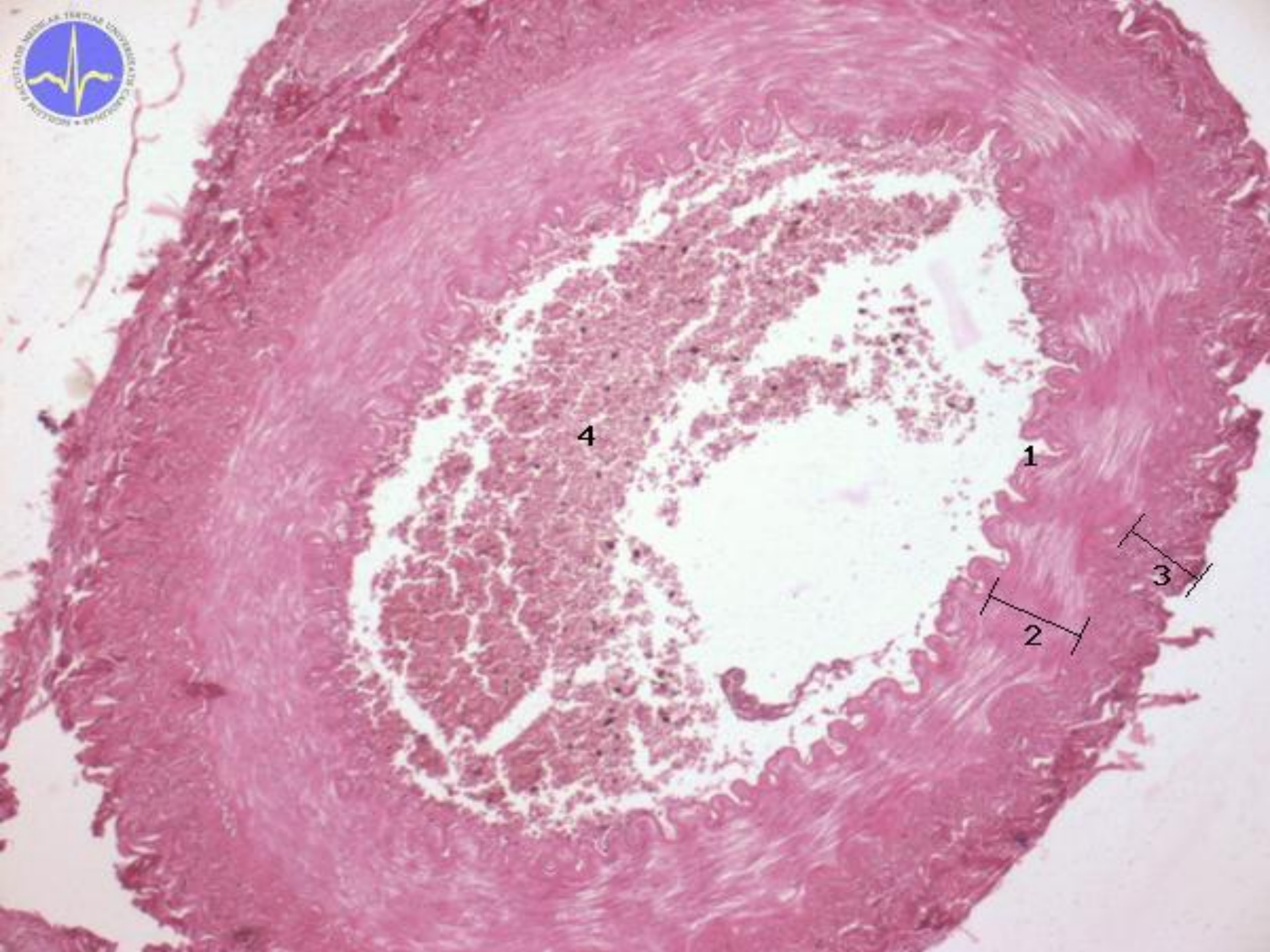


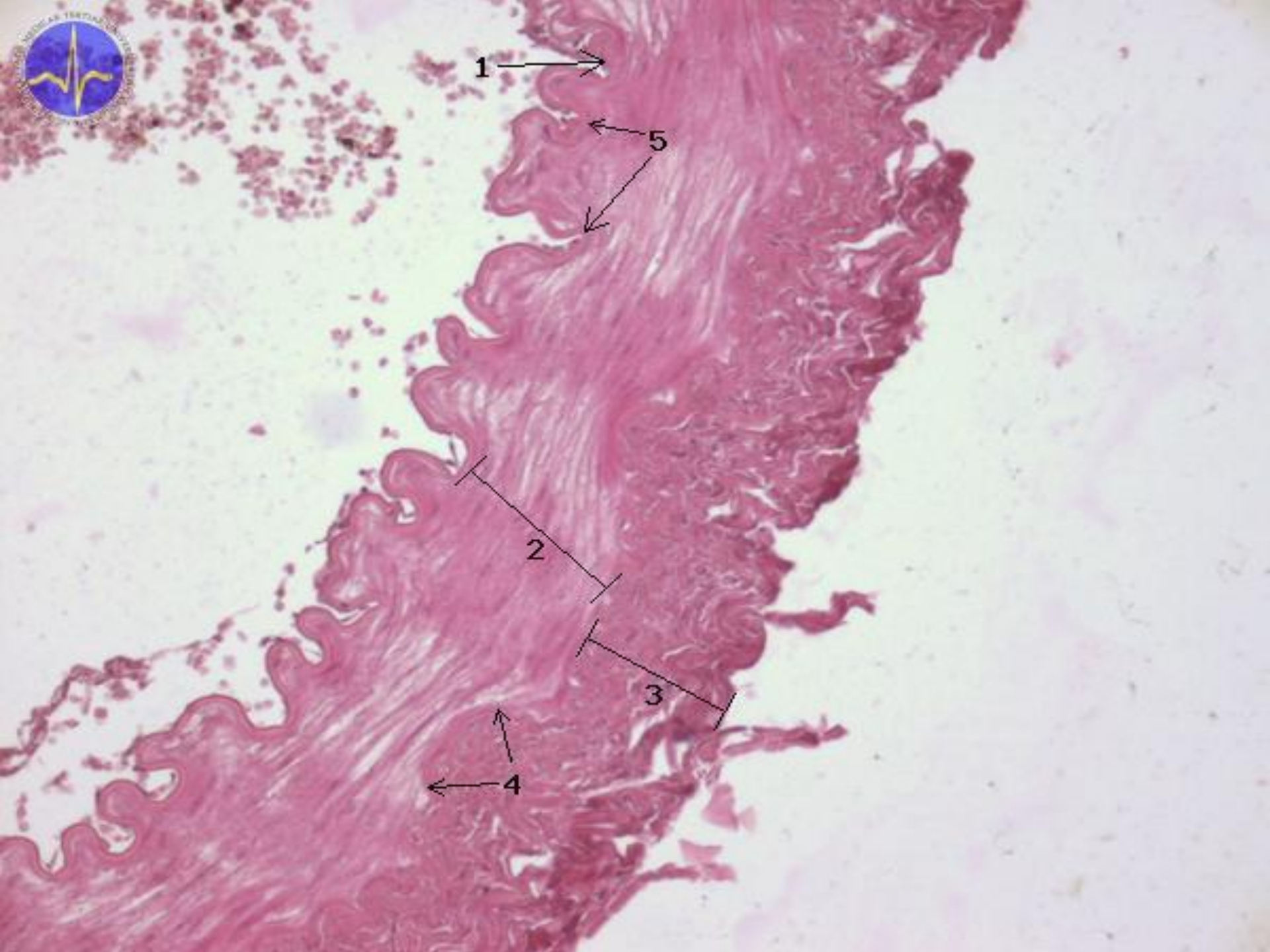
Endothelium

Media

Adventitia







1 →

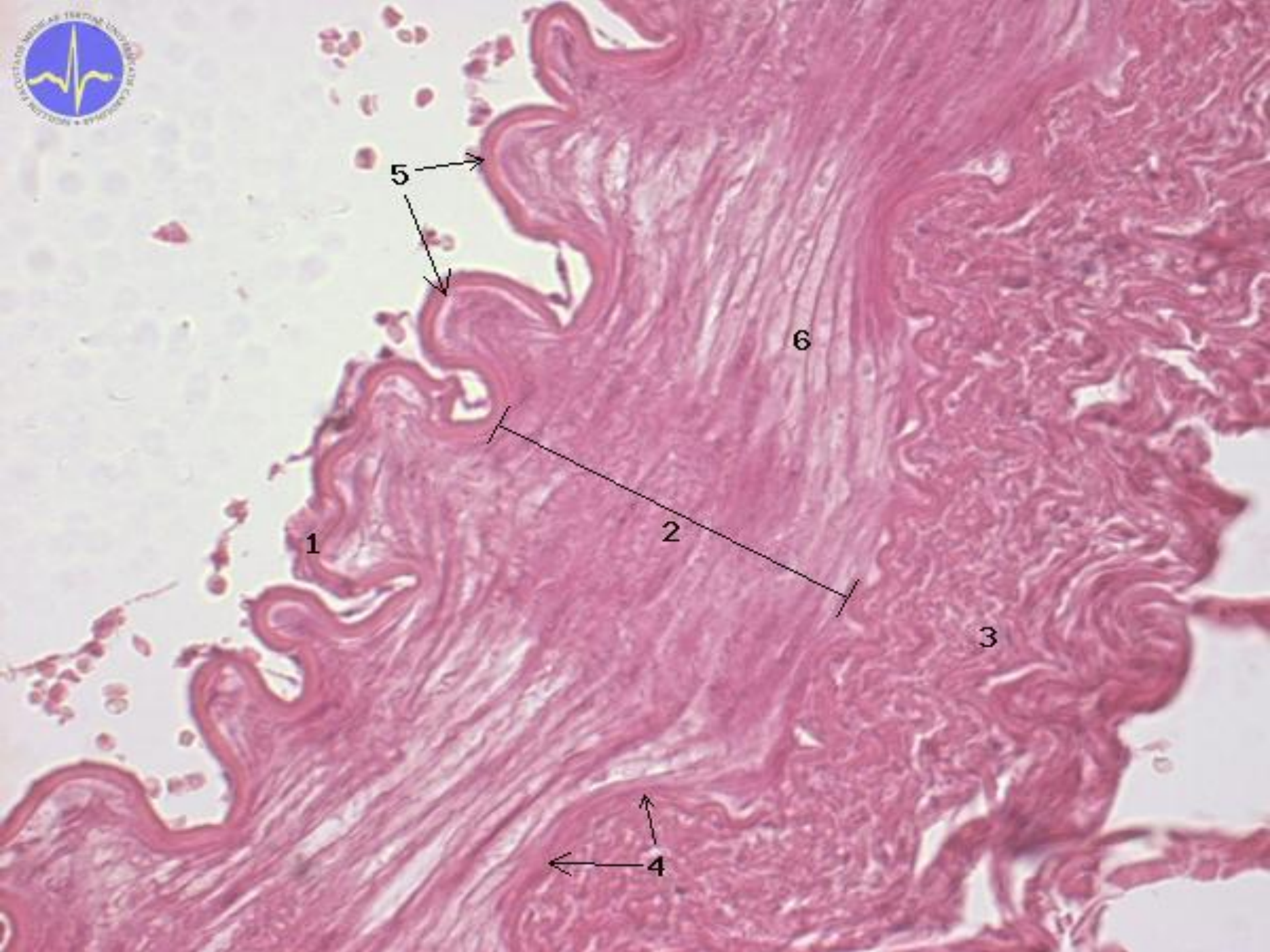
← 5

←

2

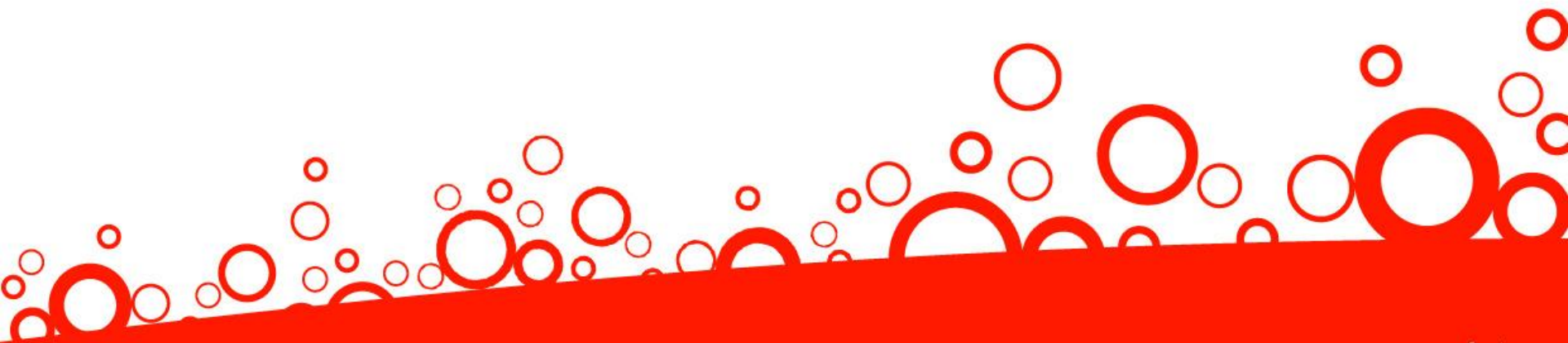
3

← 4

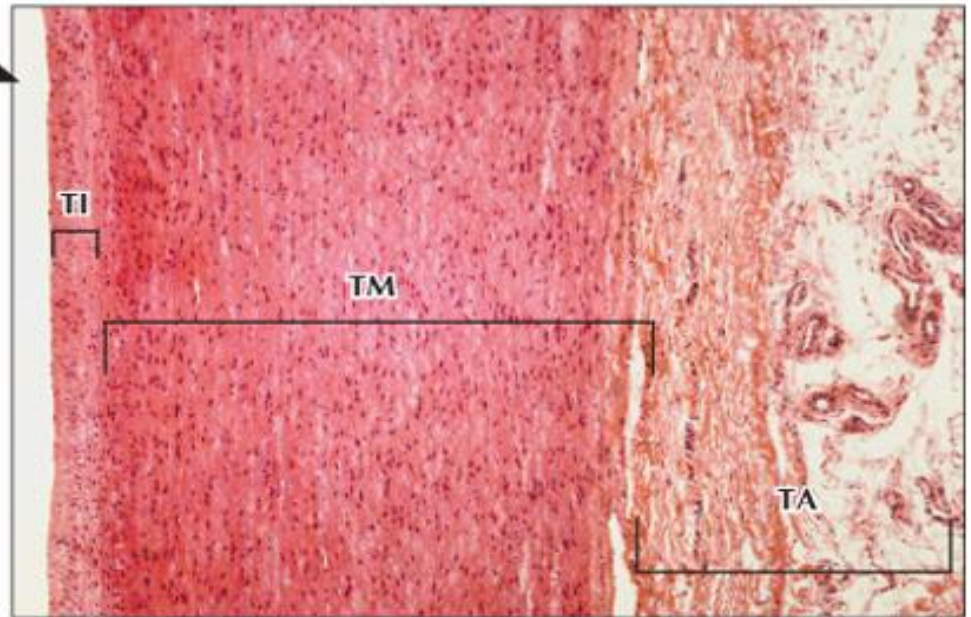
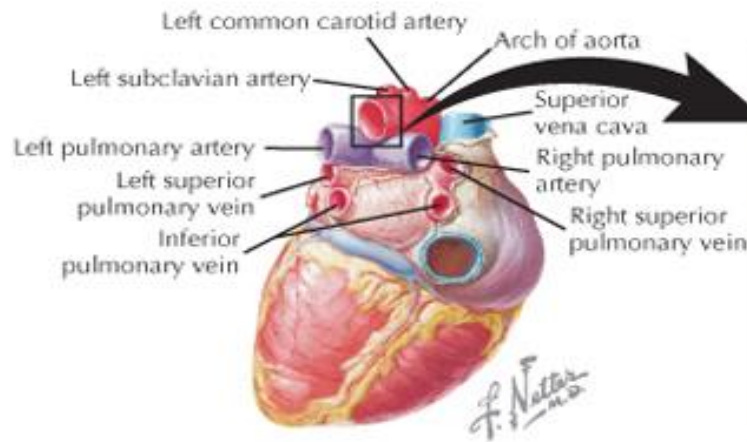


Tunica media - EA

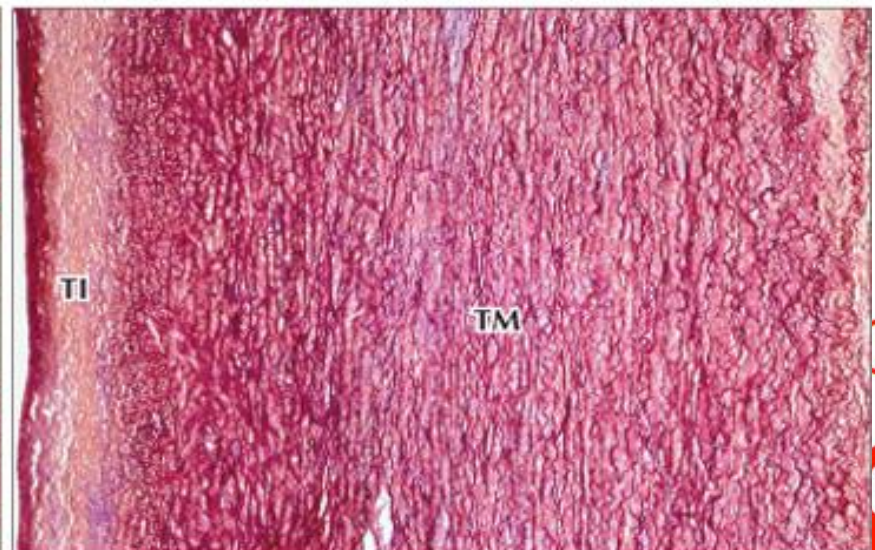
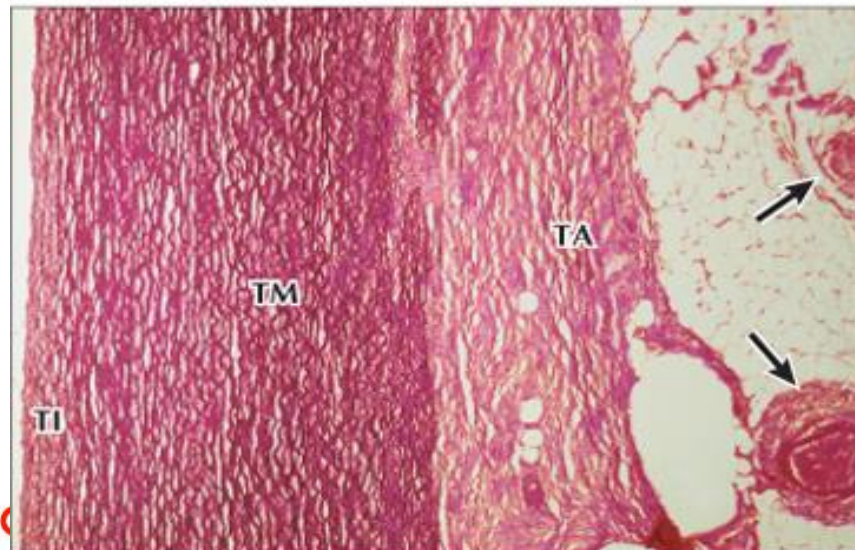
- **Elastické lamely** – koncentricky uspořádané
- Bb hladké svaloviny
 - Spojení pomocí mikrofibril



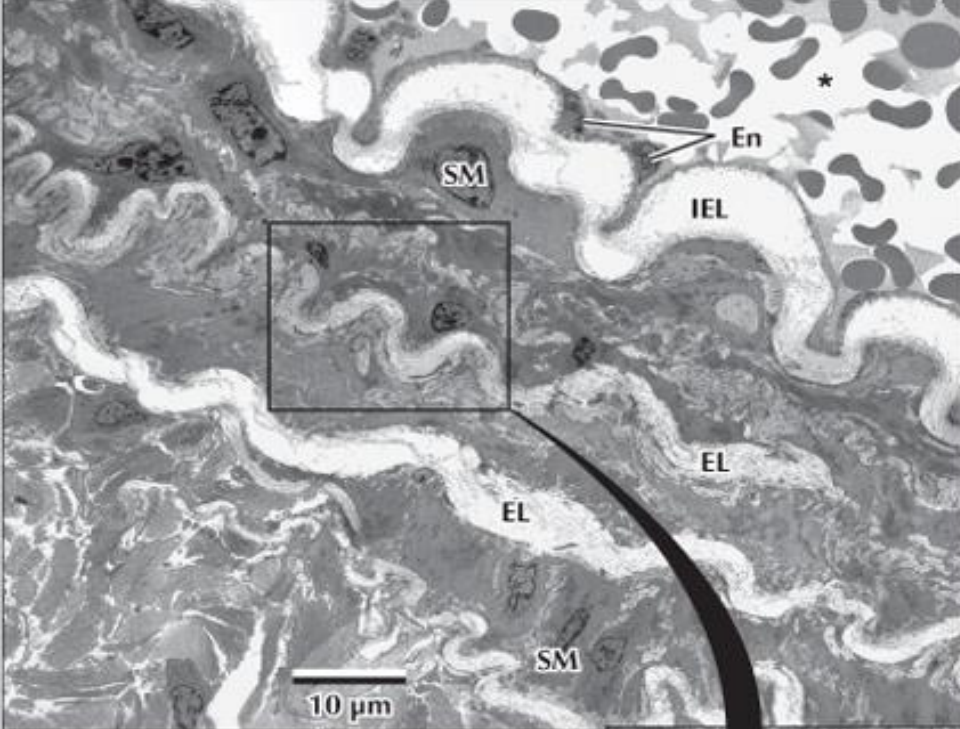
Heart viewed from below and behind.



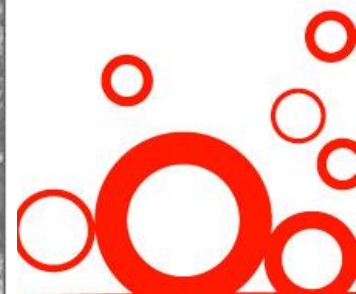
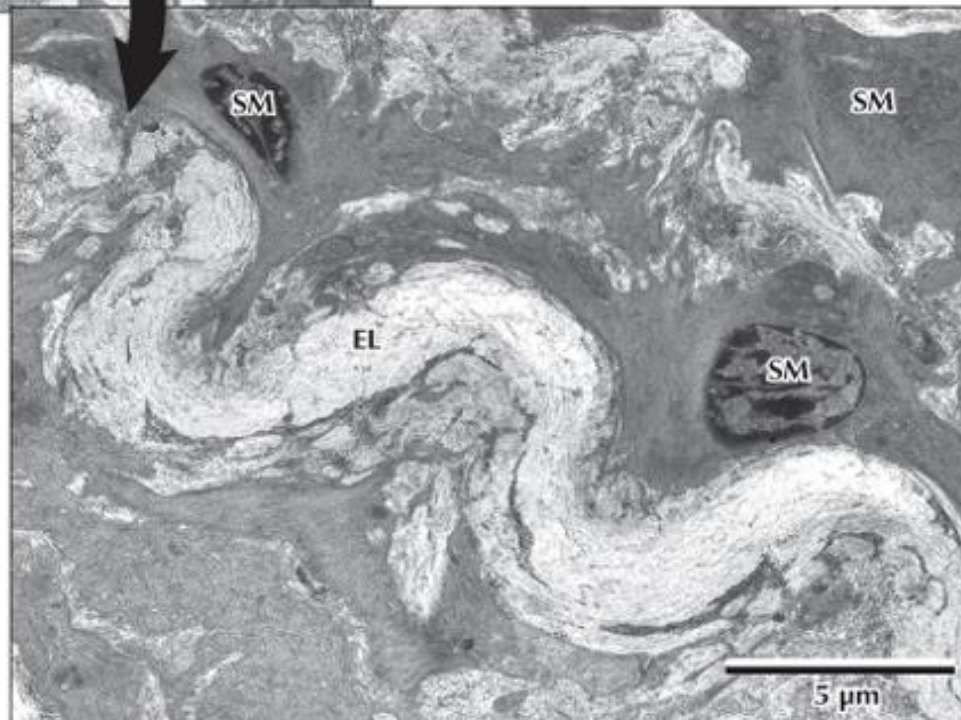
► **LM of part of the aortic wall.** The intima (TI) abuts the lumen (left). A thick media (TM) and an outer adventitia (TA) are also shown. Nuclei in the media at this magnification are mostly those of smooth muscle cells. Elastic laminae are not easily seen with this stain and need special preparative and staining methods for elucidation. 60×. H&E.

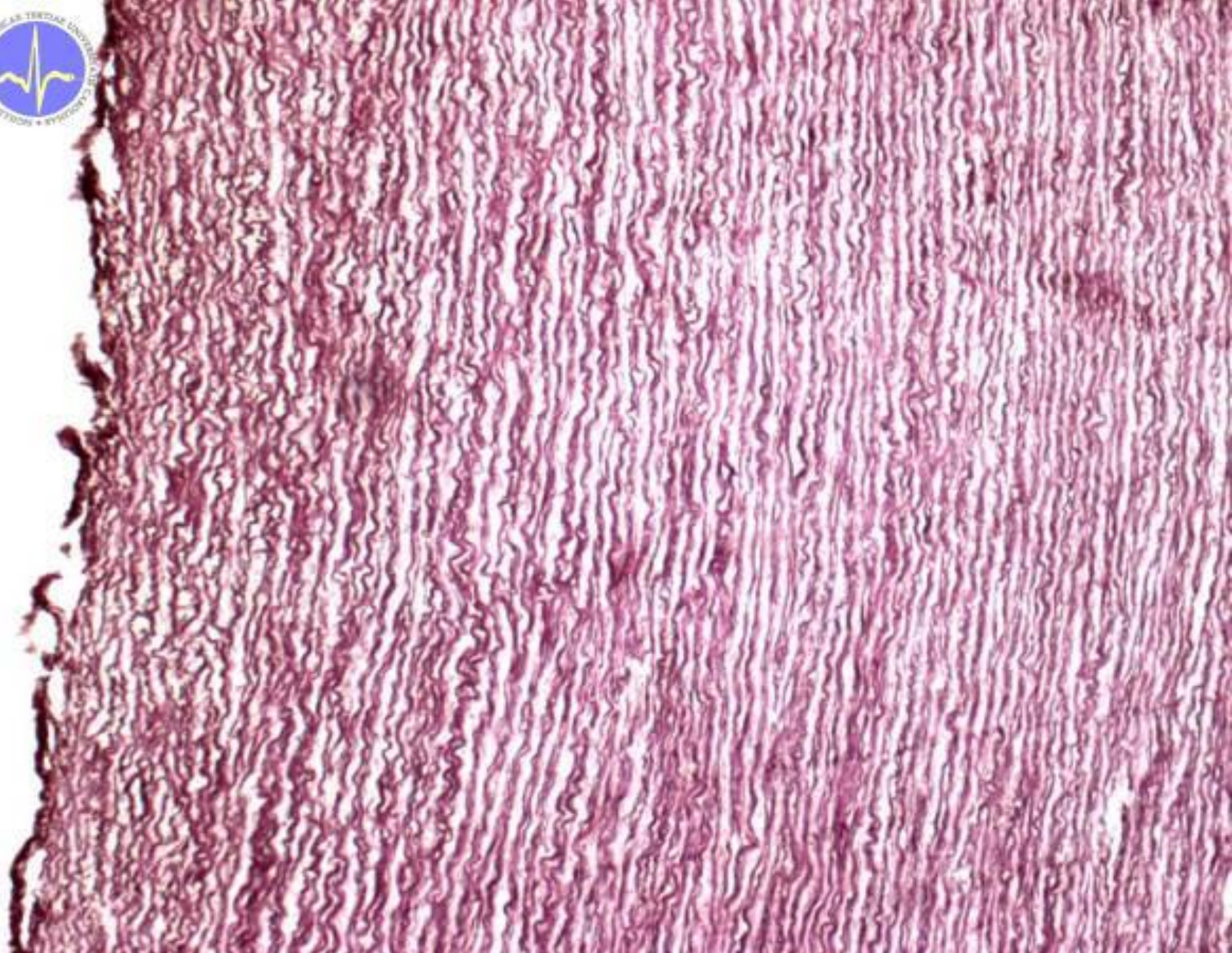


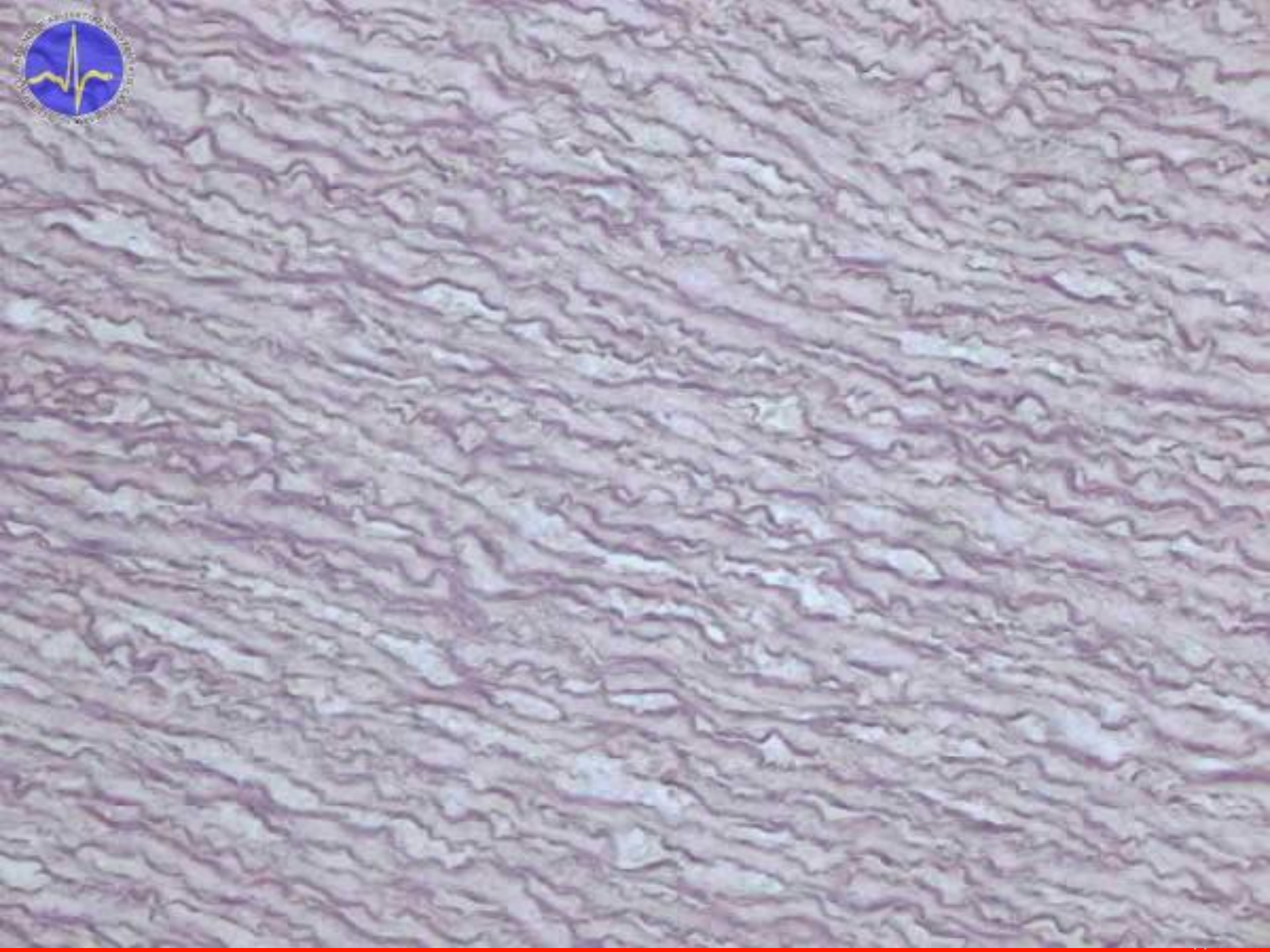
▲ **Comparative LMs of the wall of the aorta of a newborn (Left) and 25-year-old (Right).** In both vessels, a relatively thin tunica intima (TI) merges with a prominent tunica media (TM). This stain specifically demonstrates elastic tissue, a prominent feature of these arteries. The number of elastic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

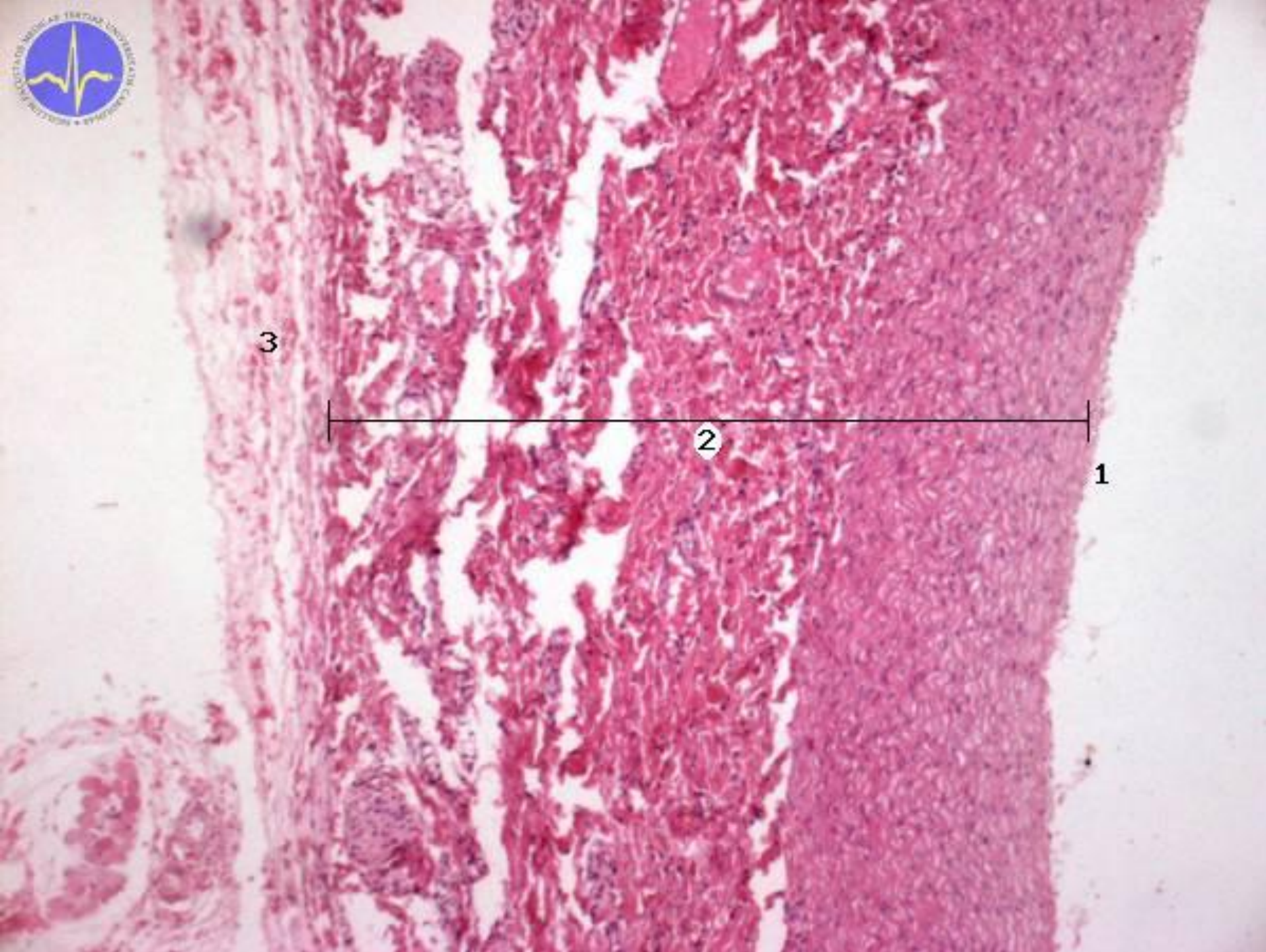


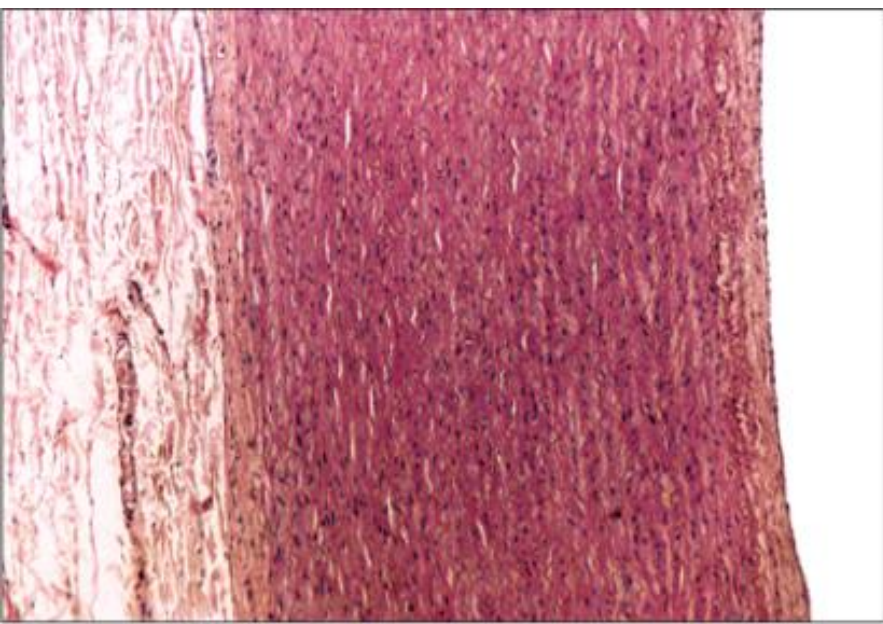
◀ ▼ **Electron micrographs (EMs) of parts of the aortic wall at low (Left) and medium (Below) magnification.** The endothelium (**En**) lining the lumen (★) consists of elongated cells, some of which are sectioned at the level of the nuclei. The underlying internal elastic lamina (**IEL**) is thick and electron lucent. The mononucleated smooth muscle cells (**SM**) alternate with multiple, concentric elastic laminae (**EL**) in the media. These muscle cells are branched and touch other muscle cells. The elastic laminae look corrugated because of partial constriction of the vessel at the time of fixation. **Left:** 1100×; **Below:** 4250×.







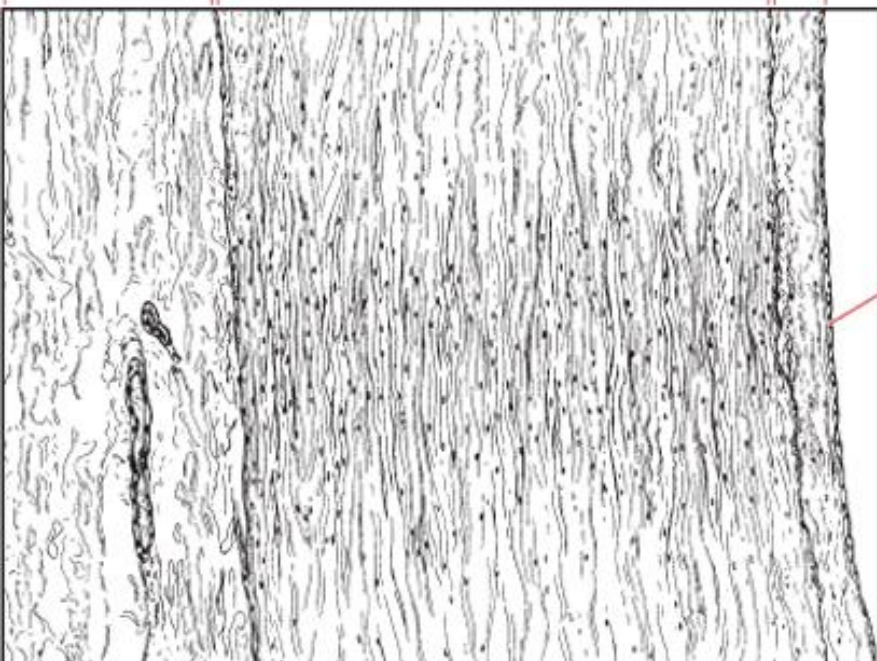




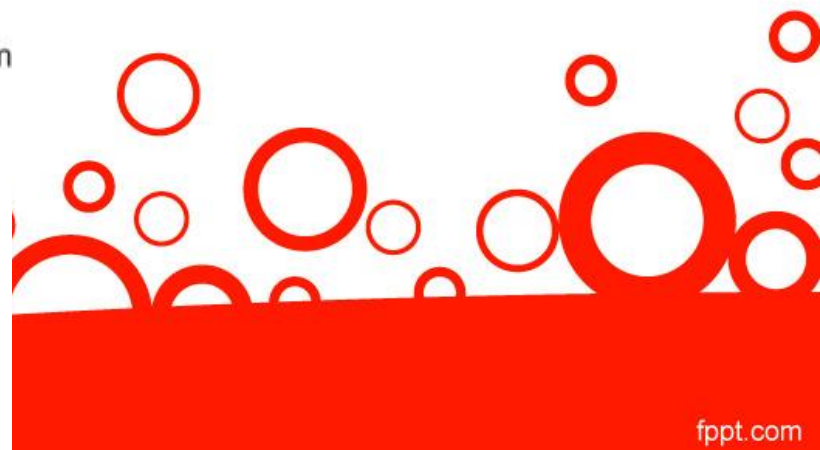
Adventitia

Media

Intima



Endothelium



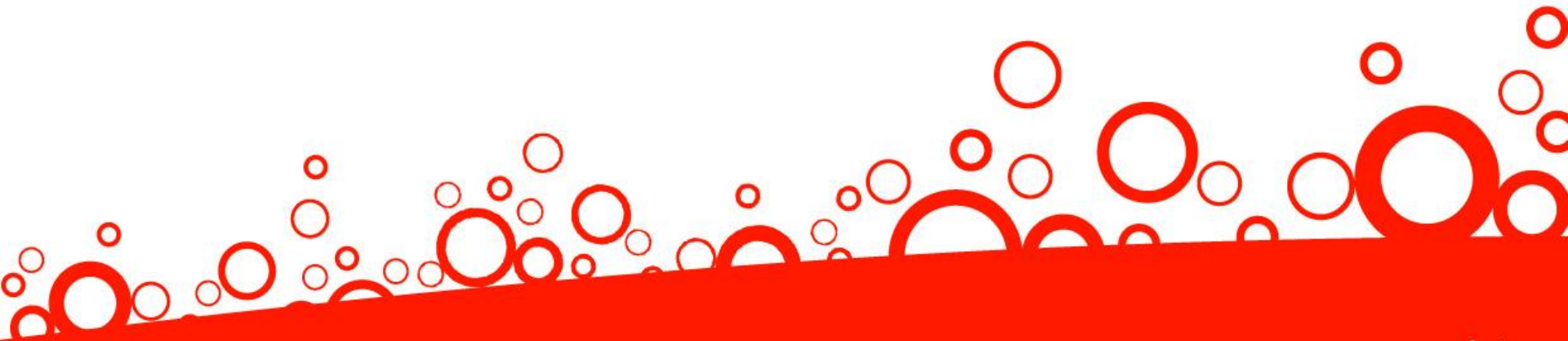
Tunica adventitia

- Fibroblasty
- Kolagenní vlákna (I)
- Proteoglykany
- Elastická vlákna

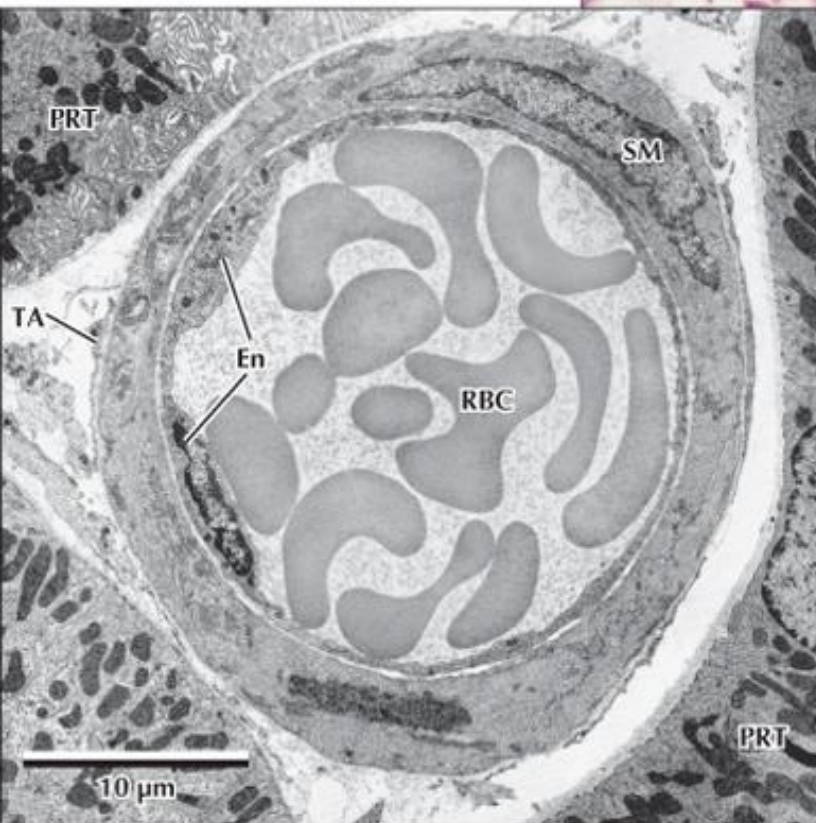
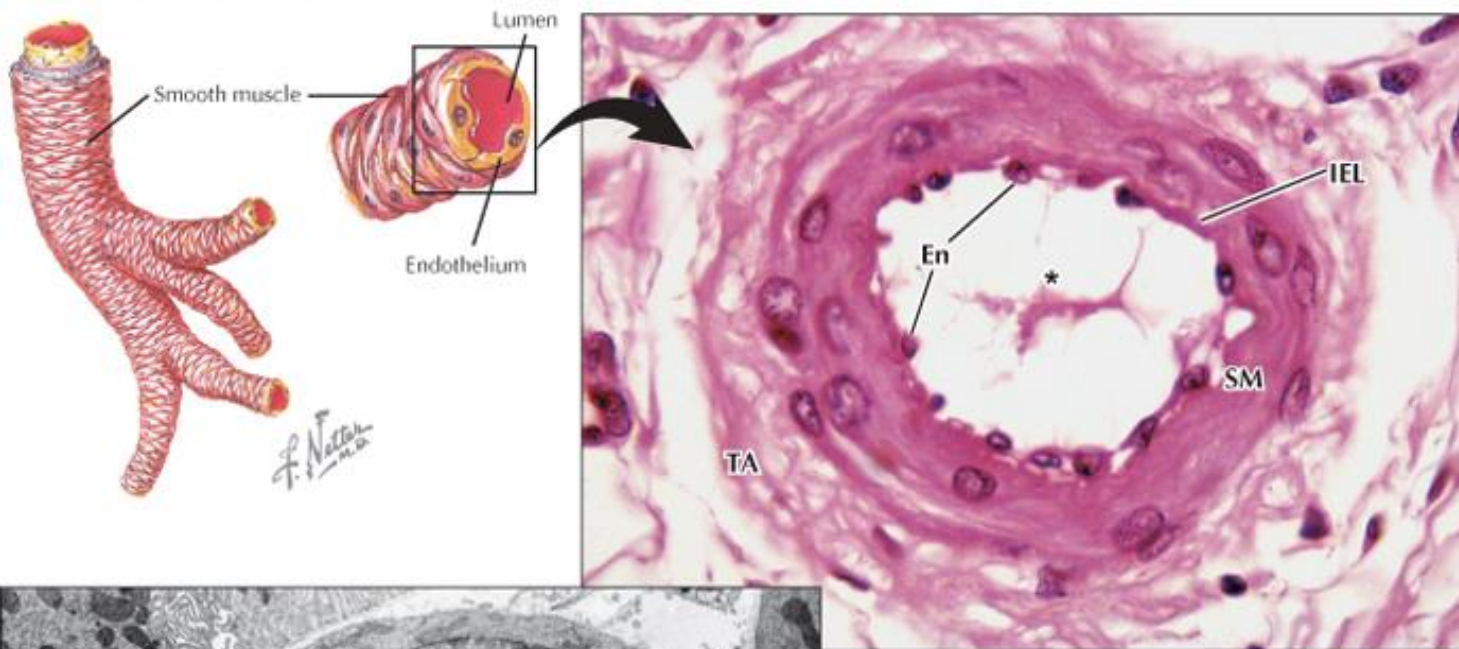
- Vasa vasorum – zevní ½ tunica media
- Nervové zásobení

Arterioly

- 1-2 vrstvy svalových bb, průměr <100um
- MEI chybí (x od malých arterií)
- Prekapilární sfinktery
- Periferní vaskulární rezistence

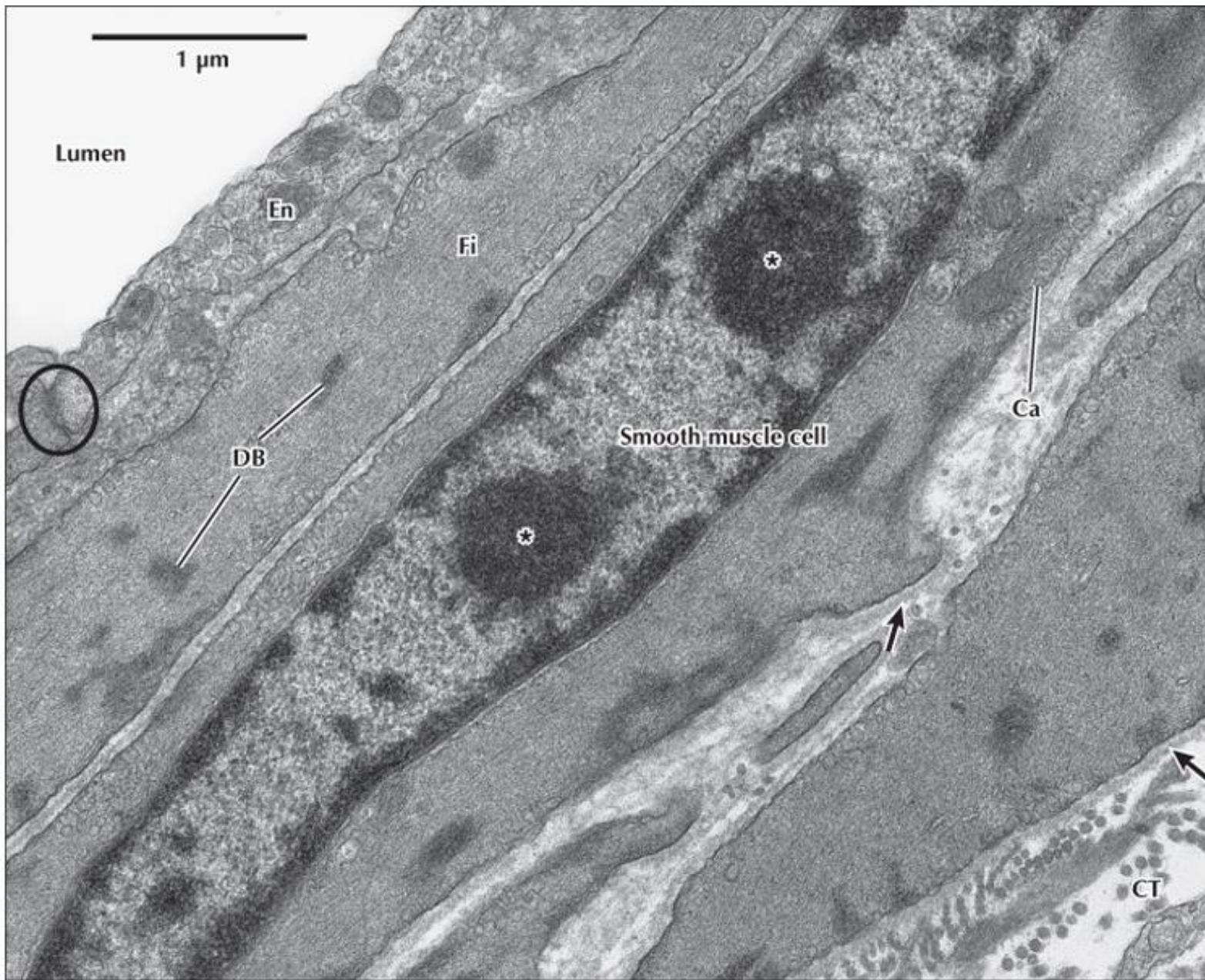


▼ Structure of arterioles.



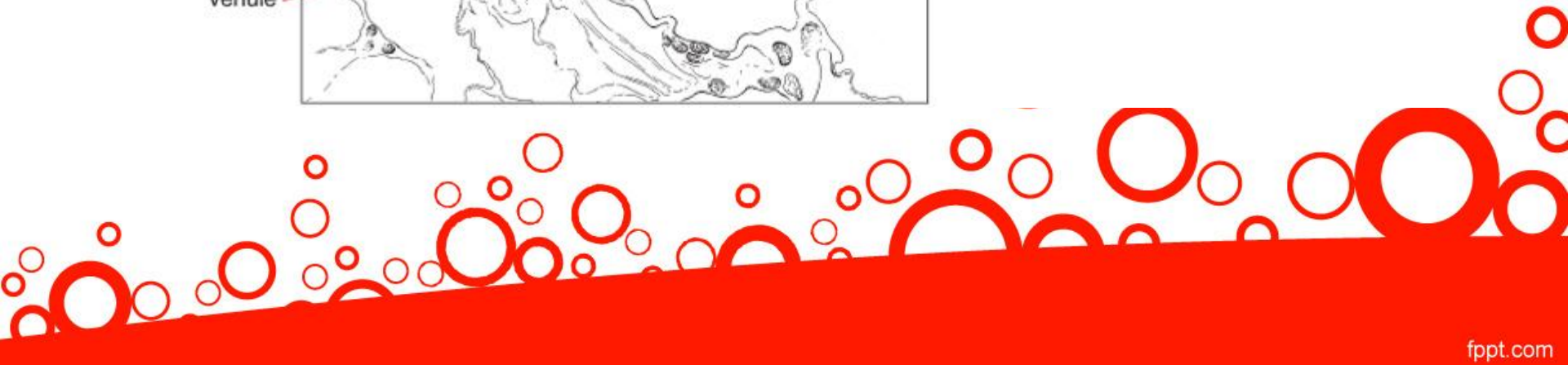
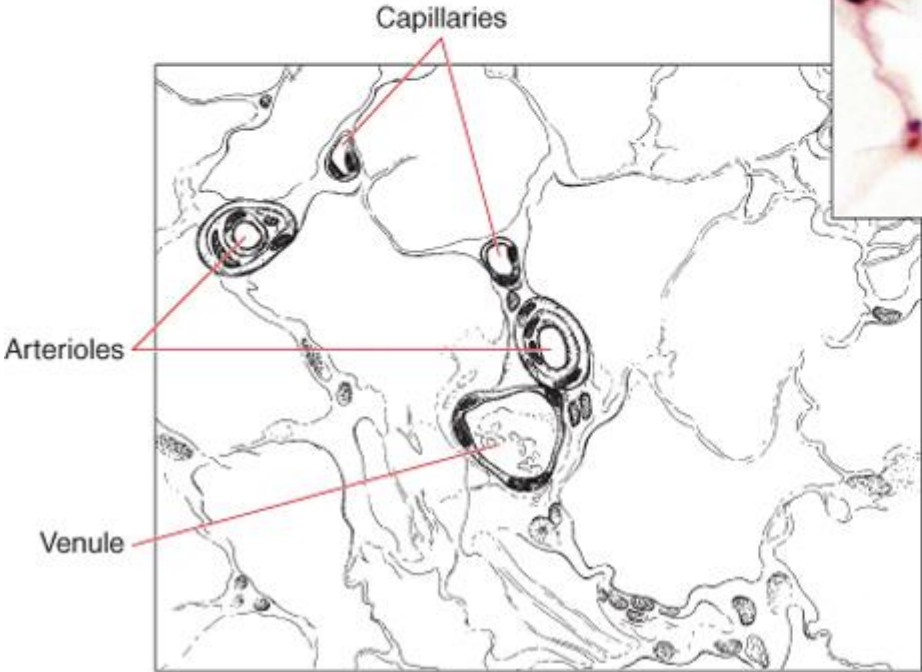
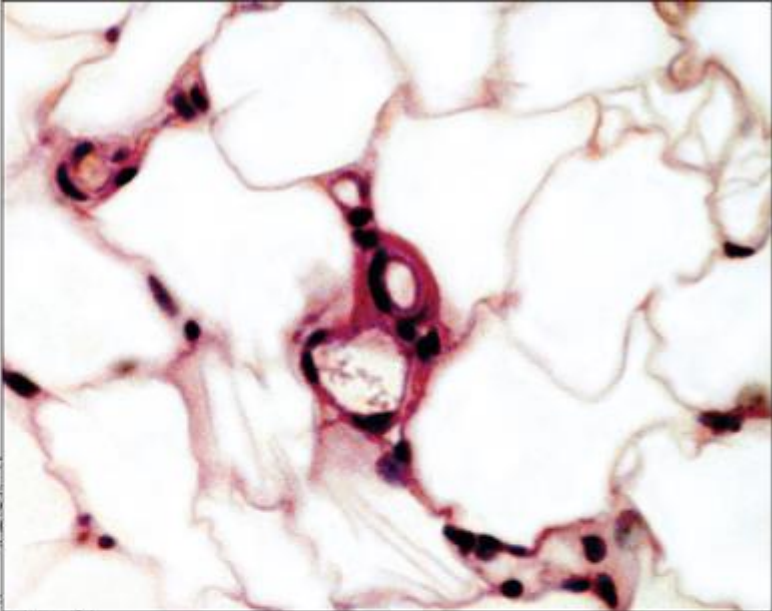
▲ **LM of an arteriole in transverse section.** Tightly arranged smooth muscle cells (**SM**) are oriented more or less circularly relative to the lumen (*). Their contraction causes the internal elastic lamina (**IEL**) to appear corrugated and endothelial cell (**En**) nuclei to bulge into the lumen.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

◀ **EM of an arteriole in the kidney in transverse section.** The lumen, filled with erythrocytes (**RBC**), is lined by one layer of endothelial cells (**En**). An inconspicuous adventitia (**TA**) surrounds circularly arranged smooth muscle cells (**SM**) in the media. Parts of proximal renal tubules (**PRT**) are in surrounding areas. 2800×. (Courtesy of Dr. W. A. Webber)



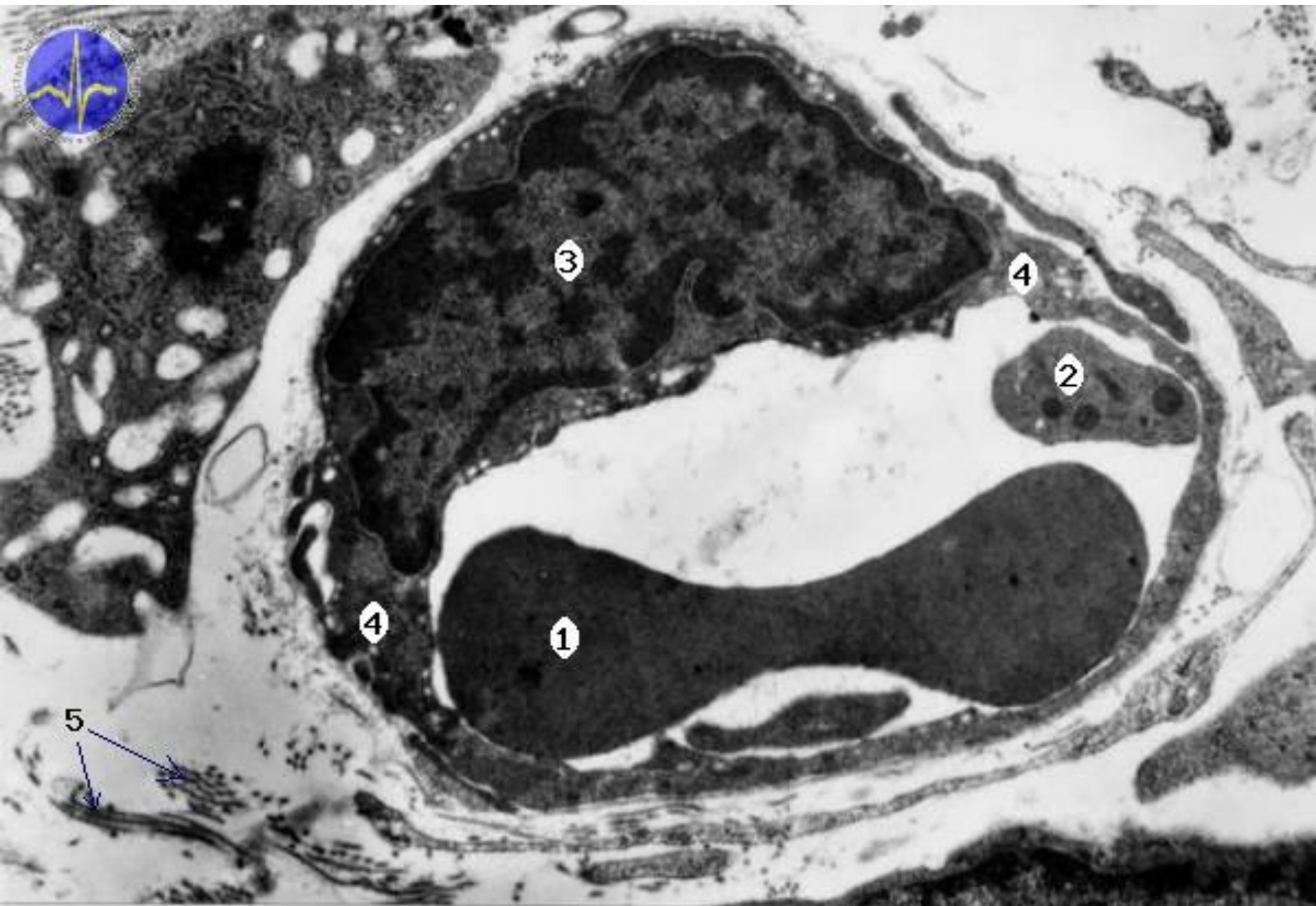
▲ **EM of the wall of an arteriole.** Endothelium (**En**) lines the lumen, and an intercellular junction (**circle**) lies between two endothelial cells. Cytoplasm of several smooth muscle cells, sectioned longitudinally, shows filaments (**Fi**), dense bodies (**DB**), and caveolae (**Ca**). A basal lamina (**arrows**) surrounds each cell. The elongated nucleus of one muscle cell contains two nucleoli (*). Connective tissue (**CT**) occupies intervening areas. 31,000 \times .





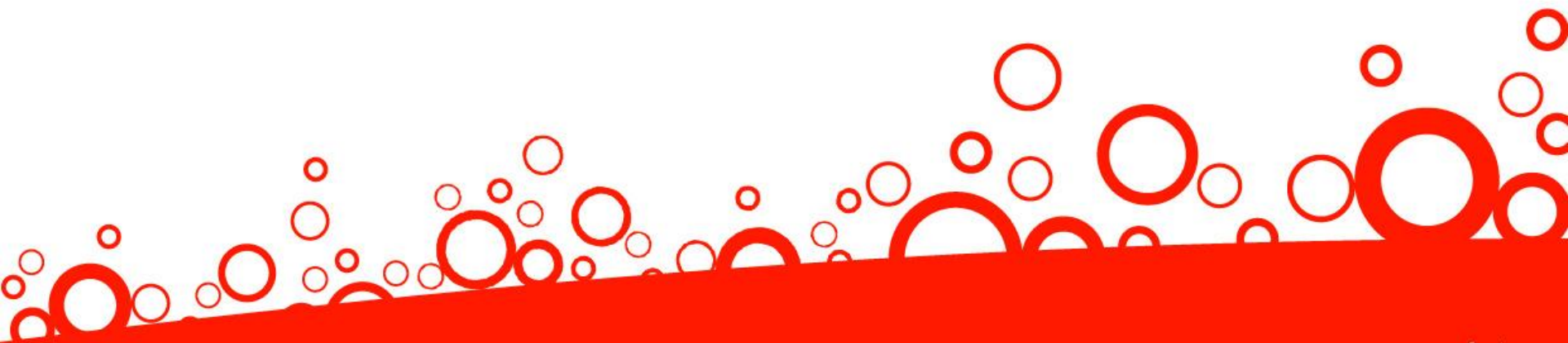
Kapiláry

- Vrstva endotelu na bazální lamině, ojediněle **pericyty** (Rougetovy bb)
 - Vaskulární podpora
 - Kontraktilní
- 1. Kontinuální endotel
- 2. Fenestrováný endotel
- 3. Nespojitý endotel

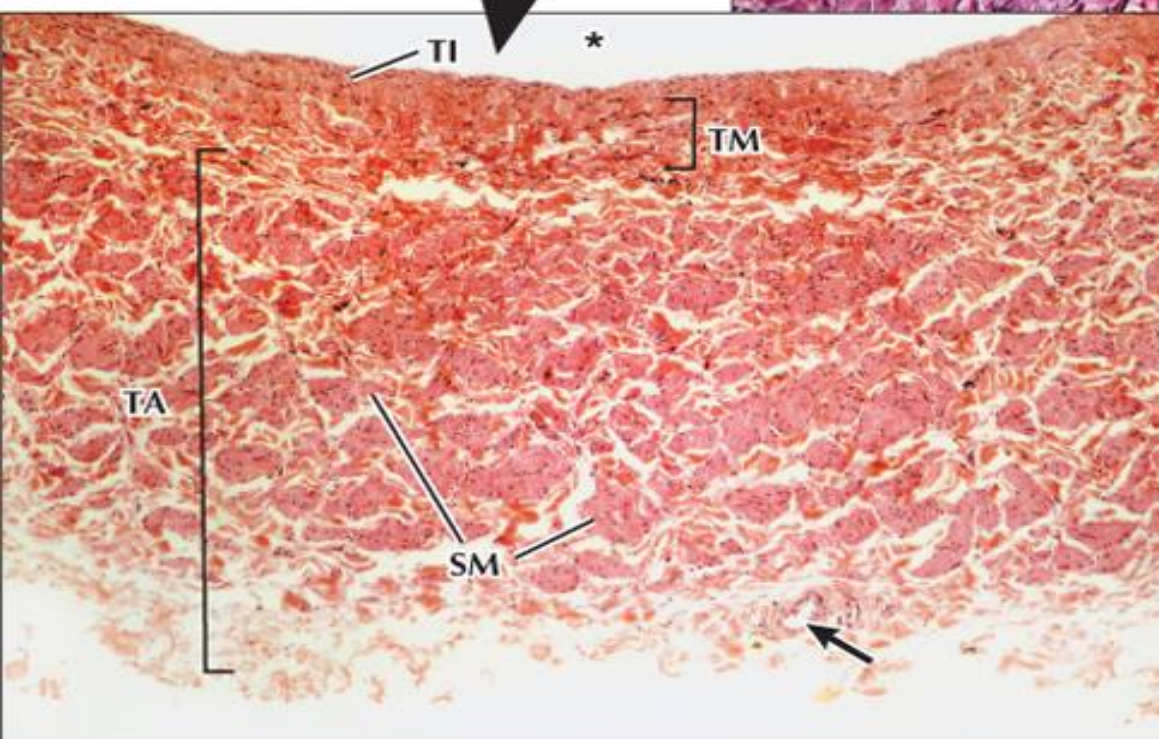
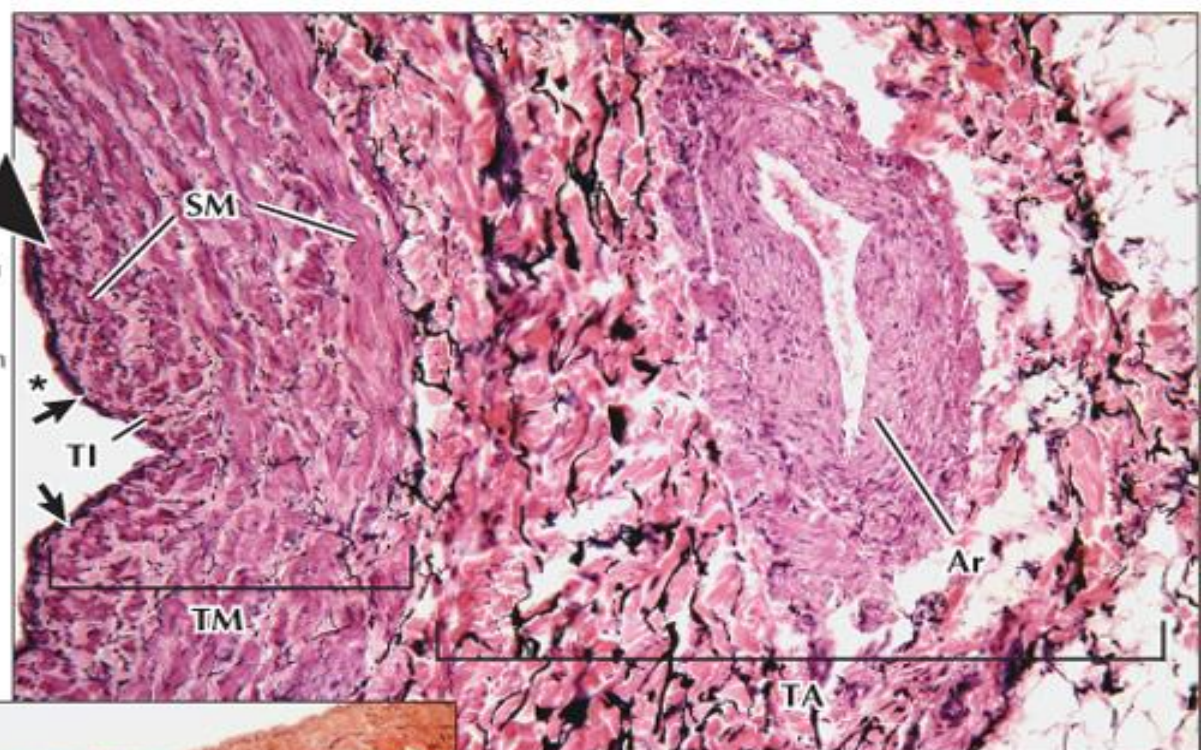
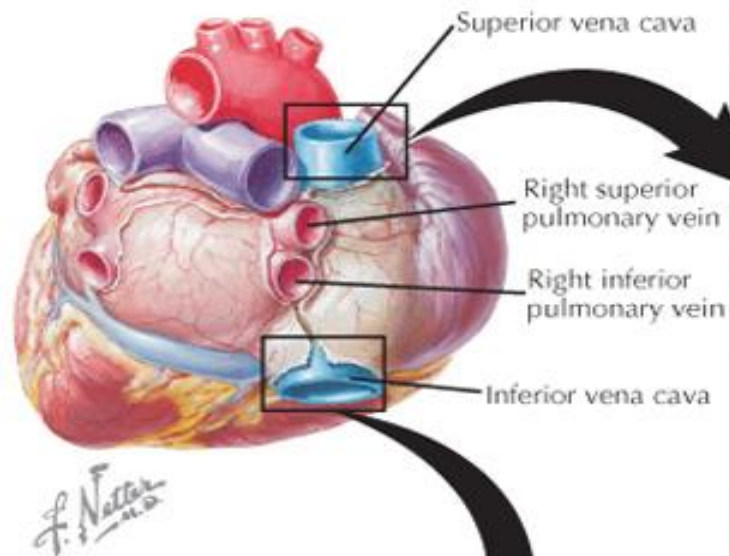


Žíly

- Tenčí stěna
- MEI – variabilně vytvořena, nesouvislá
- Tunica intima – chlopně
- Tunica media – slabá
- Tunica adventitia – nejtlustší

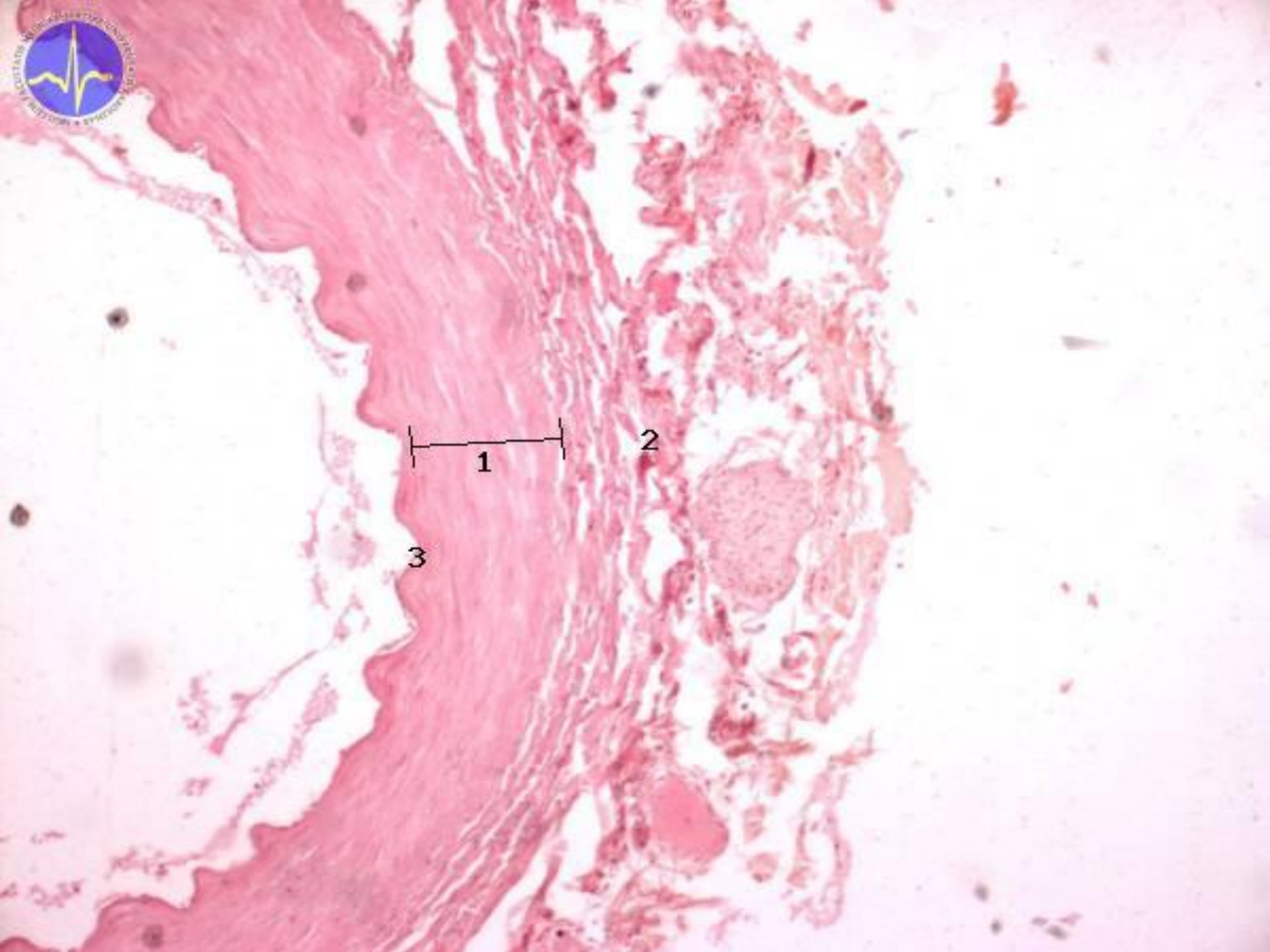


▼ Posterior aspect (base) of heart.



▲ **LM of the wall of the superior vena cava.** Elastic fibers stain black and are seen in the intima (**arrows**) and scattered in the media (**TM**) and adventitia (**TA**). The media also contains layers of smooth muscle (**SM**) oriented in different directions. A small muscular artery (**Ar**) is part of the rich vasa vasorum feature of veins of this caliber. The intima (**TI**) is indicated, and lumen of the vessel (*) is at the left. 100×. *Verhoeff-van Gieson*.

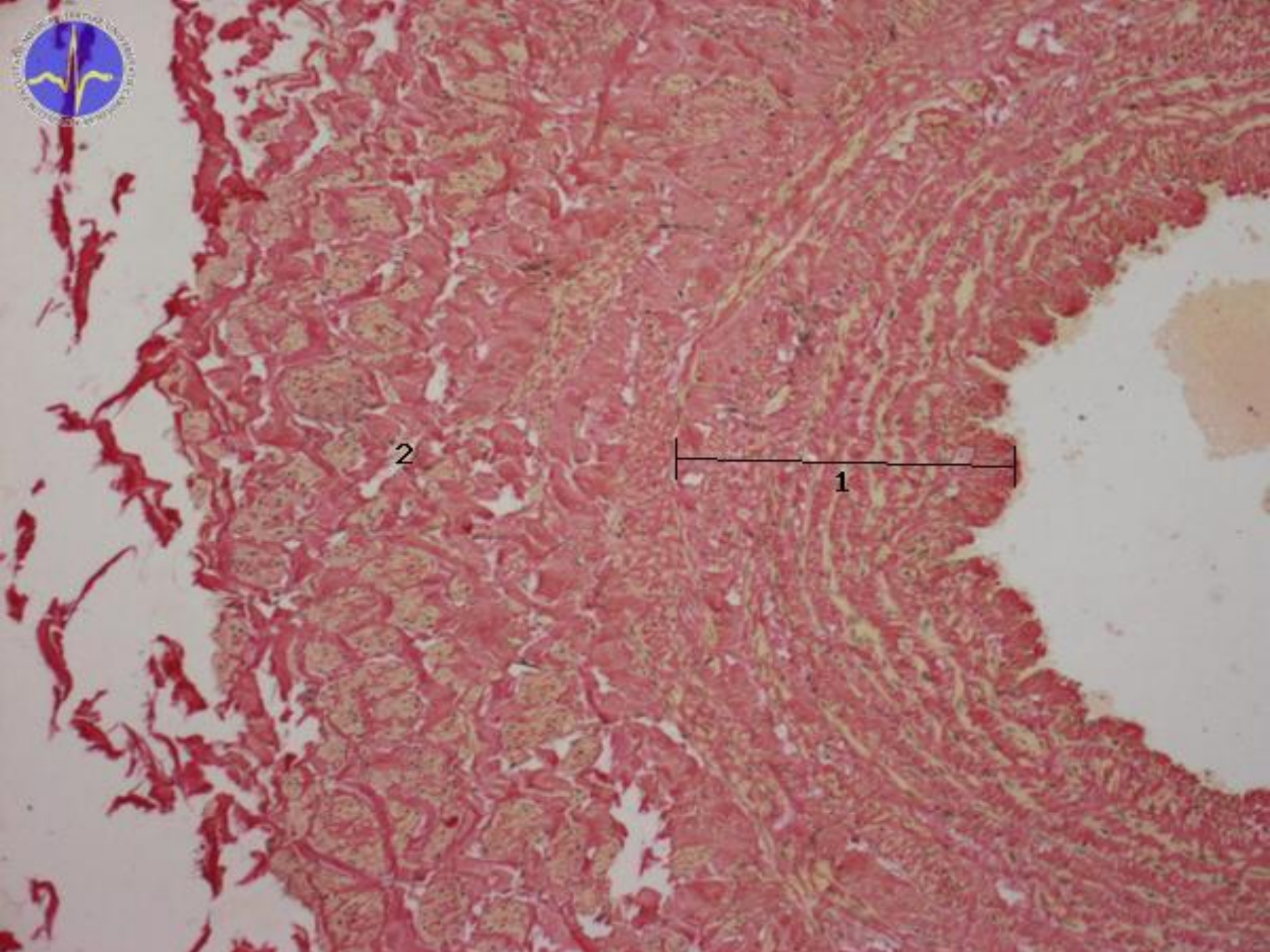
◀ **LM of the wall of the inferior vena cava.** The lumen (*) is lined by an attenuated intima (**TI**). A few layers of circular smooth muscle cells occupy the thin media (**TM**). The adventitia (**TA**), the thickest layer, contains longitudinal bundles of smooth muscle (**SM**) interspersed with collagen fibers, as well as vasa vasorum (**arrow**). 60×. *H&E*.



1

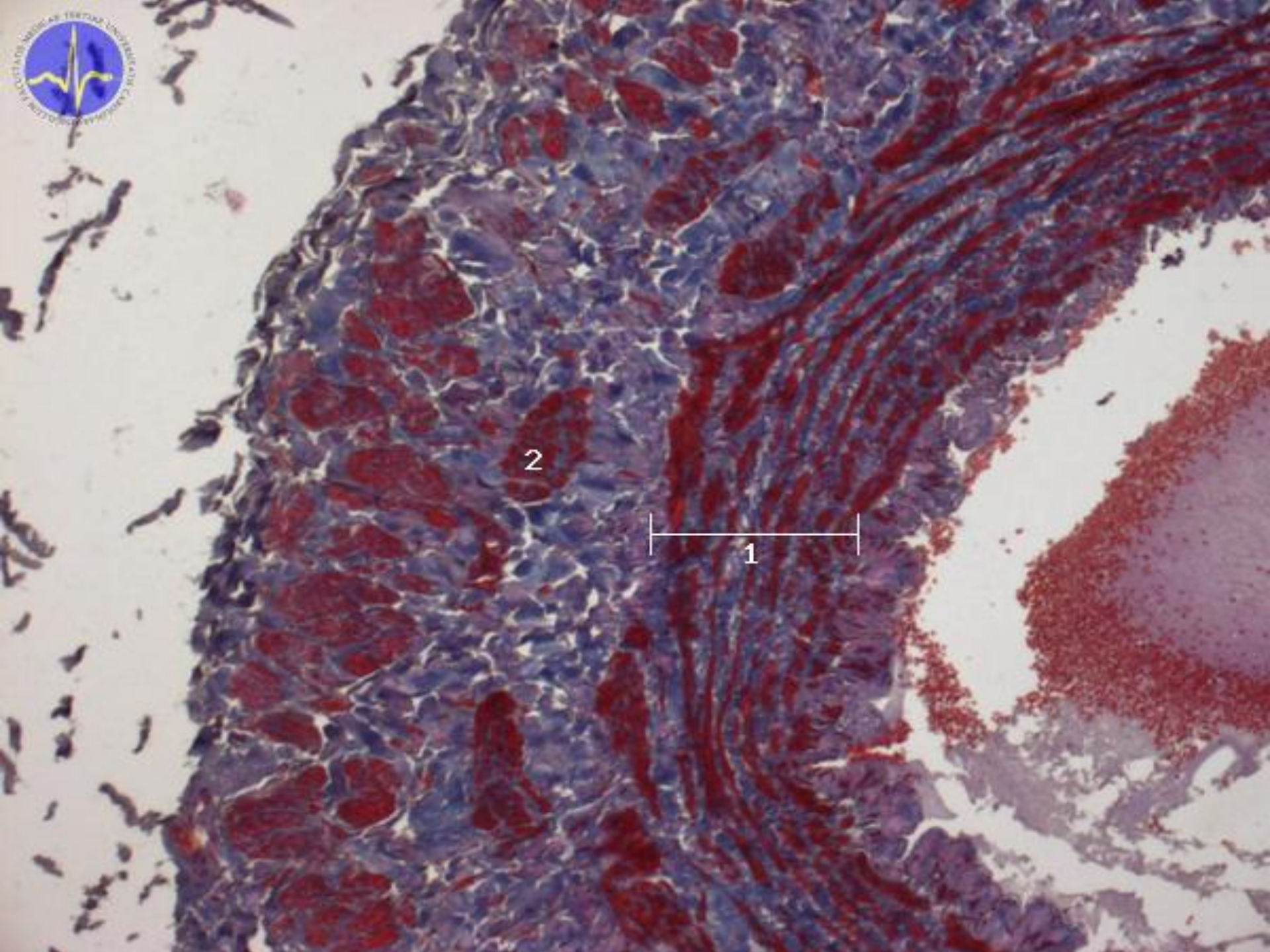
2

3



2

1



2

1

Artery

Vein

Tunica externa
(adventitia, contains
vaso vasorum)

Tunica media
(smooth muscle)

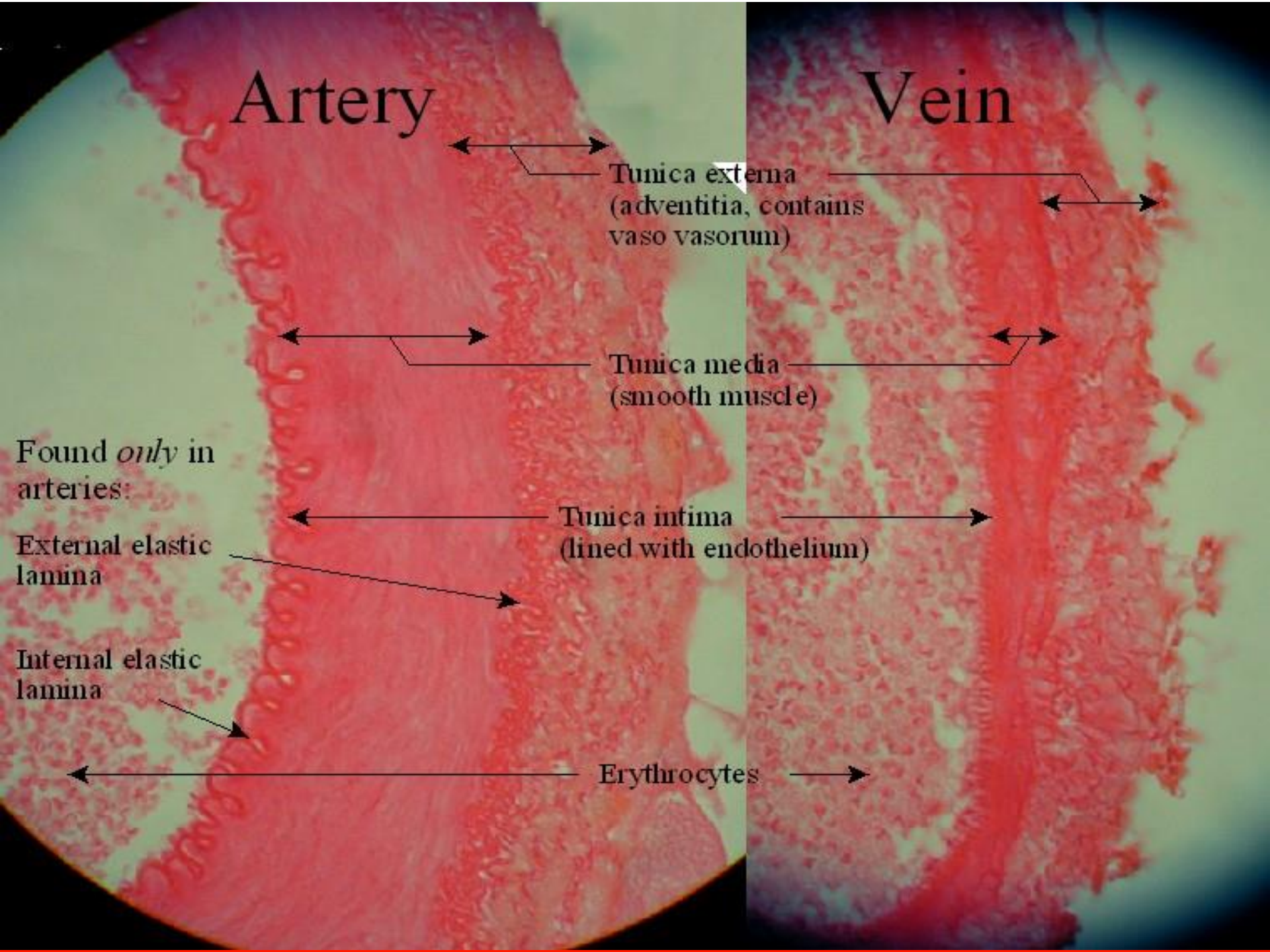
Tunica intima
(lined with endothelium)

Erythrocytes

Found *only* in
arteries:

External elastic
lamina

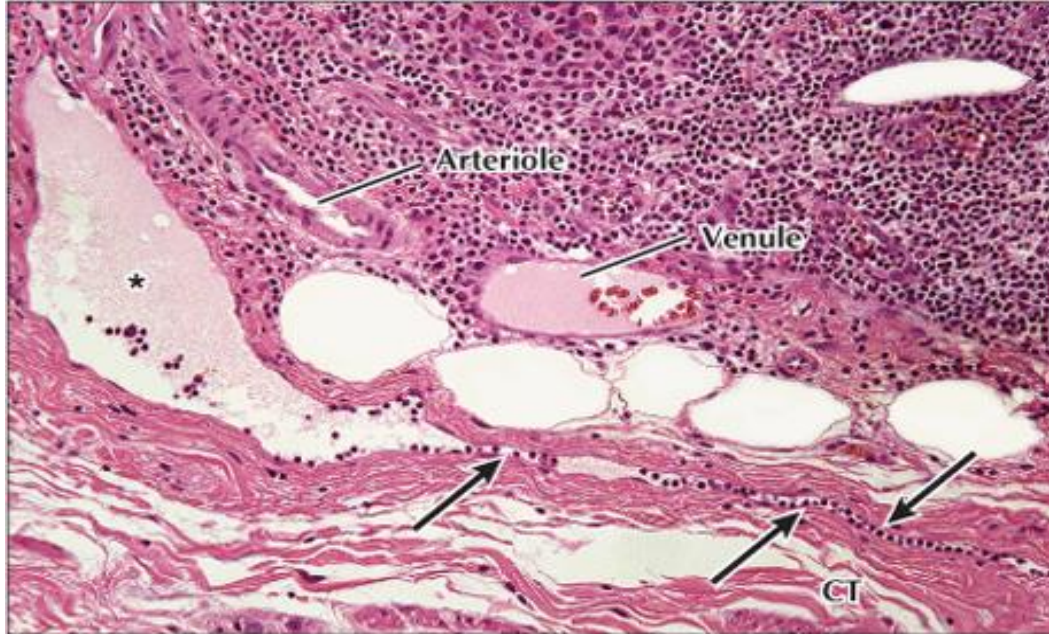
Internal elastic
lamina



Lymfatické cévy

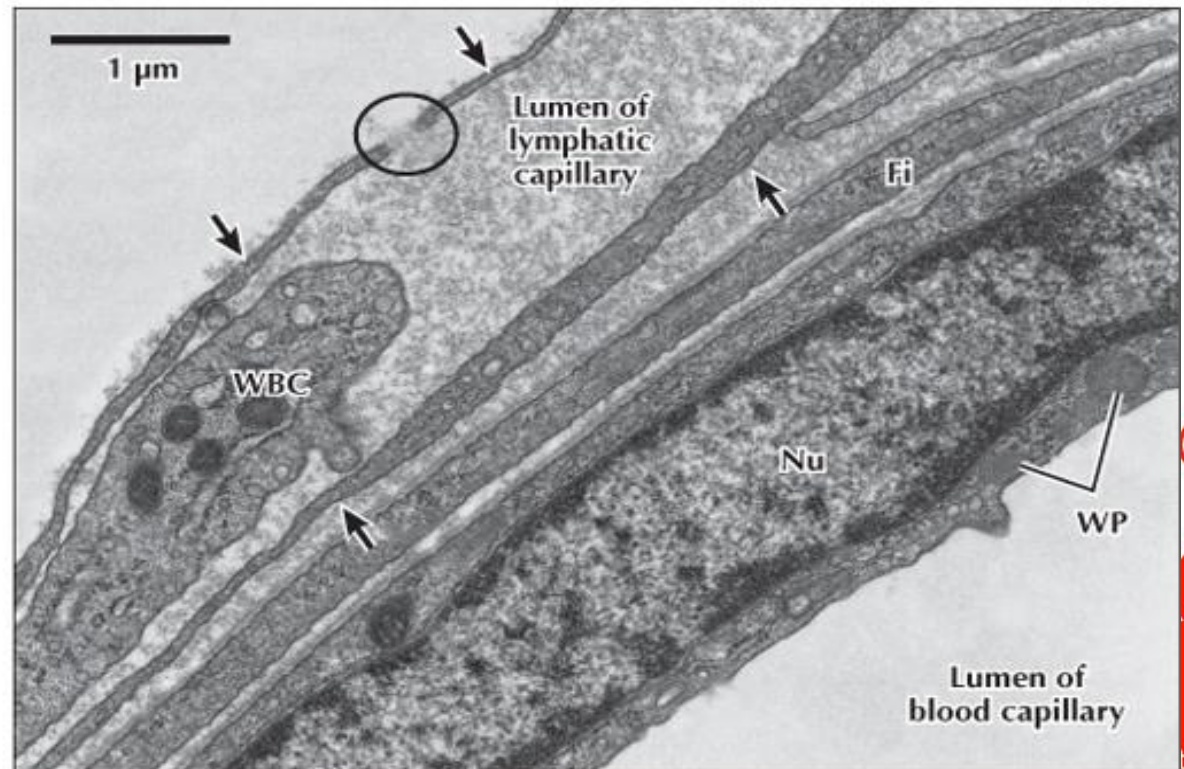
- Lymfatické kapiláry
 - Endotel, není klasická BL
 - Kotevní fibrily – kolagenní vlákna

- Lymfatické cévy
 - Stěna tlustší – vazivo + hl.sv.bb
 - chlopně



◀ **LM of a lymphatic capillary in longitudinal section.** This narrow, thin-walled vessel (**arrows**) has a uniform caliber, and its lumen contains a row of lymphocytes. It courses through connective tissue (**CT**), gradually increases in size, and drains into a larger lymphatic channel (*****), which has an irregular contour and a lumen filled with flocculent precipitate and scattered lymphocytes. An arteriole and venule are close to the lymphatic channel. Smooth muscle cells make up the arteriole wall; erythrocytes are in the lumen of the venule. 280 \times . H&E.

▶ **EM contrasting endothelium of lymphatic and blood capillaries.** Note the proximity of the two vessels. The highly attenuated endothelium of the lymphatic (**arrows**) encloses its lumen, which holds a white blood cell (**WBC**). A wide intercellular gap (**circle**) separates ends of two endothelial cells of the lymphatic. The cells have many vesicles and filaments. The thicker endothelium of the blood capillary is sectioned at the level of a nucleus (**Nu**). The cytoplasm contains Weibel-Palade bodies (**WP**), which are unique to these cells, are close to the surface, and face the lumen. The process of a fibroblast (**Fi**) is in interstitial connective tissue between the two vessels. 19,000 \times . (Courtesy of Dr. A. W. Vogl)



Díky za pozornost

blankovabetka@seznam.cz

