Department of Histology and Embryology
Faculty of Medicine, PU, Olomouc, CZ

Histology practical No. 11

Topics:

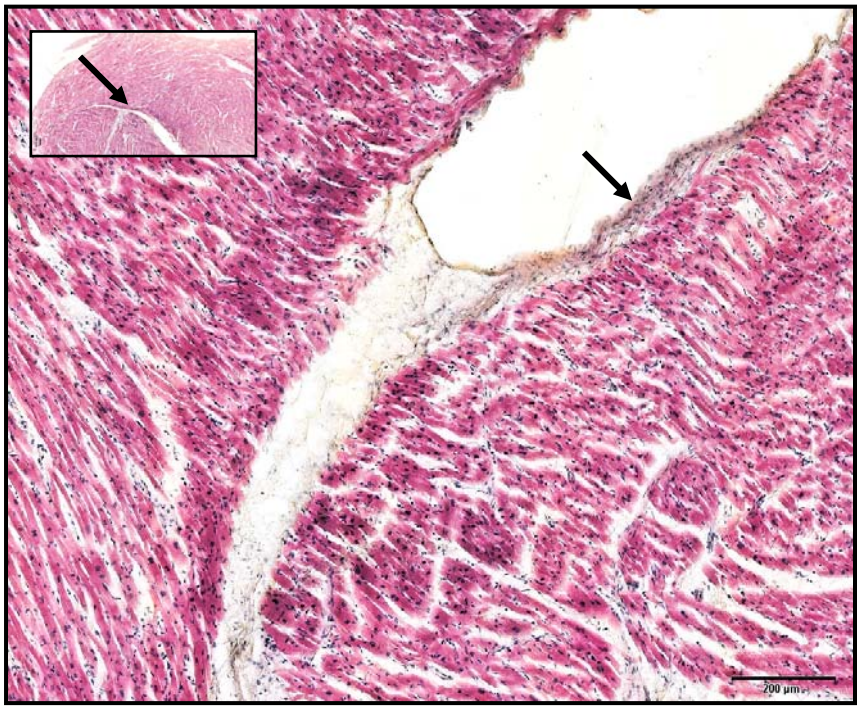
1 - STRUCTURE OF THE HEART, ELASTIC AND MUSCULAR BLOOD VESSELS, ARTERIOLES, VENULES AND BLOOD CAPILLARIES. (Pre-lab rev.ppt).

2 - IDENTIFICATION OF LAYERS IN THE HEART WALL, RECOGNITION OF LARGE AND SMALL BLOOD VESSELS AND CAPILLARIES IN STAINED HISTOLOGY AND PC-MONITORED SLIDES OR PRINTED IMAGES.

3 - UNDERSTANDING THE UTRASTRUCTURE AND RECOGNITION OF THE THREE TYPES OF BLOOD CAPILLARIES IN EM IMAGES.

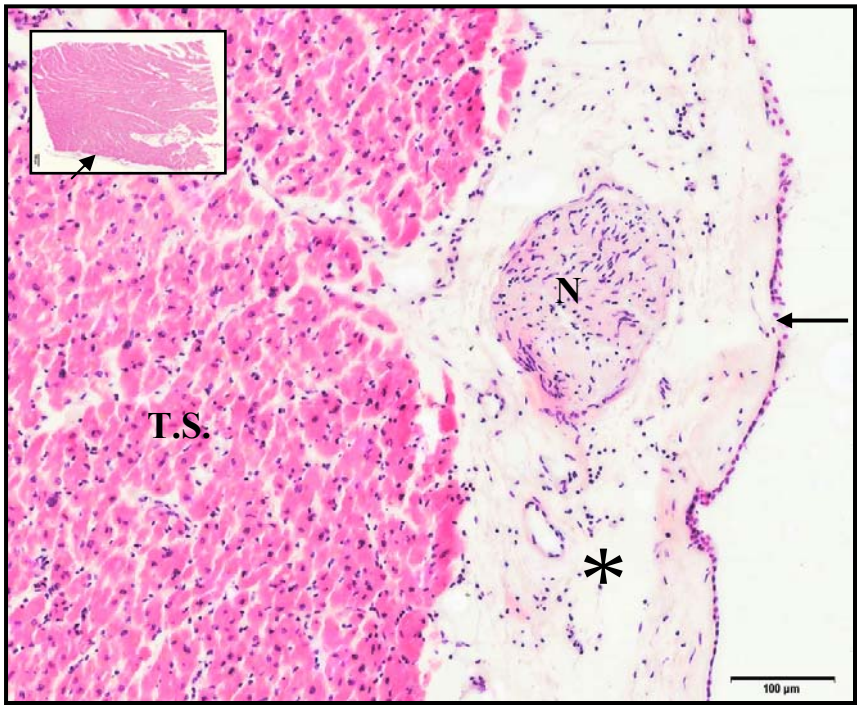
Slides:

1. Myocardium (myokard, sl.n. 1) section, Harris H&E stain.



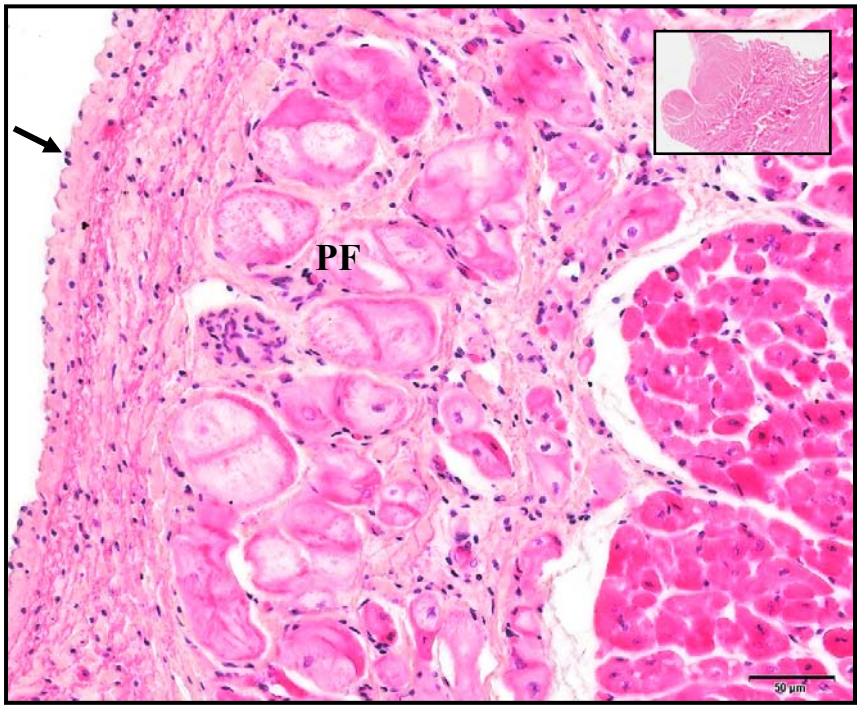
Heart has a three-layered wall composed of **endocardium, myocardium** and **epicardium**. It is externally also surrounded by a fibrous sac – the **pericardium**. Due to the large thickness of the heart wall, this section shows only two components – the endocardium and myocardium. Note the variable orientation of the cardiac muscle cells in the myocardium. Revise your knowledge on the structure of cardiomyocytes, look for striations in their cytoplasm and locate some intercalated discs. Note the numerous capillaries between the muscle cells. The thin endocardial layer (arrow) is incomplete or missing in some parts of the section. Where available, locate the endothelial cells. Several medium-sized blood vessels - the branches of coronary arteries and veins - are available in the connective tissue of this muscle. What is the structure of the endocardium? What is the structure and function of intercalated discs?

2. Epicardium (epikard, sl.n. 1A) section, H&E stain.



This slide shows the most external part of the heart wall that includes a big portion of the myocardium and the adherent layer of the **epicardium**. The cardiac muscle cells are shown here in longitudinal sections (the internal part of the heart wall), and in transverse sections (the external part of the heart wall, T.S.). This part of the wall is covered with the epicardium (arrow), which consists of one layer of a simple squamous epithelium (**mesothelium**) and a layer of subepicardial connective tissue of variable thickness (*). In this layer, you can observe accumulations of adipose tissue as well as sections of autonomic peripheral nerves that enter the heart for innervation (N).

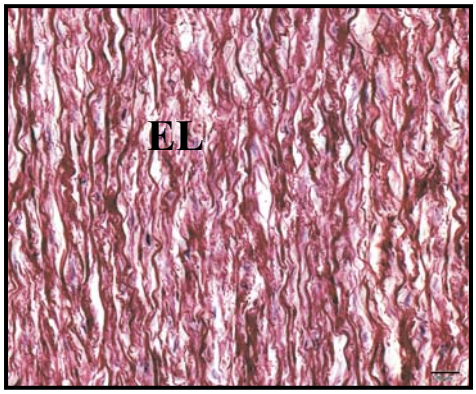
3. Myocardium, conductive system (převodní systém srdeční, sl.n. 84) s., H&E stain.

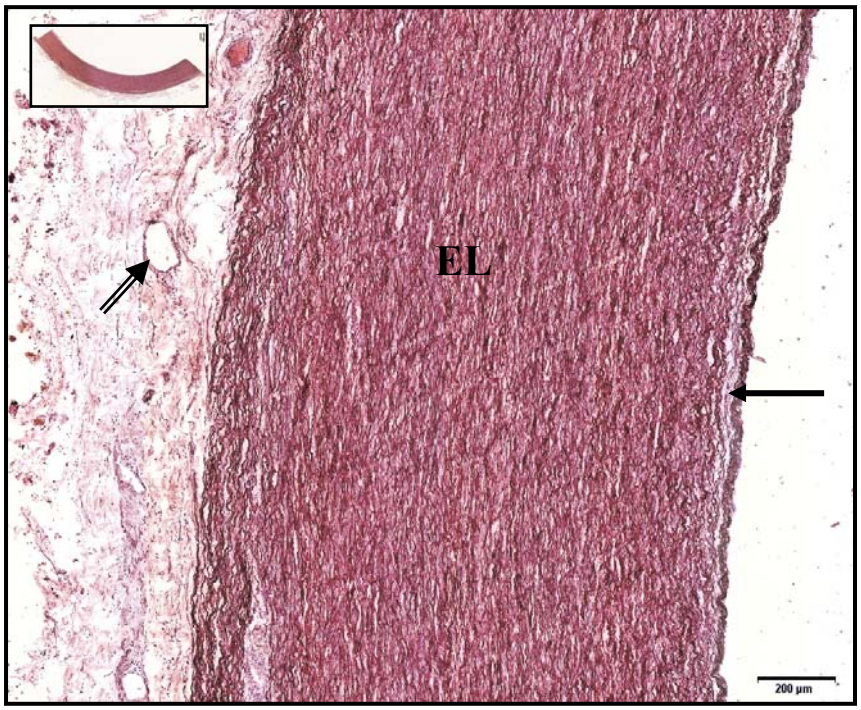


This slide shows the most internal part of the cardiac muscle that is covered with the **endocardium**. Here, you can clearly observe the simple squamous endothelial cells (arrow) and the layer of the **subendothelial connective tissue**. In the deeper layer of the **endocardium** (the **subendocardial connective tissue**) are located conductive cells of the heart (**Purkinje fibers**, PF). They are large, modified cardiac muscle cells which contain a few myofibrils, centrally located nucleus and a cytoplasm that is rich in glycogen - hence it is pale stained. These cells are arranged longitudinally into fibers and make contacts between themselves, and also with cardiomyocytes, through gap junctions in order to transfer the contraction impulse further. In the same section, compare these cells with the ordinary cardiomyocytes. What is the functional significance of these conducting cells? What are the impulse-generating cardiac muscle cells and where are they located?

4. <u>Aorta (aorta, orcein, sl.n. 4) t.s., Orcein stain.</u>

This transverse section through the thick wall of aorta (elastic type of blood vessel) shows all three layers of its wall. The **tunica intima** is on the concave side of the section (arrow). Due to the special staining of this specimen, the endothelial cells





are not clearly visible as they are lining the surface. The sub-endothelial connective tissue as well as the complete **tunica media** are filled up with the parallel-running, tortuous brown-black **elastic laminae** (lamellae, EL), which are specifically visualized in this slide. Note, that the prominent elastic laminae are branching and rejoining again. The pale spaces between them contain a sparse network of collagen fibers (pale pink stained) and some fibroblasts and smooth muscle cells. What is the function of these laminae in this organ? Can you identify the internal and the external limiting laminas here? The most external layer of the wall – the **tunica adventitia** – contains some fragments of elastic fibers, a good proportion of collagen fibers and cells of the connective tissue. Several **vasa vasorum** (double arrow) can be observed in this layer of aorta.

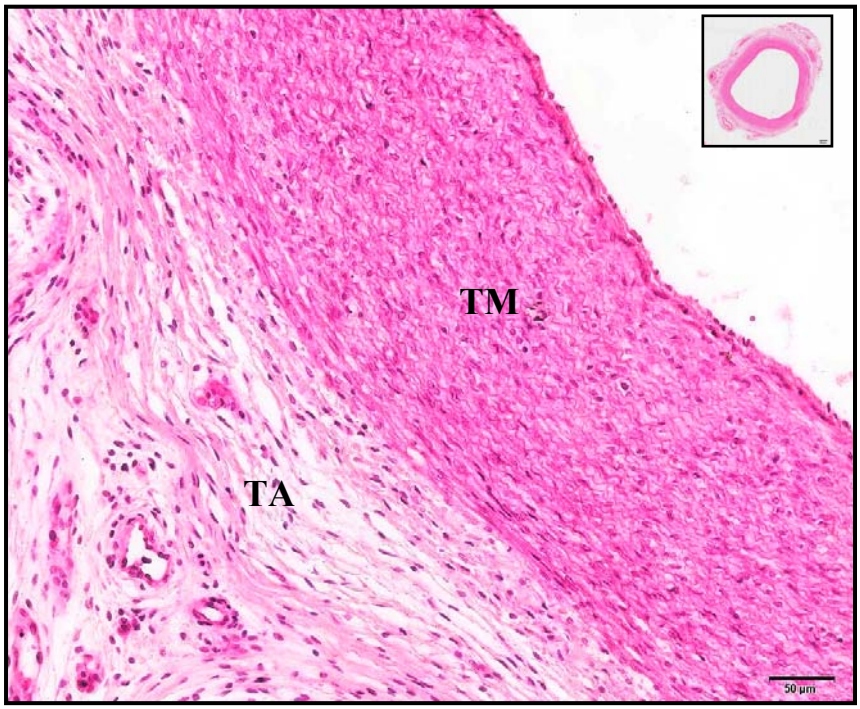
5. <u>Aorta (aorta, sl.n. 4A) t.s., H&E stain.</u>

This slide shows a similar section of aorta stained with the standard acidic and basic stain for overview of the wall structures. All the three layers are visible here, with the **tunica intima** (TI) and **tunica adventitia** (TA) stained lighter as compared to the **tunica media**. No elastic component of the wall is visualized here but it can be traced as white, empty-looking undulated spaces in the

middle layer. Nuclei and the cytoplasm of smooth muscle cells are visible in t. media and the connective tissue elements are seen in the adventitia layer. **Vasa vasorum** (arrow) and **nervi vasorum** are also present in this most external layer. What is the reason behind the presence of the vasa vasorum?

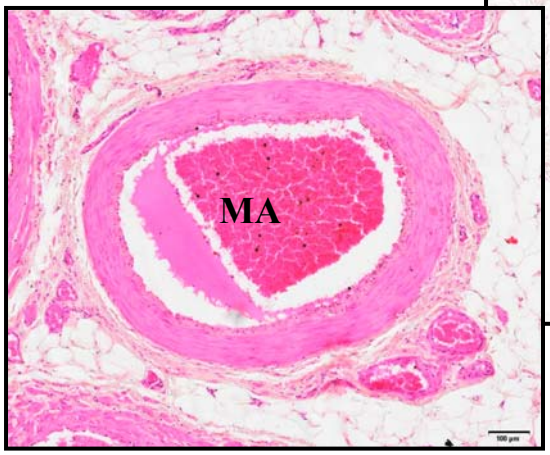
6. Elastic artery (arterie, sl.n. 5) t.s., H&E stain.

This slide shows a complete profile of a smaller **elastic artery** with its layers shown in a standard stain. The **intima** layer clearly shows the **endothelial cells** (in places slightly detached from the inner surface). The **tunica media** (TM) is darker-stained here and shows both – the **elastic** and the **muscular** components of this layer. The **tunica adventitia** (TA) with many **vasa vasorum** is located on the outside surface of this vessel. Try to classify these small blood vessels as you know their morphological features.

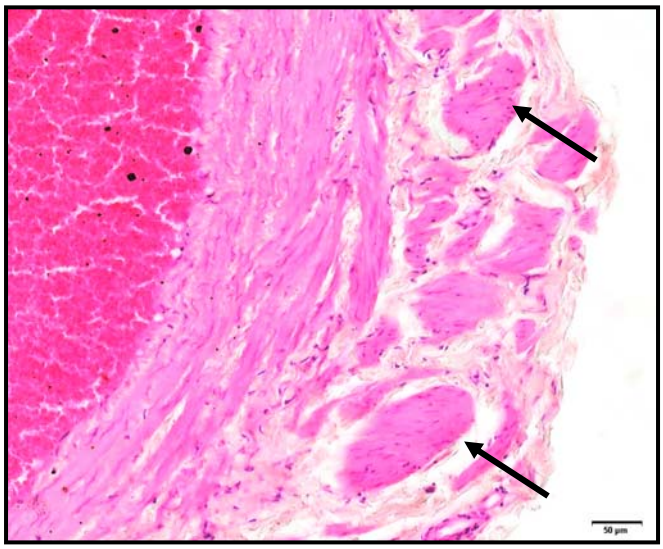


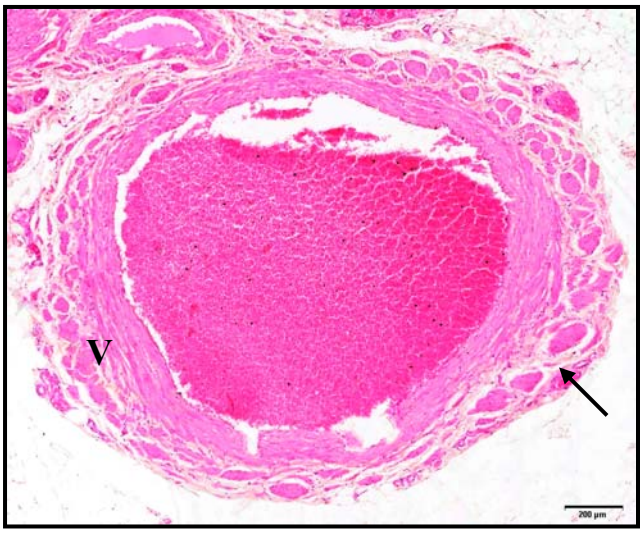
7. Blood vessels (cévy, sl.n. 5A), t.s., H&E stain.

This slide contains a bundle of blood vessels taken from a limb. All vessels are shown in transverse sections and the bundle contains one **muscular artery** (MA) and several accompanying **veins** and **venules** surrounded with the adipose tissue. Locate the muscular artery (MA) first. It can be recognized by the presence of



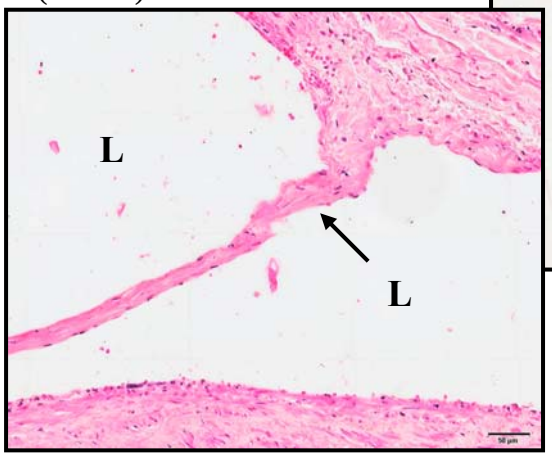
the **internal elastic lamina** and a thick layer of **muscular media**. The **adventitia** of this vessel is relatively thin. The other medium-sized vessels around are veins. Study the layer of their wall and note the presence of the **smooth muscle cells**, arranged in small bundles in the **tunica adventitia** (arrows). What is the orientation of these smooth muscle cells in the adventitia? Try to locate also some small-sized blood vessels in the surrounding connective tissue (**arterioles** and **venules**).





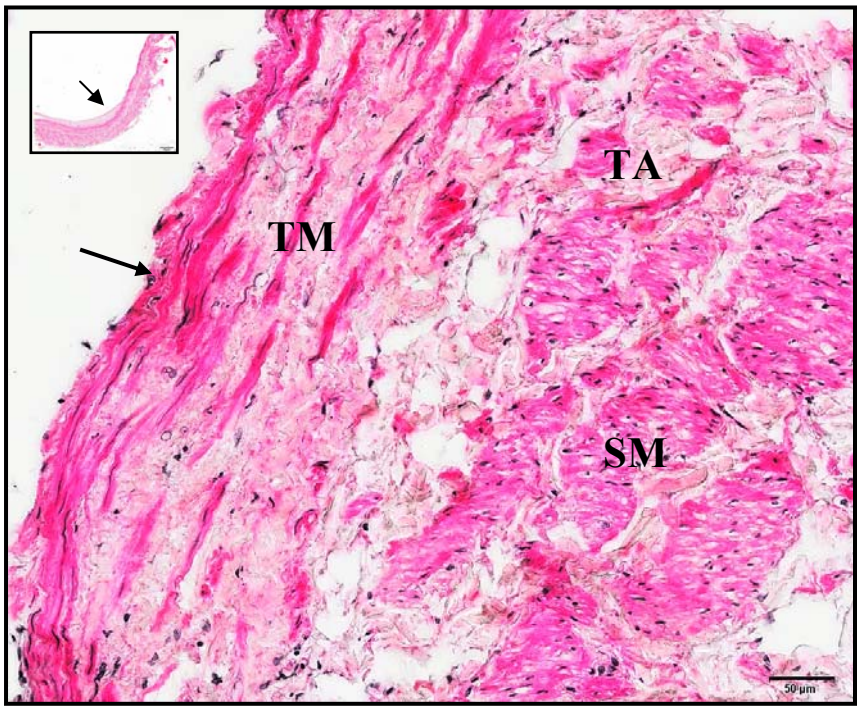
8. Vein with a valve (žíla s chlopní, sl.n. 85) l.s., H&E stain.

This is a medium-sized **vein** cut longitudinally to show a **valve** inside its lumen (L). In some sections, the valve may appear like attached to the wall of the vessel on its two sides, not showing its free-floating end. This is due to the suboptimal orientation of the section. Note, that the valve is the **projection of** the **intima layer** only (arrows). It is covered on both sides by the **endothelium**, and it contains only the connective tissue of the **subendothelial layer** of the intima. Study the wall of this vein in detail and describe the orientation of the smooth muscle cells in this layer.



9. Inferior vena cava (vena cava inferior, sl.n. 6) t.s., H&E stain.

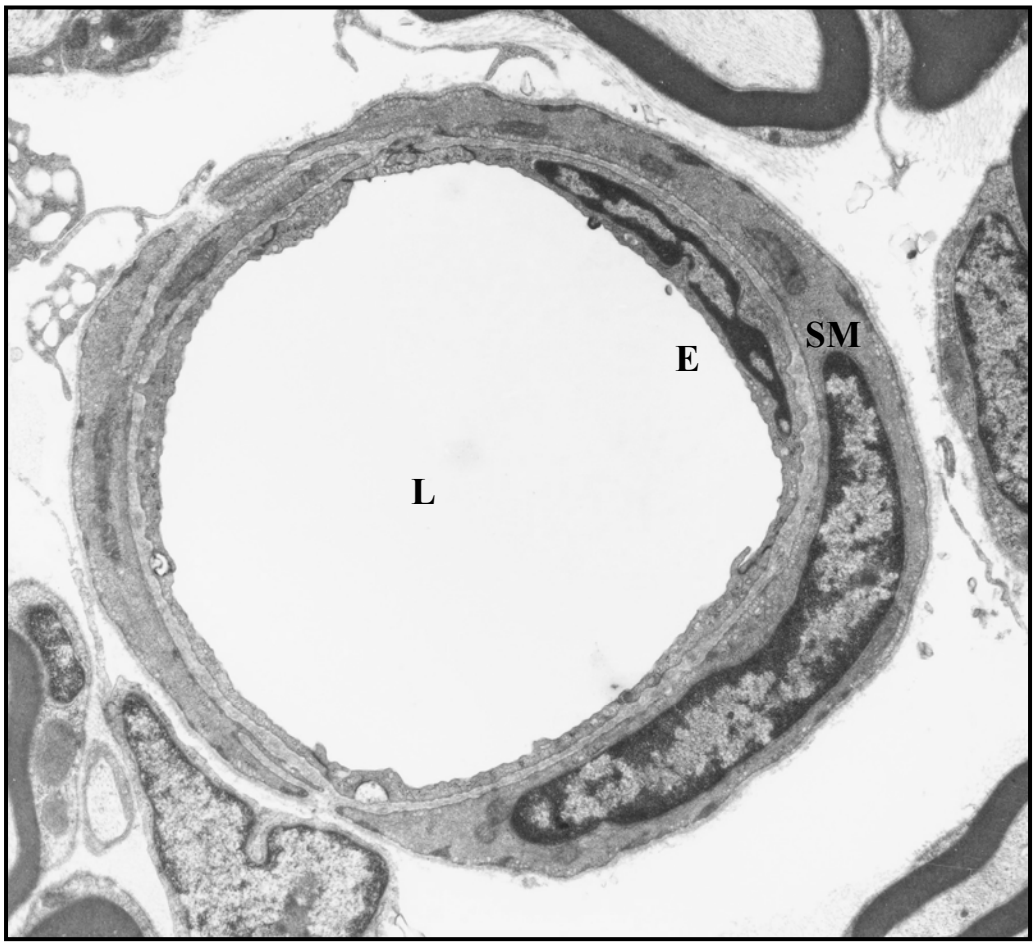
This **large vein** is shown here in transverse section. Note the **tunica intima** with the endothelium (arrow) and the subendothelial connective tissue. The **tunica media** (TM) is relatively thin and it contains bundles of circularly-oriented smooth muscle cells. The **tunica adventitia** (TA) is the thickest layer here and, in addition to the c.t. component, it contains many bundles of smooth muscle cells (SM) oriented longitudinally to the axis of the vessel. In which plain are the smooth muscle cells of this layer cut in this section? Why this large vein has the muscle cells also in its adventitia?



10. Study the following electron micrographs of small blood vessels:

PRECAPILLARY ARTERIOLE

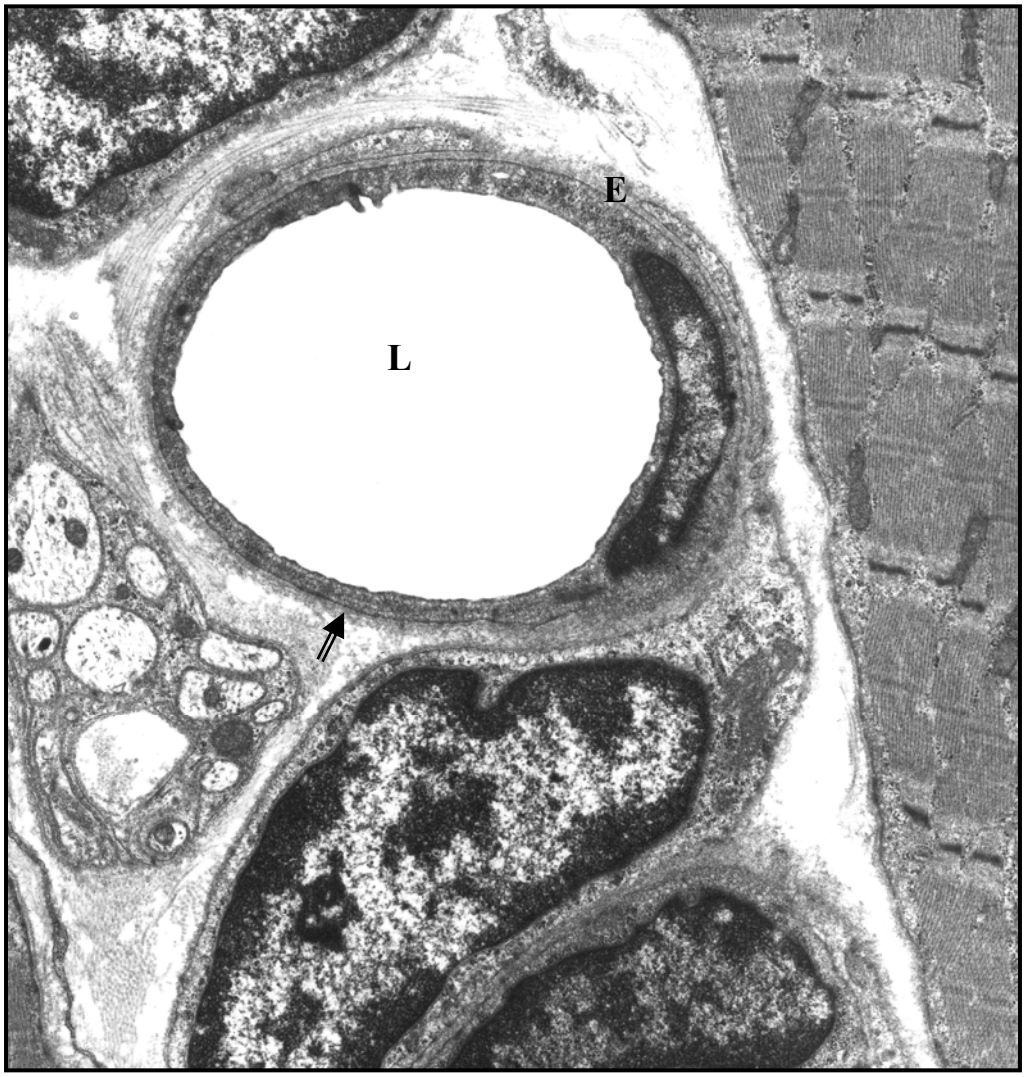
E – endothelium (continuous)
SM – smooth muscle cell (one continuous layer)
L – lumen



CONTINUOUS CAPILLARY

E – endothelium (continuous)
L – lumen

Arrow – basal lamina



Websites:

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