



Faculty of Biological Science and Technology
Zoology and Botanical Department
Practical Histology

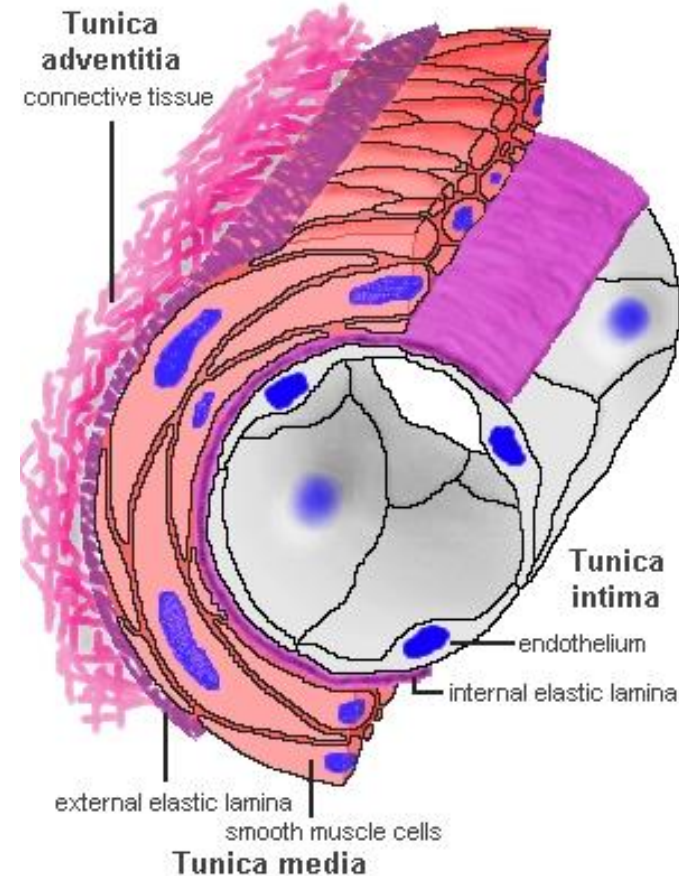
Blood Vessels

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Introduction

- ▶ Blood vessels are tubes by which blood leaves the heart to supply tissue or return blood from tissue to the heart
- ▶ Histologically, there are three concentric layers or tunics of different tissue types that form blood vessels wall, including:
 - ▶ Tunica intima- is the innermost layer which consists of a layer of simple squamous epithelium known as endothelium and a relatively thin layer of connective tissue
 - ▶ Tunica media- is the middle layer which consists of smooth muscle and elastic fibers in varying proportions according to the type of vessel
 - ▶ Tunica adventitia (externa)- is the outermost layer which consists of fibrous connective tissue (mainly collagen type I and elastic fibers)
- ▶ Larger blood vessels have smaller vessels in their tunica adventitia layer known as vasa vasorum
- ▶ Blood vessels are usually classified by function, including: arteries, veins and capillaries
- ▶ Arteries conduct blood away from heart. They have more muscular and elastic components in their walls compared to veins of comparable size. Their luminal diameter becomes smaller as the arteries branch. Arteries are usually sub-classify into elastic arteries, muscular arteries and arterioles
- ▶ Veins return blood to the heart and have less muscular and elastic tissue than arteries of comparable size
- ▶ Capillaries are the vessels in the circulatory system that allow the exchange of gas and nutrients between the blood and extracellular fluid. Histologically, they contain endothelial cells and basal lamina



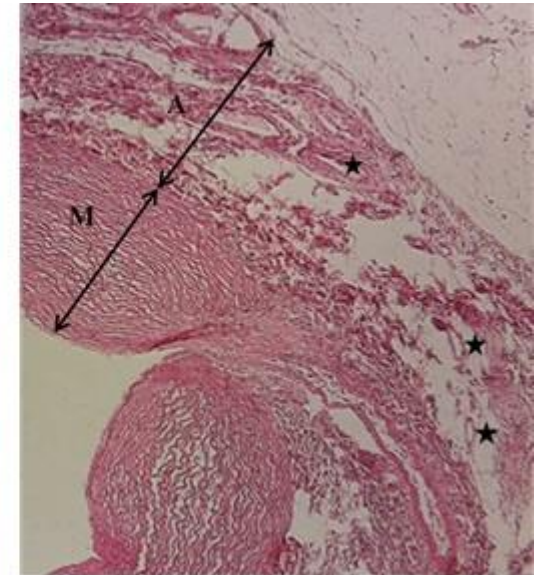
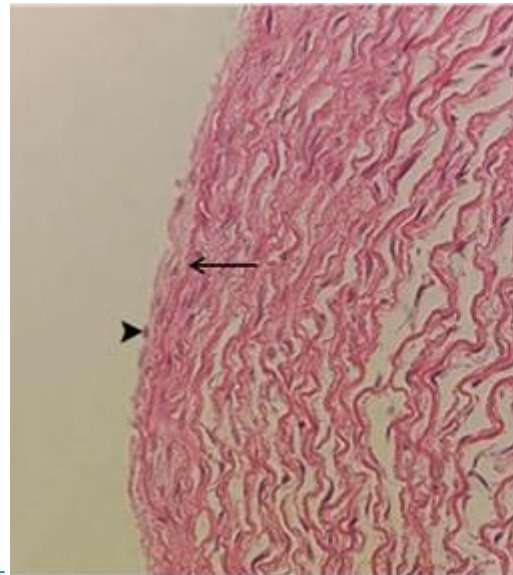
From:
<https://histology.siu.edu/crr/cvguide.htm#:~:text=Histologically%2C%20blood%20vessels%20consist%20of,layer%20of%20supporting%20connective%20tissue.>



Elastic Arteries

- ▶ Elastic arteries are very close to the heart. Examples include the aorta, the main branches of the aorta arch and pulmonary artery
- ▶ Their walls made up of:
- ▶ Tunica intima:
 - ▶ It is composed of endothelium and basal lamina, Sub-endothelial connective tissue containing elastic and collagen fibers and Internal elastic lamina
- ▶ Tunica media: is completely thick in elastic arteries
 - ▶ About 50 sheets of concentric, coiled elastin fibers. There are a few layers of smooth muscles between each sheet
- ▶ Tunica adventitia/externa
 - ▶ There is more collagen fibers than elastic fibers and Vasa vasorum pass through this layer

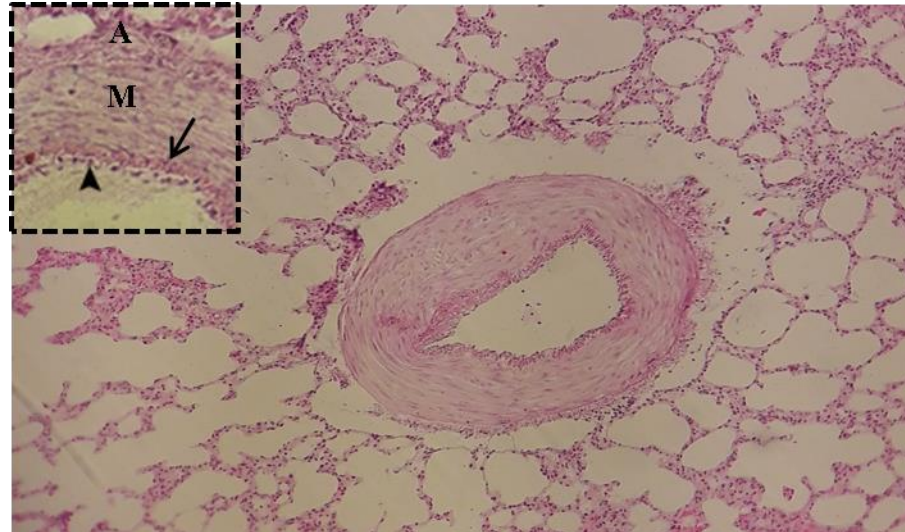
Cross sections of an elastic artery. Right: lumen can be seen in the left side of this picture next to endothelium. Tunica media (M) is basically made up of elastic fibers. Tunica adventitia (A) is seen in outside with numerous vasa vasorum (asterisks). H&E, 4X. Left: part of tunica intima and tunica media can be seen in higher magnification. An endothelial nucleus is shown by arrow head. Internal elastic lamina (arrow) depicts the boundary between tunica intima and tunica media. H&E, 40X. These pictures are taken from histological slide in histology laboratory of Isfahan University





Muscular Arteries

- ▶ Muscular arteries distribute blood throughout body and includes arteries with medium to small size. Their walls made up of:
 - ▶ Tunica intima:
 - ▶ It is composed of endothelium with basal lamina, sub-endothelium and internal elastic lamina
 - ▶ Tunica media:
 - ▶ It is composed of layers of smooth muscle (up to 40 layers) with some collagen and elastic fibers and external elastic layer
 - ▶ Tunica adventitia/externa
 - ▶ It is very broad and consists of collagen and elastic fibers

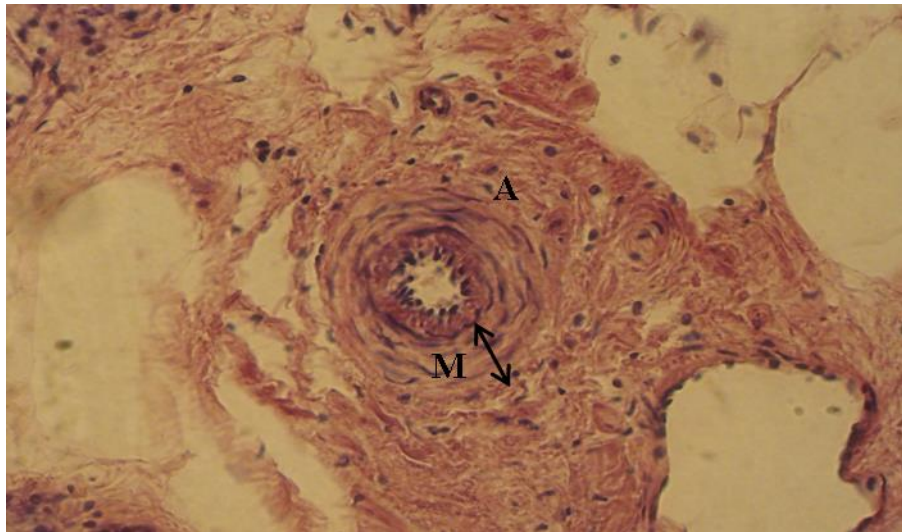


Cross section of a muscular artery in lung. Basically tunica media is composed of smooth muscles fibers with circular arrangement. Part of muscular artery wall can be seen in left frame. Arrow head depicts tunica intima. Internal elastic lamina is shown by arrow. Tunica media (M) is thicker than tunica adventitia (A). H&E, 10X. Frame: 40X These pictures are taken from histological slide in histology laboratory of Isfahan University



Arterioles

- ▶ Arterioles are small artery that deliver blood to capillaries. They have 100 μm or less diameter
- ▶ Their walls made up of:
- ▶ Tunica intima: is composed of
 - ▶ It is composed of endothelium with basal lamina and internal elastic lamina
- ▶ Tunica media:
 - ▶ It is composed of single layer up to six layers of smooth muscle cells and a few elastic fibers. The number of smooth muscle layers decrease with a decrease in diameter of these arteries
- ▶ Tunica adventitia/externa
 - ▶ It is about the same size of tunica media or less and consists of loose connective tissue



Cross section of an arteriole. Tunica media (M) is thinner than larger arteries. Tunica adventitia is merged by surrounding connective tissue. H&E, 40X. This picture is taken from histological slide in histology laboratory of Isfahan University



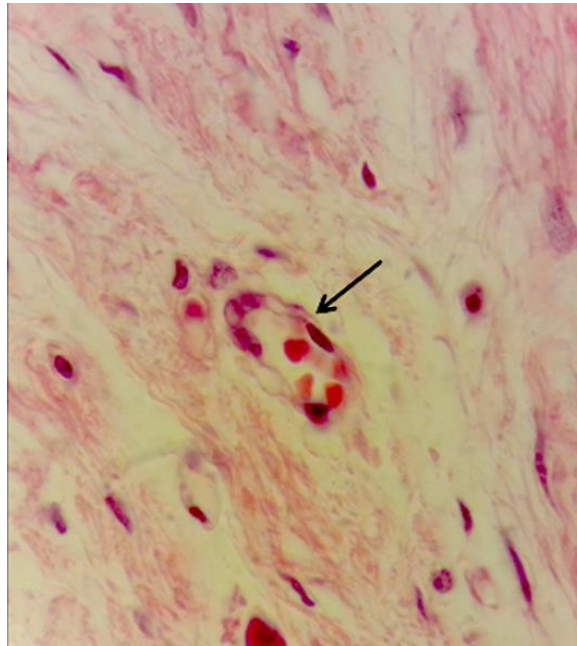
Veins

- ▶ The wall of the veins is similar to arteries but with a thinner tunica media, and more structural variation
- ▶ Additionally, they have wider lumen
- ▶ There are three types of veins including:
 - ▶ Venules
 - ▶ Small to medium size veins
 - ▶ Large veins such as superior and inferior vena cava



Venules

- ▶ The smallest veins known as venules and they have no smooth muscles
- ▶ Histologically, the wall of a venule is composed of an endothelium and some collagen layers

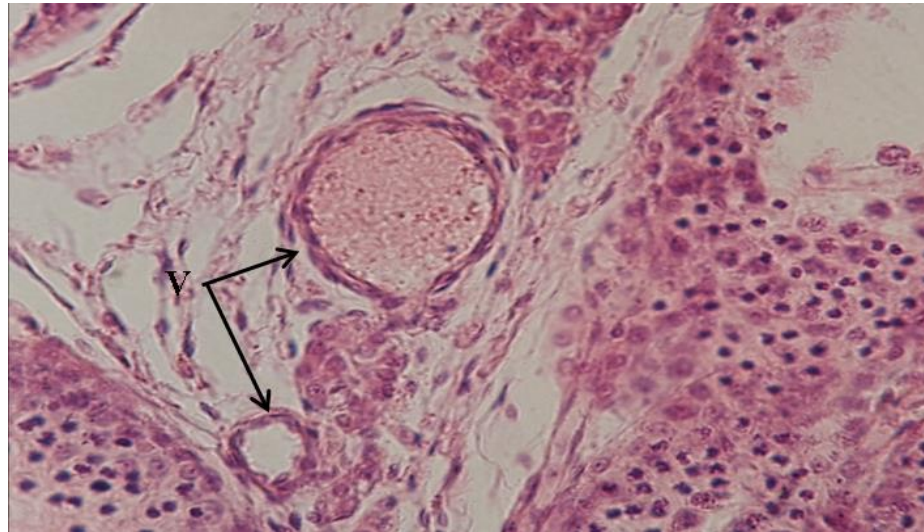


Cross section of a venule. Intima layer is depicted by arrow. There is no muscle fibers. Layer of its connective tissue is merged by surrounding connective tissue. H&E, 100X. This picture is taken from histological slide in histology laboratory of Isfahan University



Small to medium size veins

- ▶ The intima layer is thin in small to medium size veins and includes f endothelium and sub-endothelium. There is no internal elastic lamina although they have a few thin elastic fibers
- ▶ The media is also thin and includes bundles of smooth muscle fibers in circular arrangement along with collagen and elastic fibers
- ▶ The adventitia which contains collagen fibers, is well developed and forms the major part of the wall
- ▶ Some small to medium size veins which is located below the heart have valves



Small and medium size veins (arrows). The media is thin but it can be seen. H&E, 40X.
This picture is taken from histological slide in histology laboratory of Isfahan University



Capillaries

- ▶ Most capillaries are 8 to 10 μm in diameter
- ▶ Their endothelial layer is supported by basal lamina
- ▶ In cross section of capillary, it can be seen that two, three and sometimes one endothelial cell forms the capillary wall
- ▶ There are three types of capillaries including: continuous, sinusoidal (discontinuous) and fenestrated

Continuous capillaries

- ▶ They are the most common capillaries. This type of capillary exists in skin, nervous system, pulmonary system as well as muscles and fats tissue. Their endothelial cells are in close proximity with each other

Sinusoidal capillaries

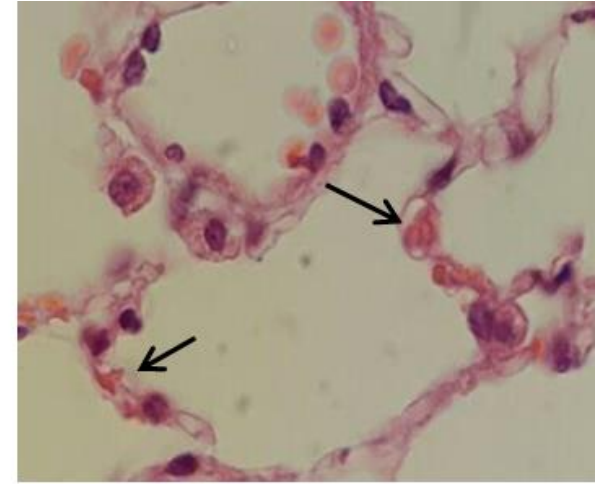
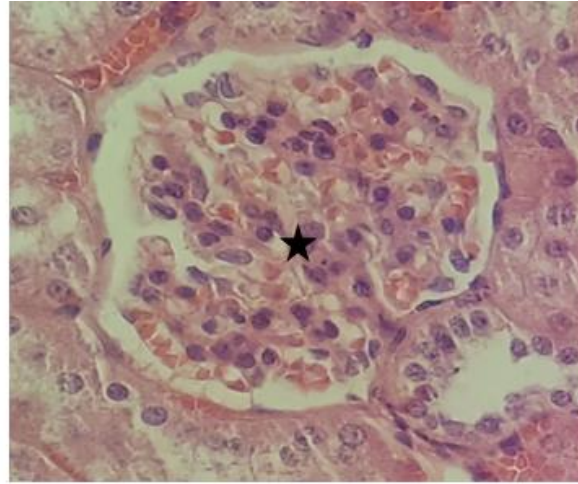
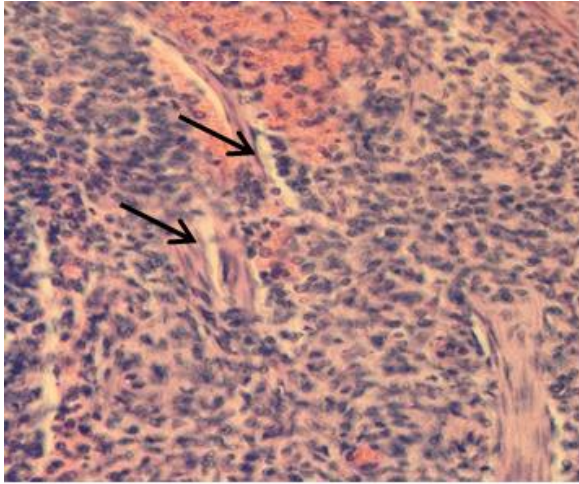
- ▶ They exist in bone marrow, spleen and liver. This type of capillary has incompletely or no basement membrane as well as widely spaced endothelial cells

Fenestrated capillaries

- ▶ These capillaries are found in Bowman's capsule of the kidney, small intestine and endocrine tissue
- ▶ They have tiny cytoplasmic pores or opening lie on an continuous basal lamina



Capillaries



Types of capillaries. Right: cross section of capillaries in lung (arrows). The capillary wall is made up of just one squamous endothelial cell. Red blood cells can be seen in the capillary lumen. Middle: renal glomerulus (asterisk) is a kind of fenestrated capillary. Left: sinusoidal capillaries (arrows) in parenchyma of spleen. H&E, 100X. These pictures are taken from histological slide in histology laboratory of Isfahan University