

# 06-00

# Vascular System

# 06 Menu 1

[06-00.](#) Vascular System

[06-001.](#) Blood Vessels. Capillaries, Arterioles, Venules, Small arteries and small veins.

[06-01.](#) Capillary, longitudinal section. Human, H-E stain, x 125.

[06-02.](#) Arteriole and capillaries. Human, H-E stain, x 100.

[06-03.](#) Capillaries and venule. Human, H-E stain, x 125.

[06-04.](#) Scheme showing two types of capillaries.

[06-05.](#) Capillaries, transverse and longitudinal sections. Rat, epon section, toluidin-blue stain, x 400.

[06-06.](#) Capillaries in the subepithelial connective tissue of the intestinal vilus. Human, H-E stain, x 400.

[06-07.](#) Capillaries beneath the intestinal epithelium. Human, H-E stain, x 160.

[06-08.](#) Arteriole and venule, transverse section. H-E stain, x 250.

[06-09.](#) Arteriole. longitudinal section. H-E stain, x 160.

[06-10.](#) Small artery, longitudinal section. Human, H-E stain, x 64.

[06-11.](#) Small artery, longitudinal section. Bovine, resorcin-fuchsin and hematoxylin stain, x 160.

[06-12.](#) Small artery, transverse section. Bovine, orcein and Kernechtrot stain, x 160.

[06-13.](#) Venule, longitudinal section. Human, H-E stain, x 160.

[06-14.](#) Venule, surface view of the endothelial cells. Human, H-E stain, x 160.

[06-15.](#) Venule, longitudinal section. Human, H-E stain, x 160.

[06-16.](#) Venule, transverse section. Rat pancreas, epon section, toluidinblue stain, x 400.

[06-17.](#) Small vein, transverse section. Human, H-E section, x 400.

[06-18.](#) Small vein, transverse sectioned. Human, H-E stain, x 160.

[06-19.](#) Small vein, transverse section. Human, H-E stain, x 160.

[06-20.](#) Small vein, transverse section. Human, H-E stain, x 64.

[06-21.](#) Small vein, longitudinal section. Human H-E stain, x 100.

[06-002.](#) Valves of Veins

[06-22.](#) Valves of small vein, longitudinal section. Monkey, H-E stain, x 160.

[06-23.](#) Valves of femoral vein 1. Human, H-E stain, x 2.5.

[06-24.](#) Valves of femoral vein 2. Human, H-E stain, x 25.

[06-003.](#) Arteries

[06-25.](#) Artery of muscular type, transverse section. Monkey, H-E stain, x 30.

[06-26.](#) Arteria radialis, transverse section. Human, H-E stain, x 10.

[06-27.](#) A. femoralis, transverse section 1. Human, H-E stain, x 30.

[06-28.](#) A. femoralis, transverse section 2. Human, resorcin-fuchsin stain, x 30.

[06-29.](#) Aorta, transverse section, 1. Human, H-E stain, x 25.



# 06 Menu 2

[06-30](#). Aorta, transverse section, 2. Human, resorcin-fuchsin stain, x 25.

[06-004](#). Veins

[06-31](#). V. cava inferior, transverse section, 1. Human, H-E stain, x 40.

[06-32](#). V. cava inferior, transverse section, 2. Human, resorcin-fuchsin stain, x 40.

[06-33](#). V. cava superior, transverse section, 1. Human, H-E stain, x 40.

[06-34](#). V. cava superior, 2. Human, resorcin-fuchsin stain, x 40.

[06-35](#). V. portae, transverse section, 1. Human, H-E stain, x 2.6.

[06-36](#). V. portae, transverse section, 2. Human, H-E stain, x 40.

[06-37](#). V. basilica, transverse section. Human, H-E stain, x 10.

[06-38](#). V. cephalica, transverse section. Human, H-E stain, x 10.

[06-39](#). V. saphena magna, transverse section. Human, H-E stain, x 10.

[06-40](#). Vein in the spermatic cord, transverse section. Human, H-E stain, x 25.

[06-005](#). Large arteries and veins

[06-41](#). A. carotis interna and V. juglaris interna, transverse section. Human, H-E stain, x 2.3.

[06-42](#). A. iliaca externa and V. iliaca externa, transverse section. Human, H-E stain, x 2.3.

[06-43](#). A. femoralis and V. femoralis, transverse section. Human, H-E stain, x 2.3.

[06-006](#). Lymphatics

[06-44](#). Lymphatic capillaries. Human, H-E stain, x 160.

[06-45](#). Artery, vein and lymphatic vessel. Monkey, H-E stain, x 100.

[06-46](#). Small lymphatic vessel. Human, H-E stain, x 160.

[06-47](#). Valves of a small lymphatic vessel. Human, H-E stain, x 64.

[06-48](#). Lymphatic vessel, transverse section, 1. Human, H-E stain, x 100.

[06-49](#). Lymphatic vessel, transverse section, 2. Human, H-E stain, x 64.

[06-50](#). Ductus thoracicus, transverse section. Human, H-E stain, x 15.

[06-007](#). Heart

[06-51](#). Wall of the left ventricle. Human, H-E stain, x 1.5.

[06-52](#). Wall of the right atrium. Human, H-E stain, x 2.5.

[06-53](#). Endocardium and myocardium. Human, H-E stain, x 25.

[06-54](#). Myocardium. Human, H-E stain, x 25.

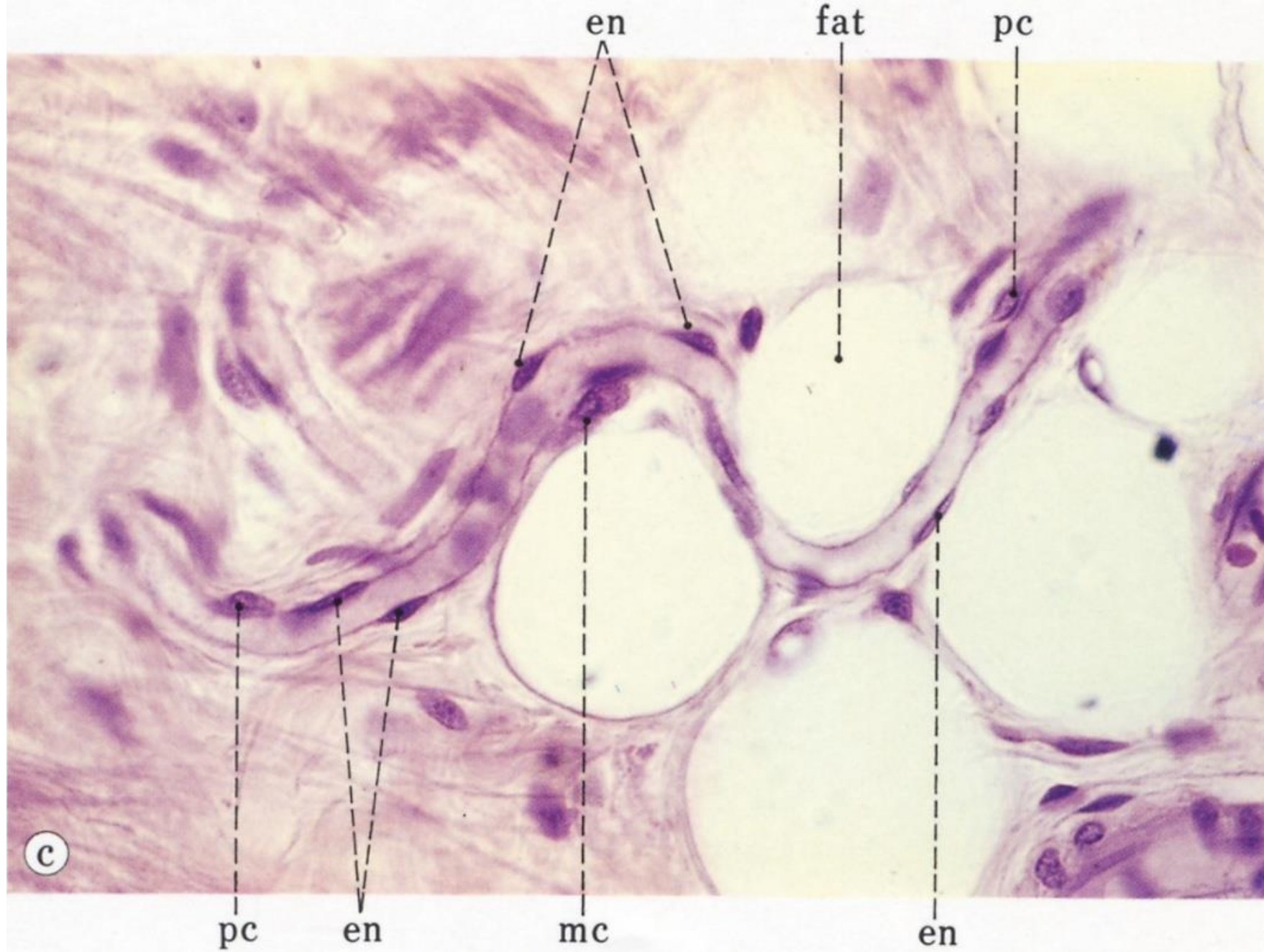
[06-55](#). Epicardium and myocardium. Human, H-E stain, x 25.

[06-56](#). Sinus node. Human, M-G stain, x 4.0.

# 06-001

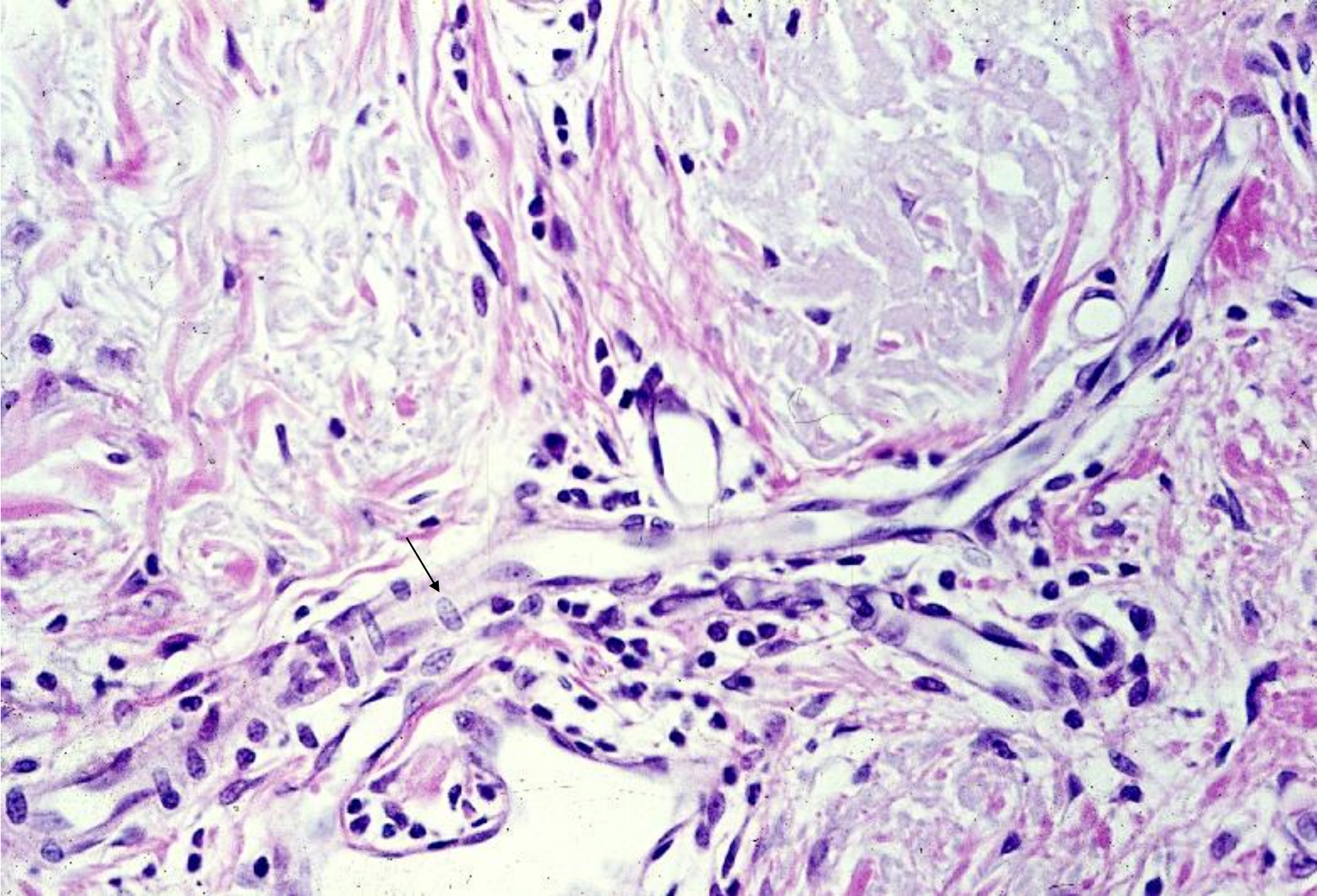
## Blood Vessels.

Capillaries, Arterioles, Venules,  
Small arteries and small veins.



06-01 Capillary, longitudinal section. Human, H-E stain, x 125.



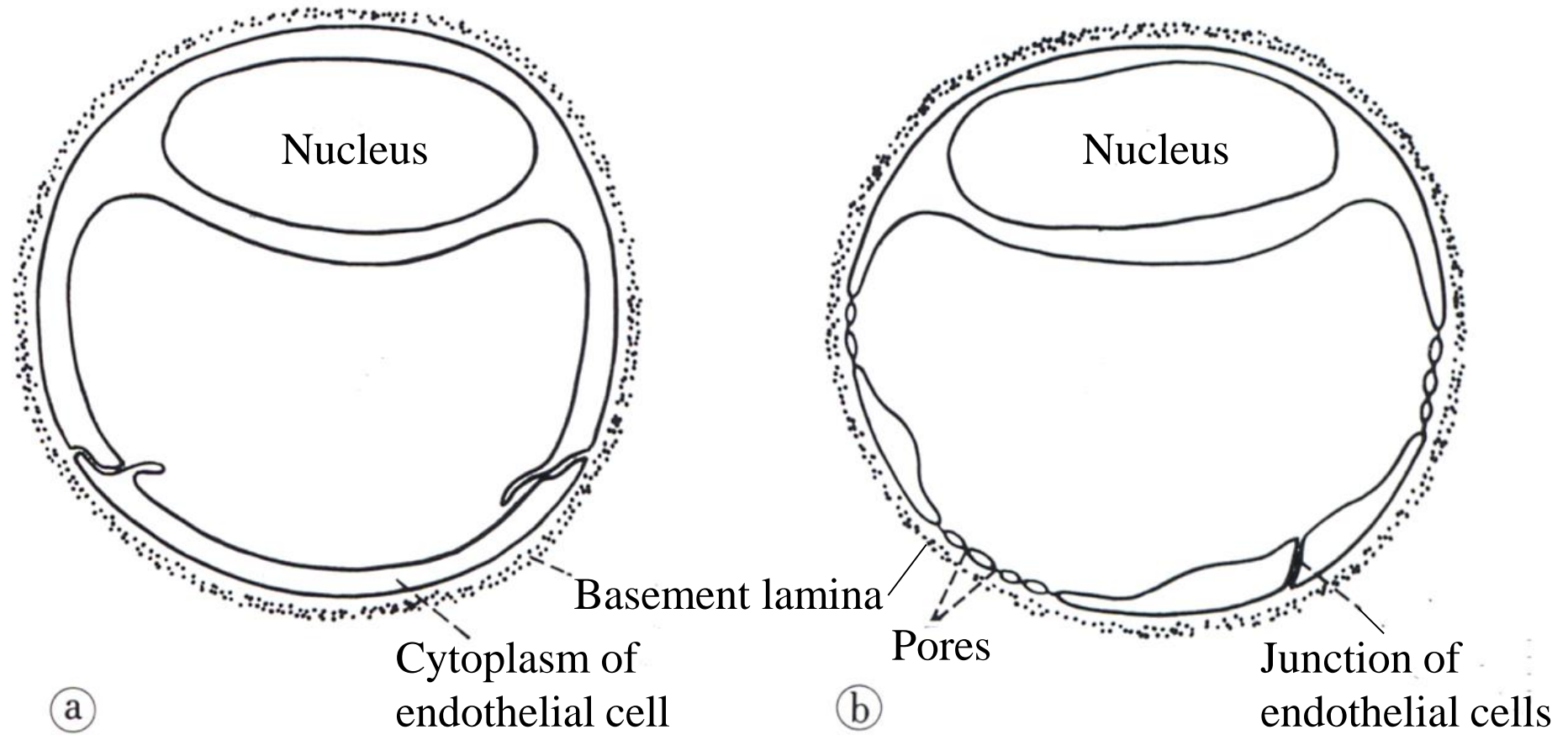


06-02 Arteriole and capillaries. Human, H-E stain, x 100.

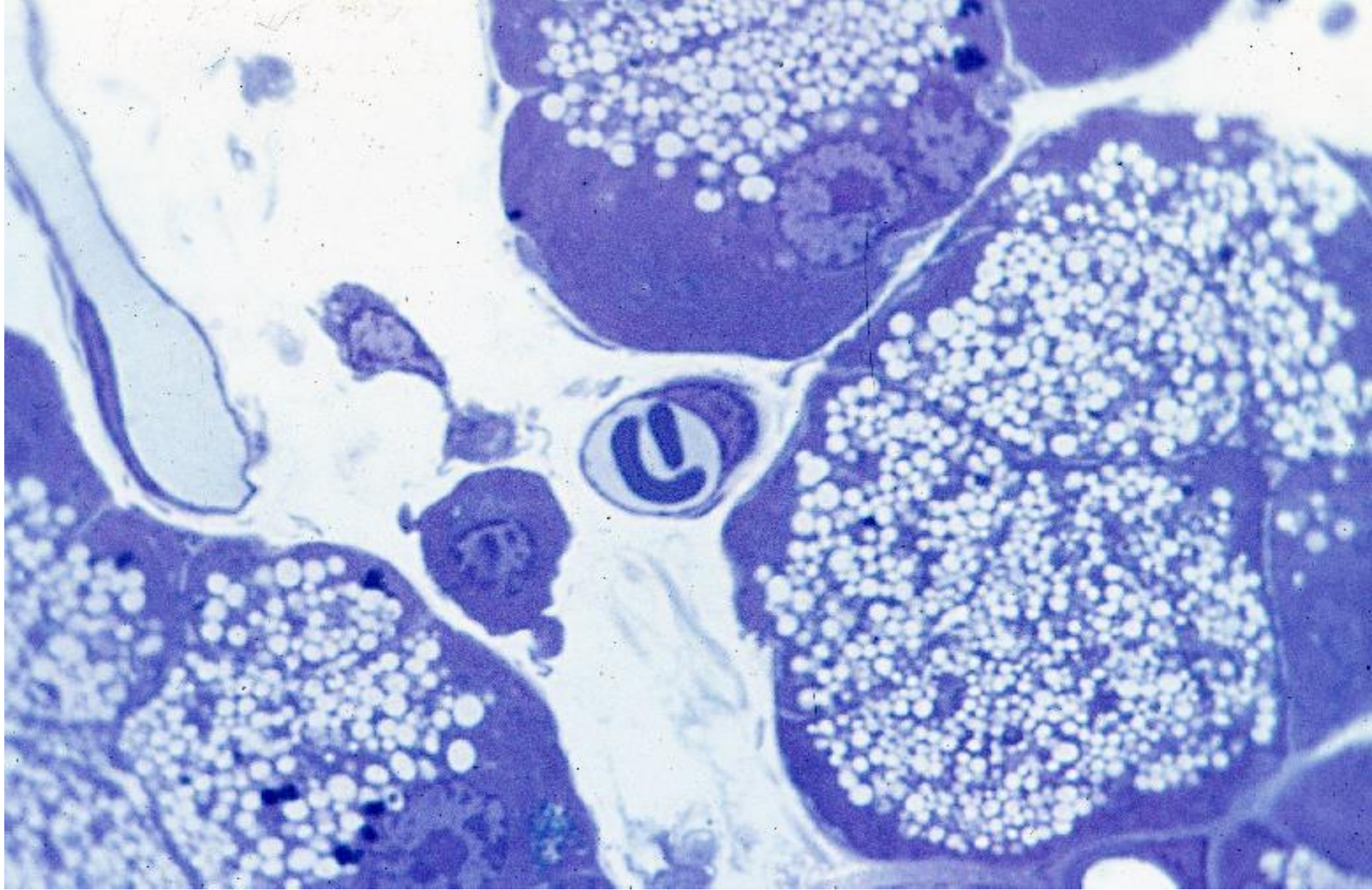




Venule

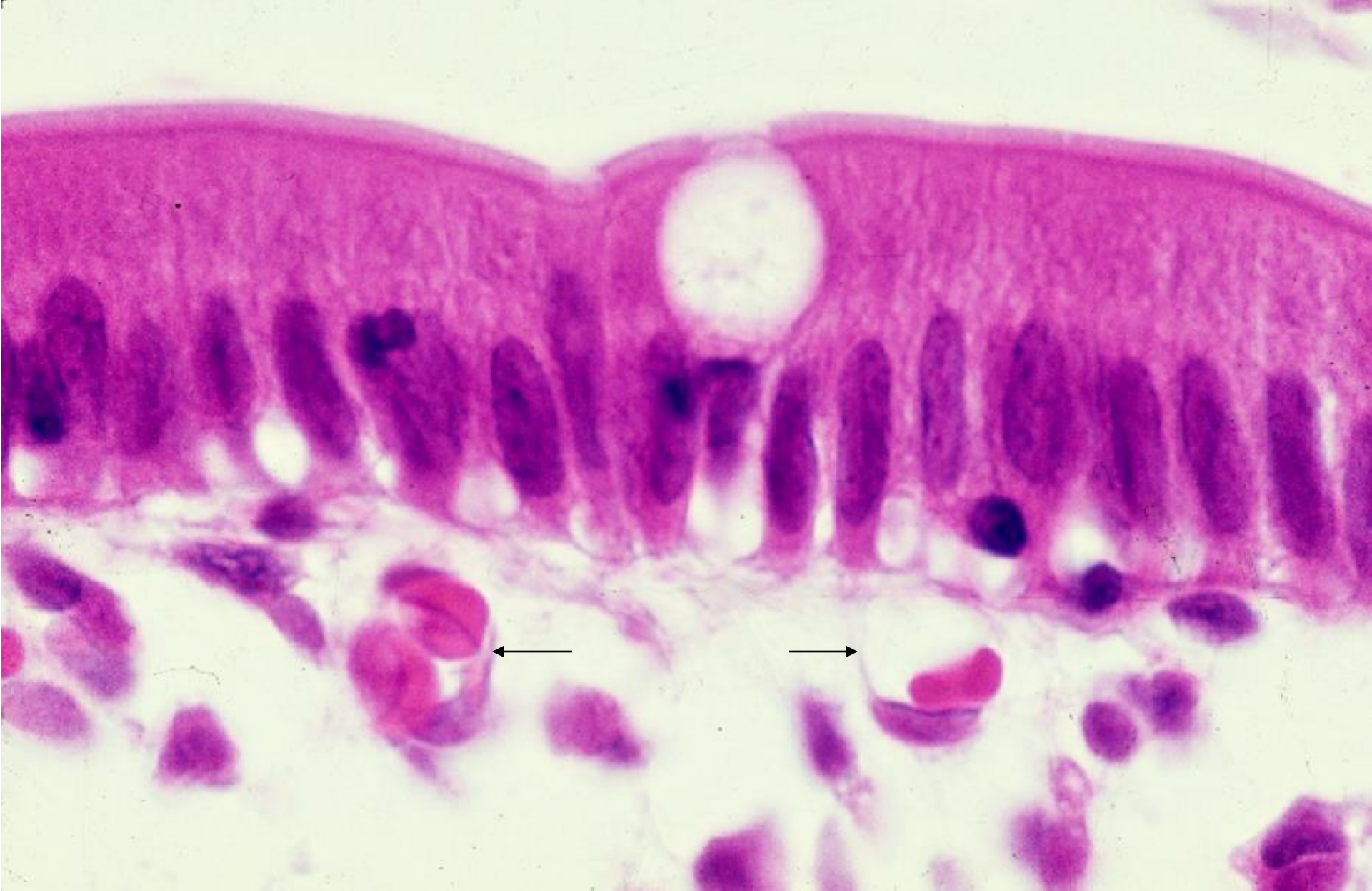






06-05 Capillaries, transverse and longitudinal sections. Rat, epon section, toluidin-blue stain, x 400.





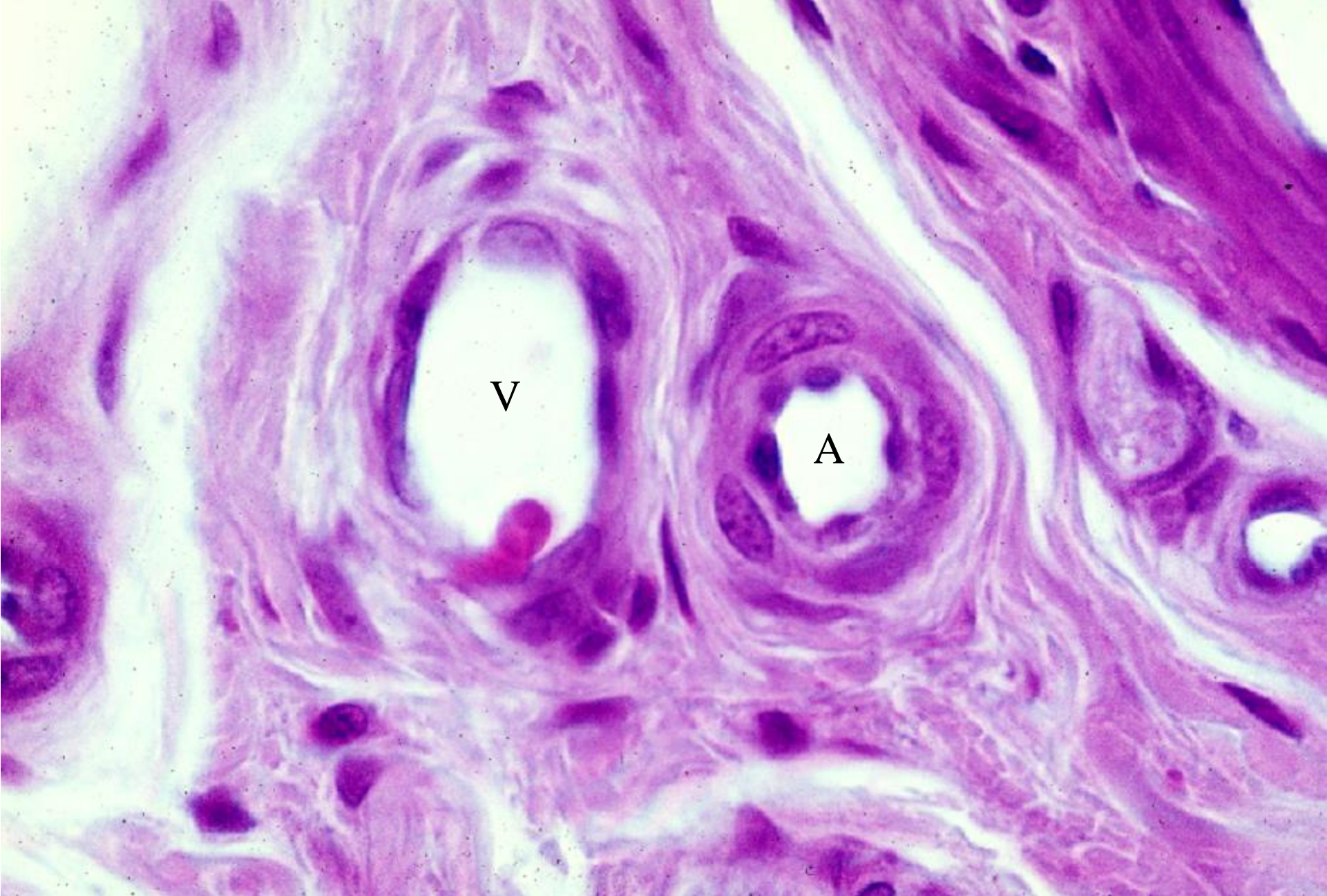
06-06 Capillaries in the subepithelial connective tissue of the intestinal vilus. Human,  
H-E stain, x 400.





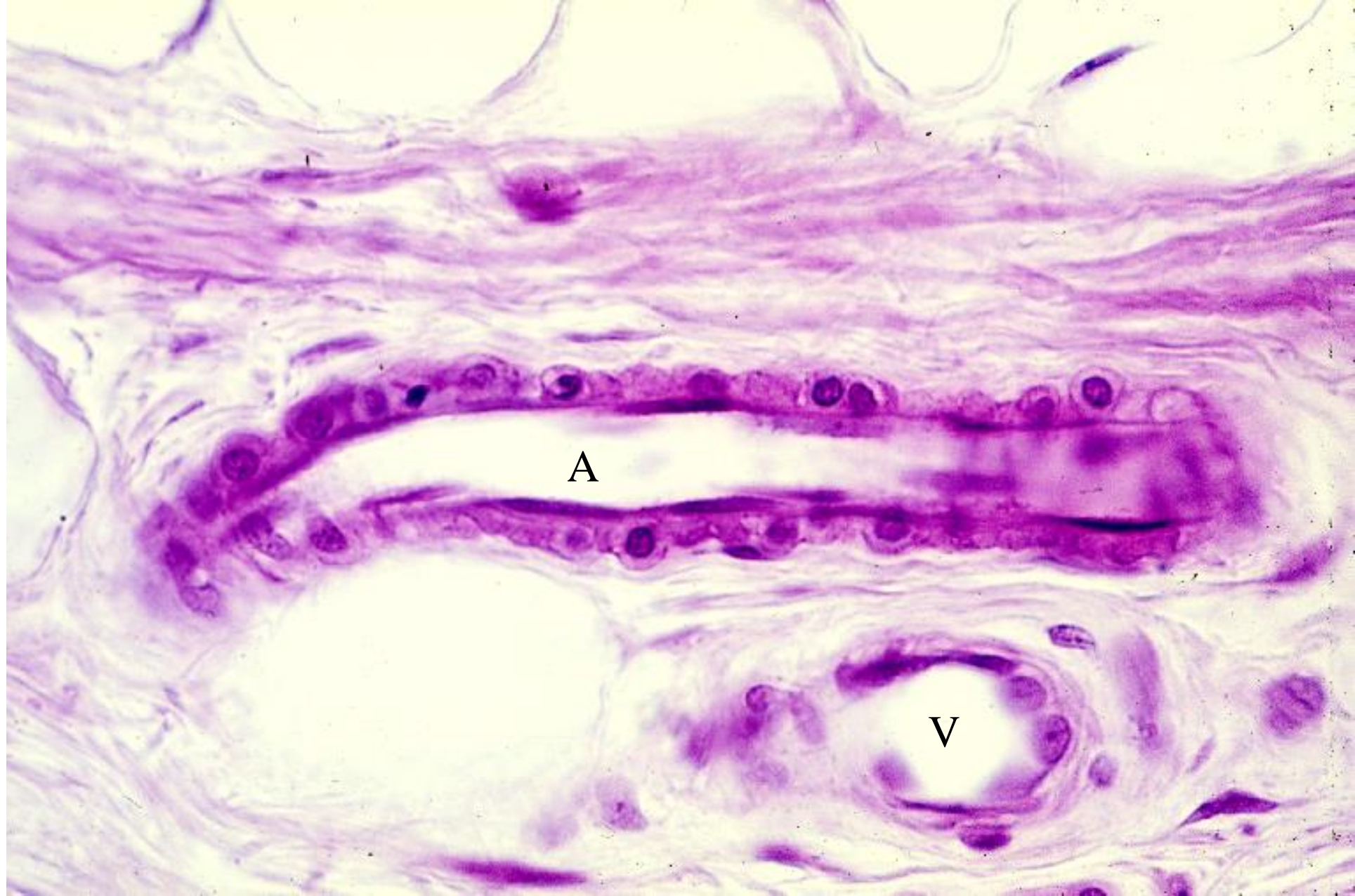
06-07 Capillaries beneath the intestinal epithelium. Human, H-E stain, x 160.





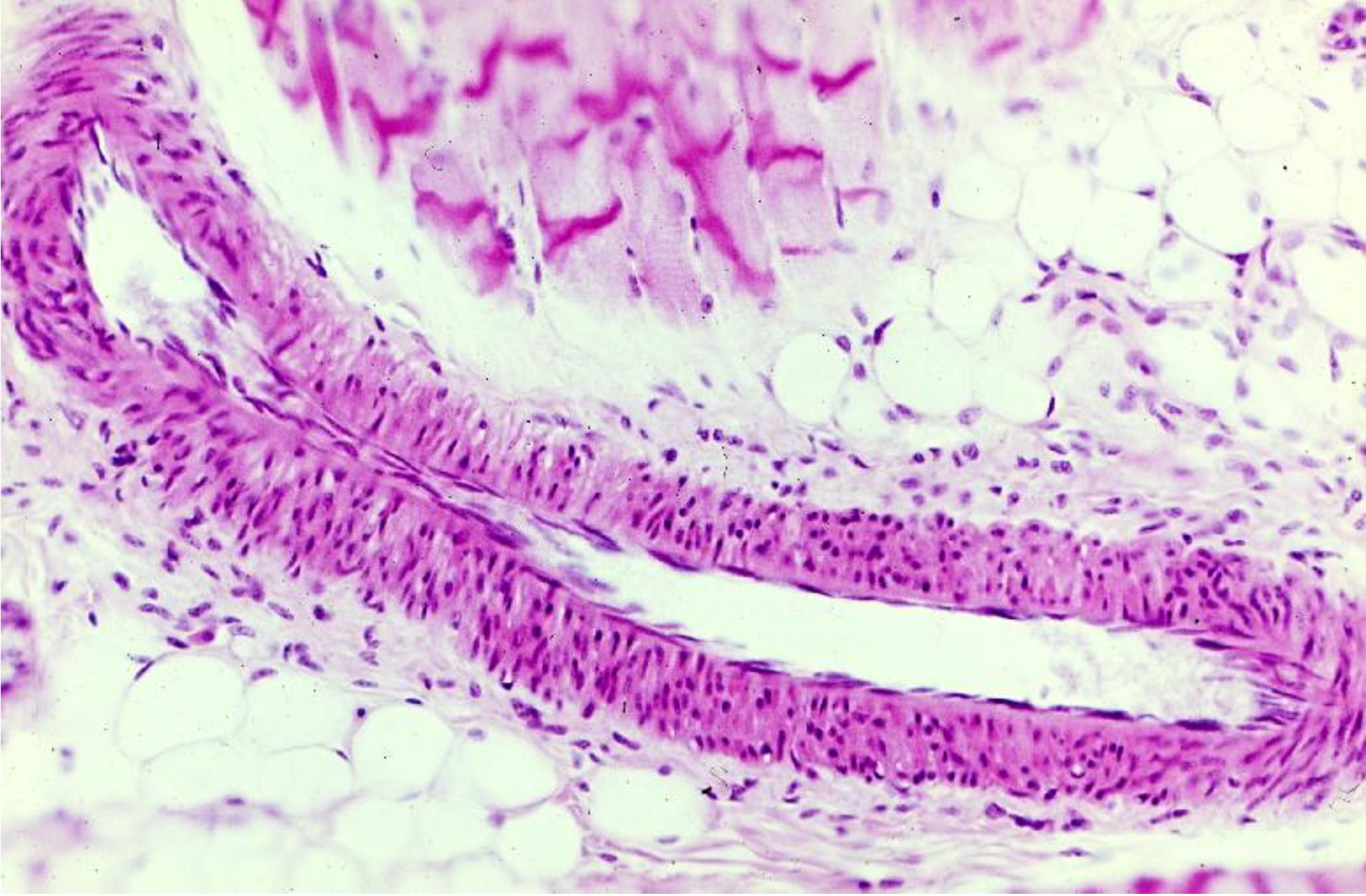
06-08 Arteriole and venule, transverse section. H-E stain, x 250.





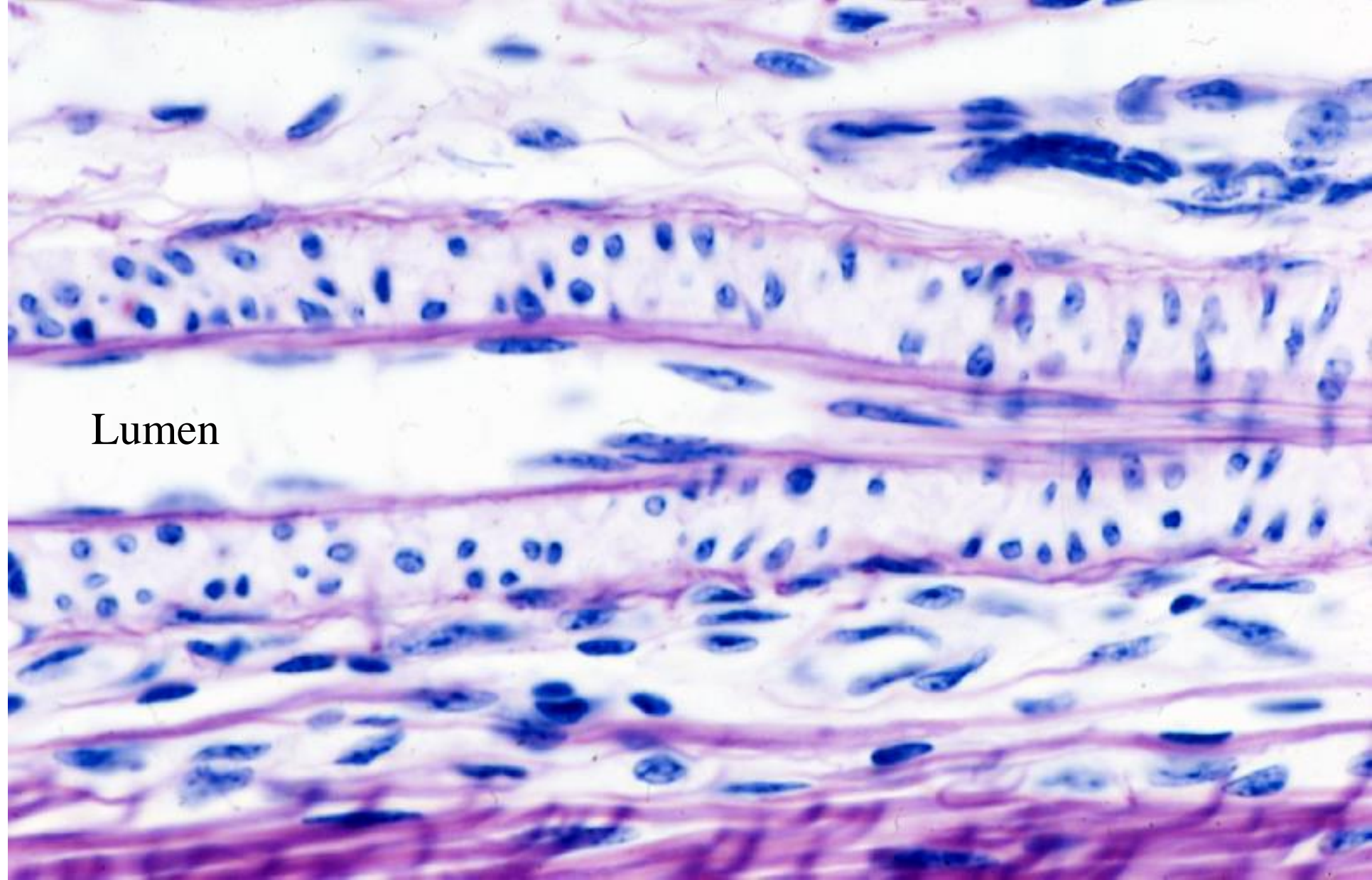
06-09 Arteriole. longitudinal section. H-E stain, x 160.





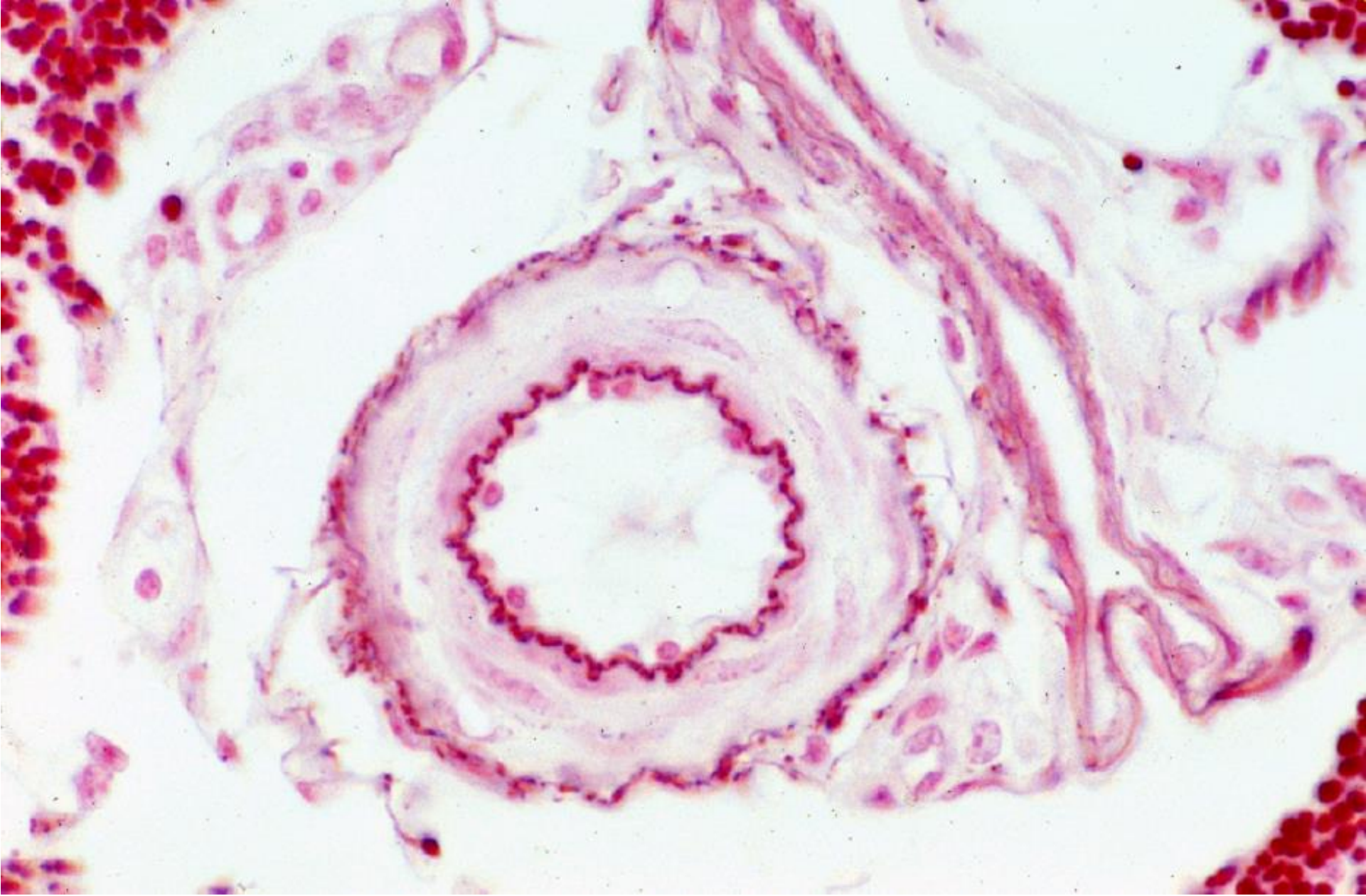
06-10 Small artery, longitudinal section. Human, H-E stain, x 64.





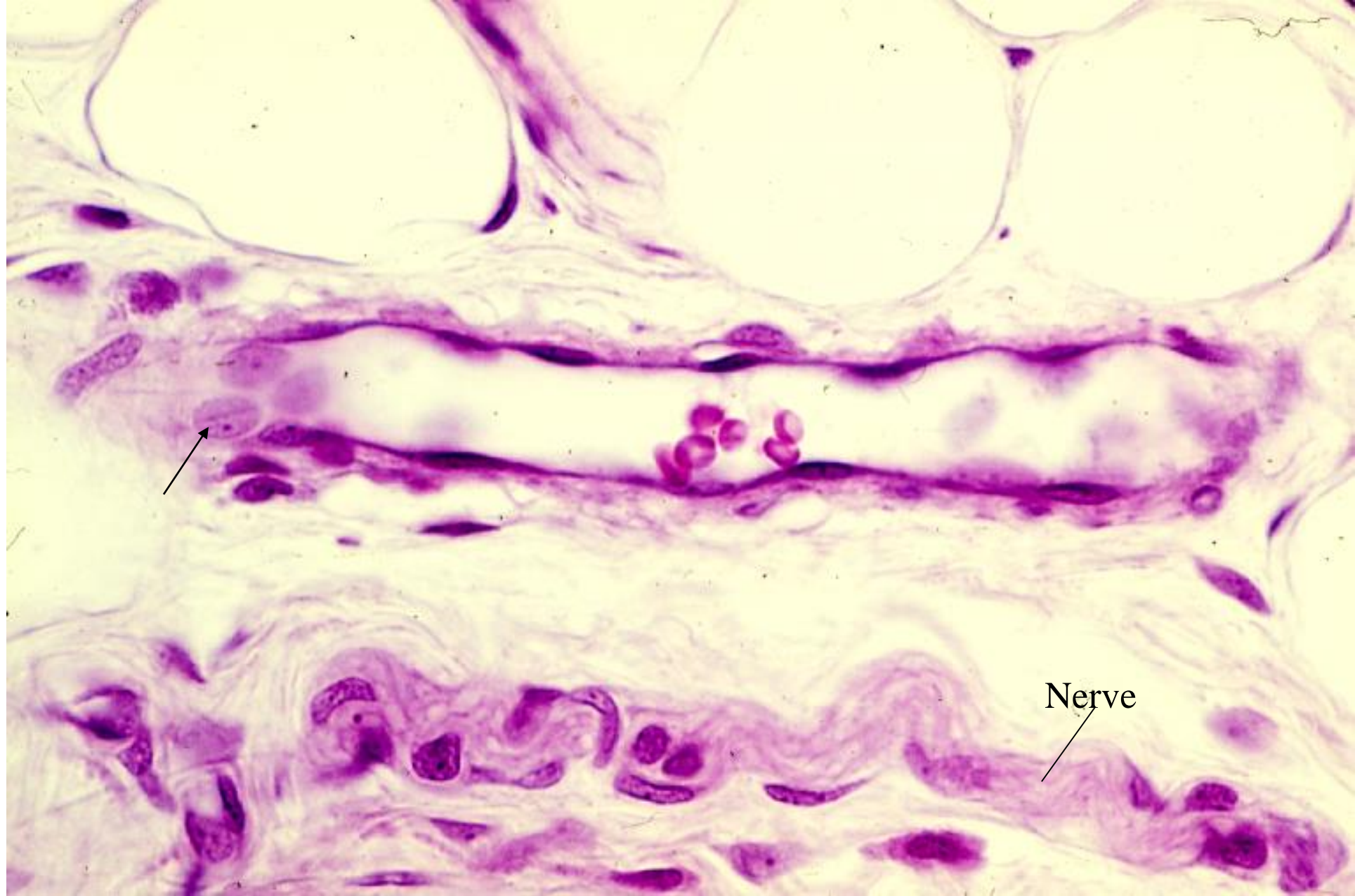
Lumen

06-11 Small artery, longitudinal section. Bovine, resorcin-fuchsin and hematoxylin stain, x 160.

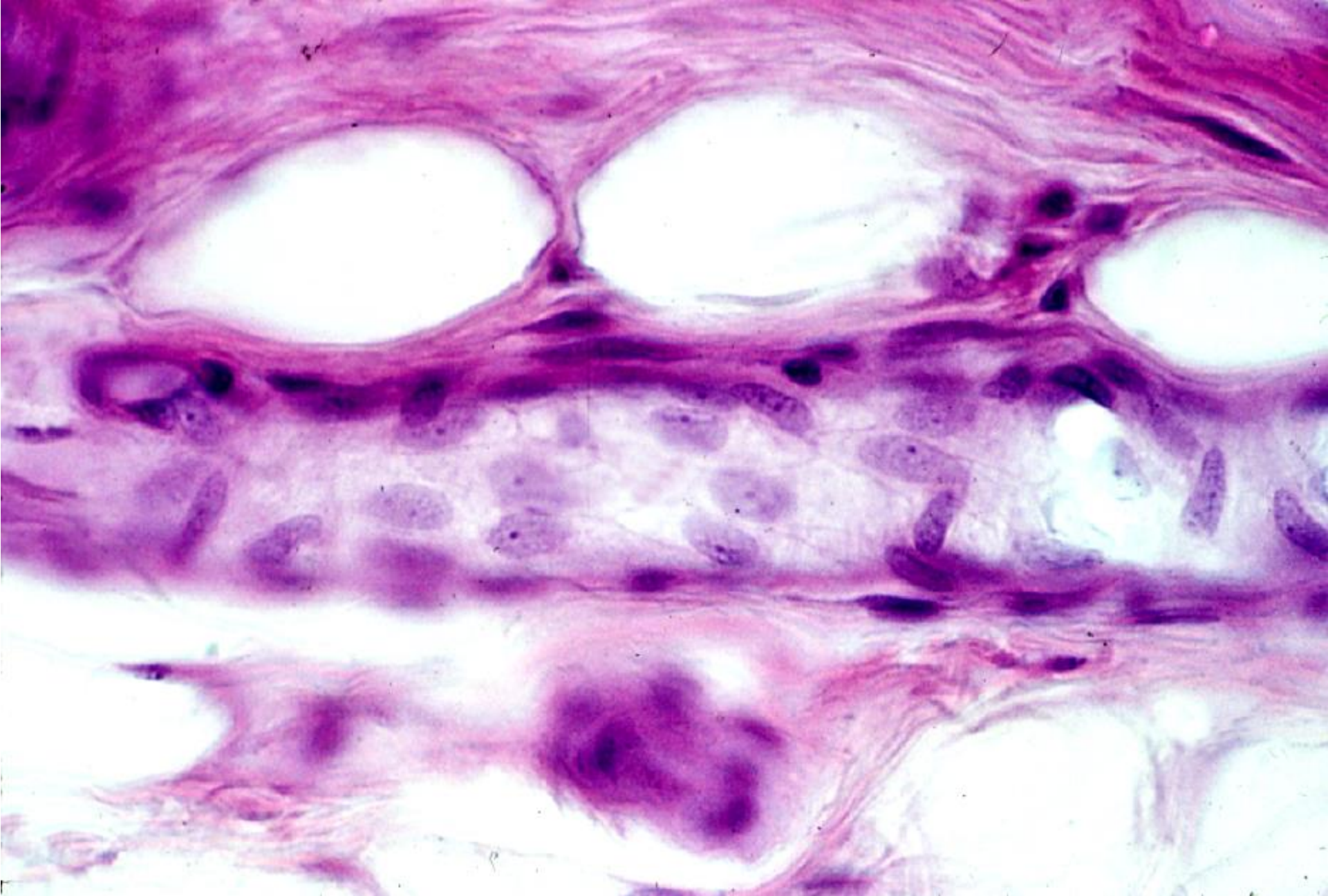


06-12 Small artery, transverse section. Bovine, orcein and Kernechtrot stain, x 160.



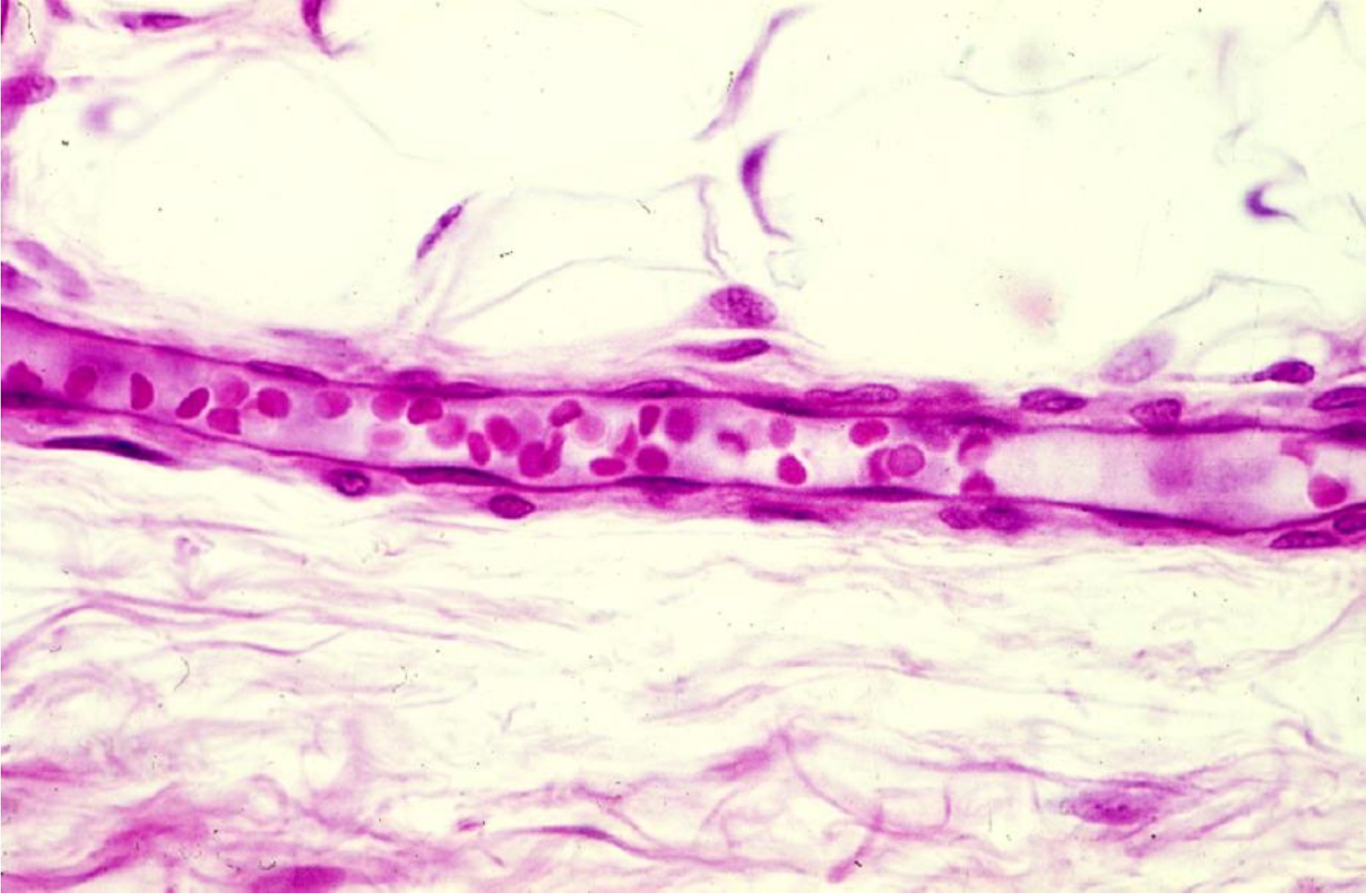


06-13 Venule, longitudinal section. Human, H-E stain, x 160.



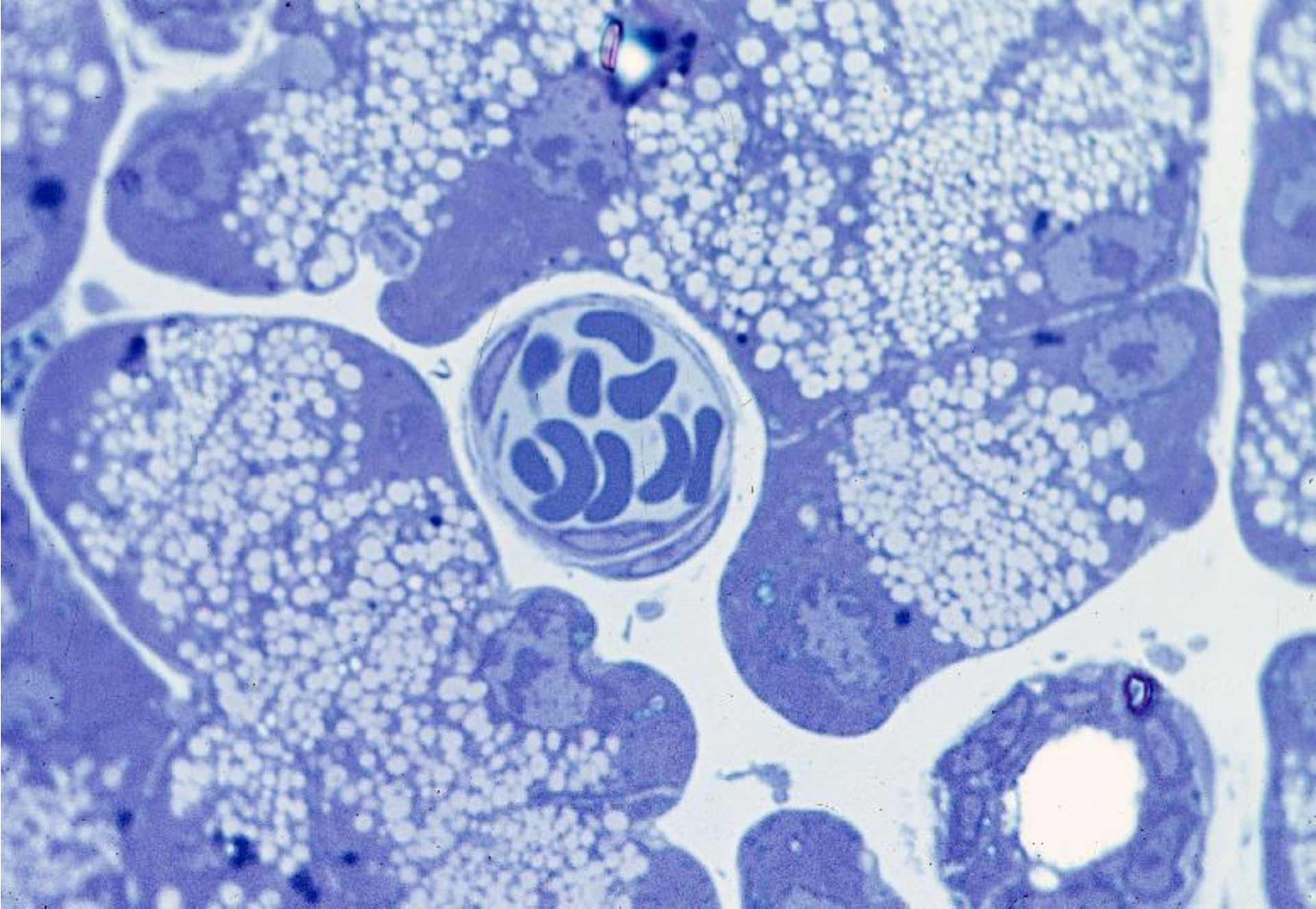
06-14 Venule, surface view of the endothelial cells. Human, H-E stain, x 160.





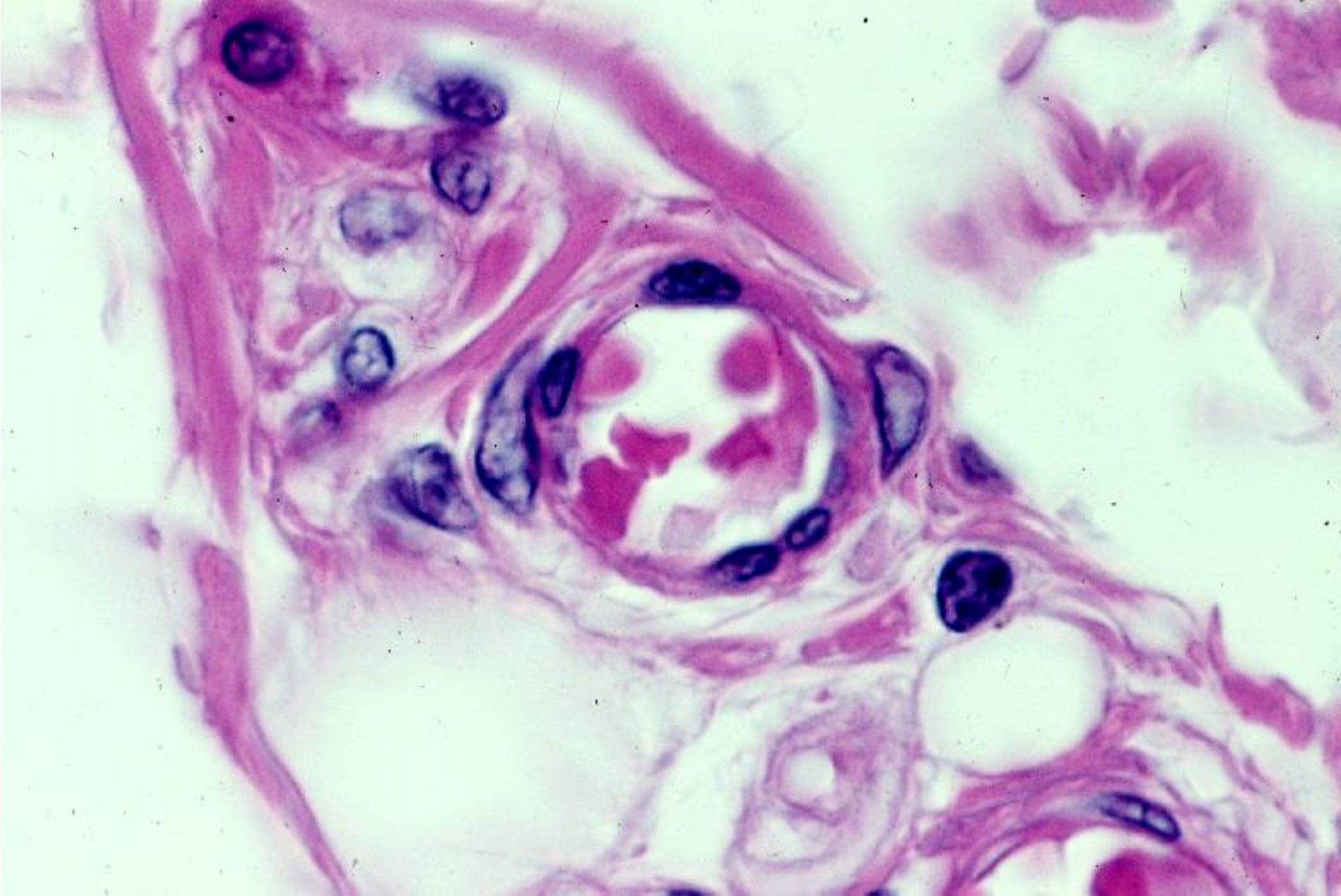
06-15 Venule, longitudinal section. Human, H-E stain, x 160.





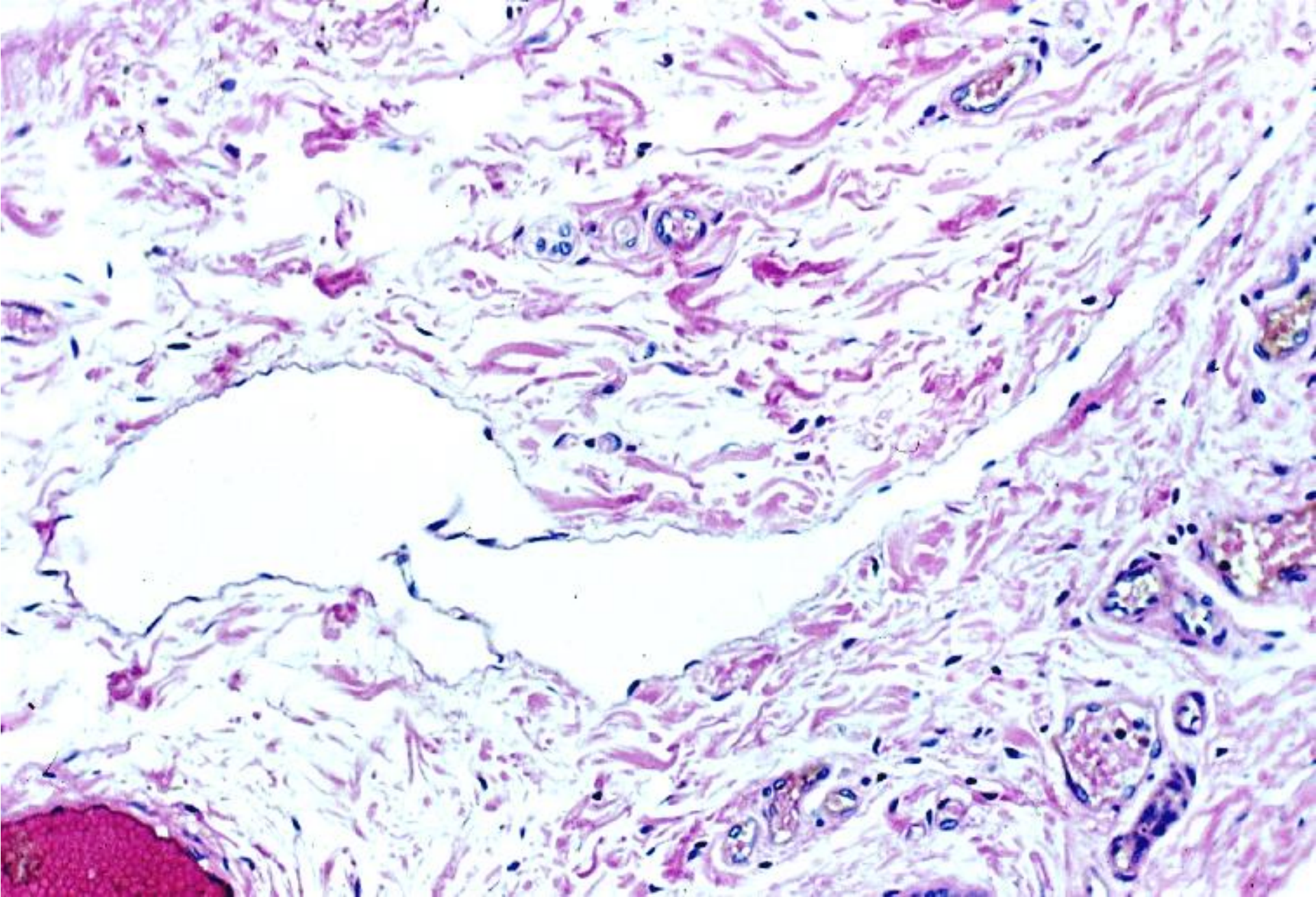
06-16 Venule, transverse section. Rat pancreas, epon section, toluidinblue stain, x 400.





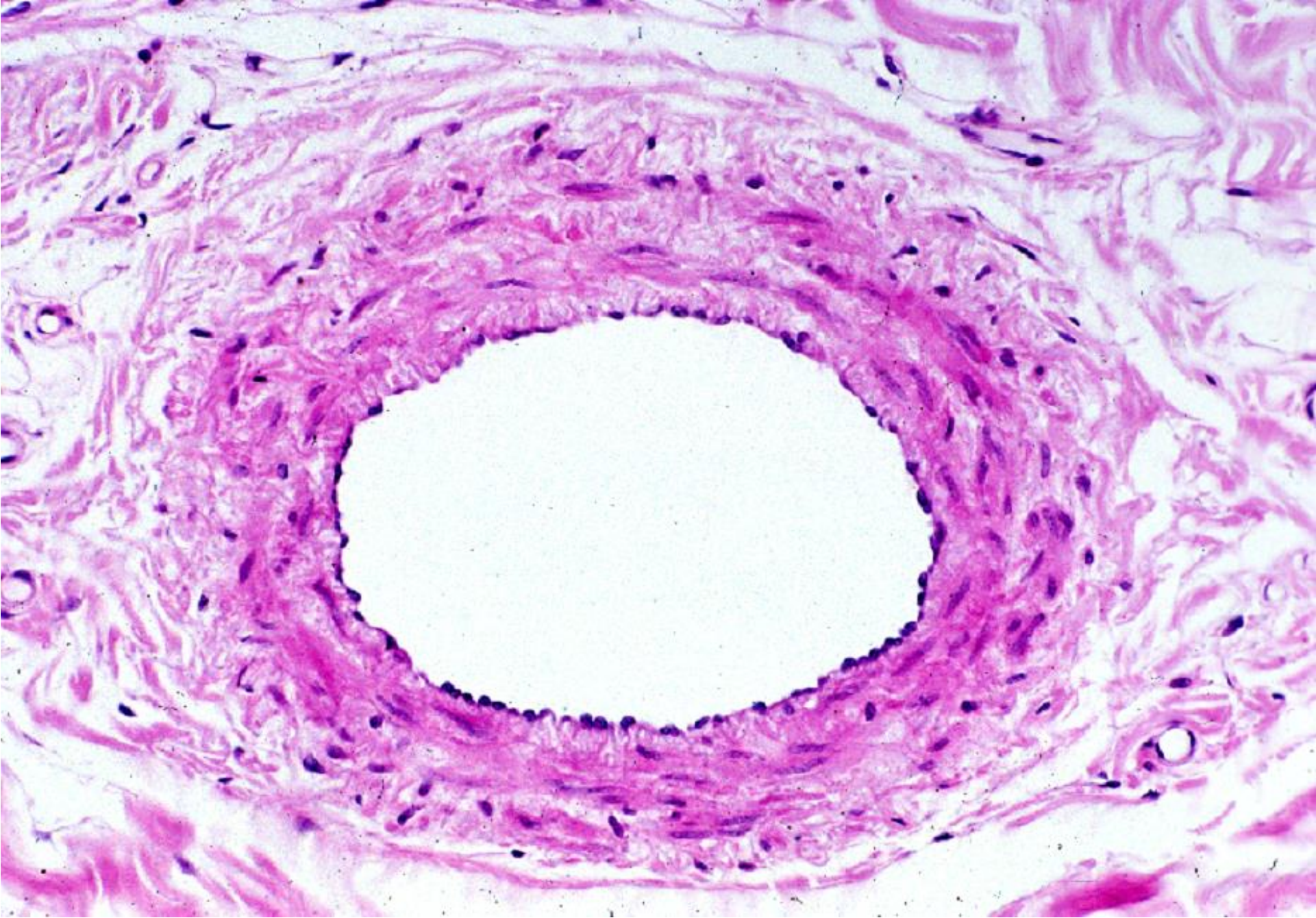
06-17 Small vein, transverse section. Human, H-E section, x 400.





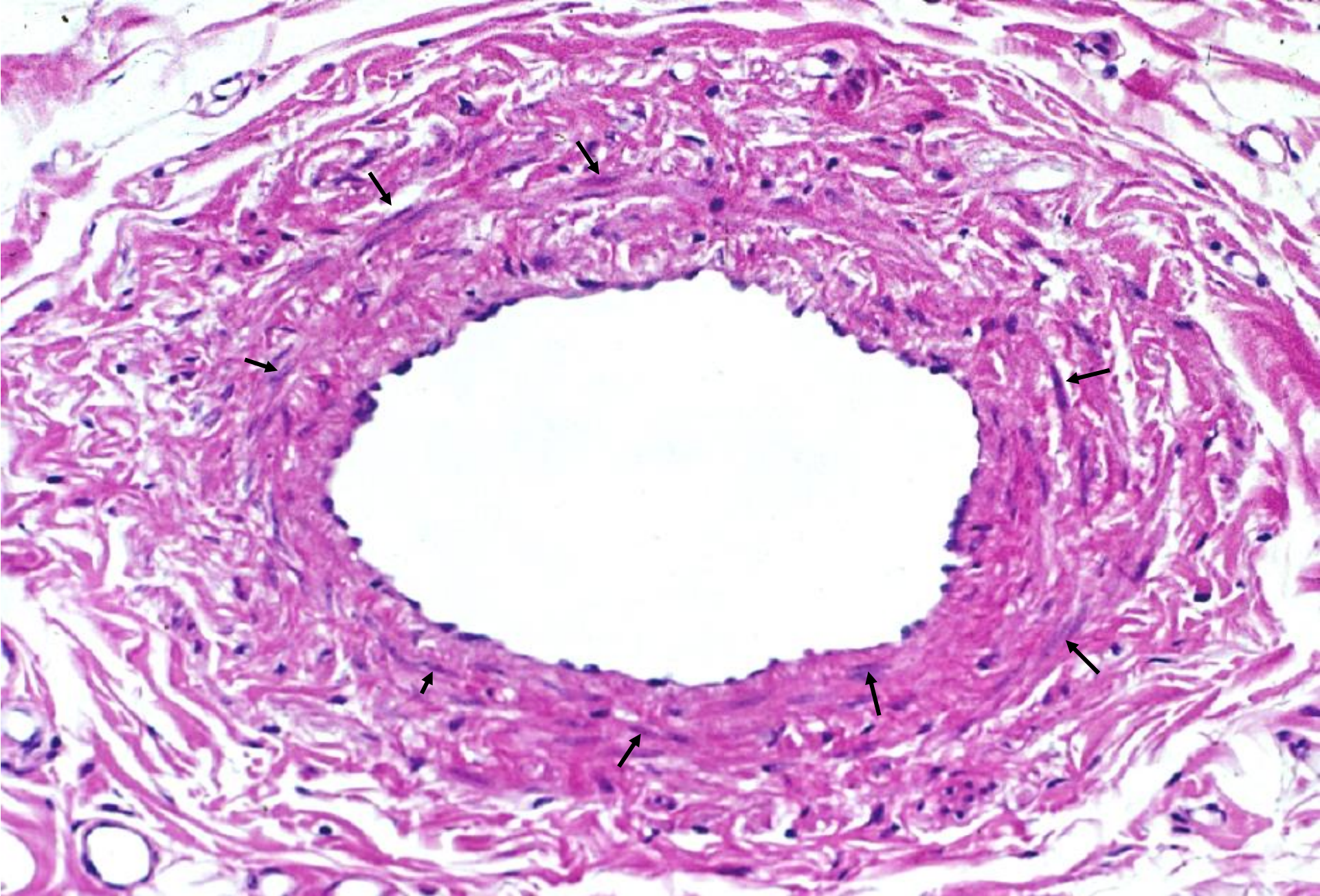
06-47 Valves of a small lymphatic vessel. Human, H-E stain, x 64.





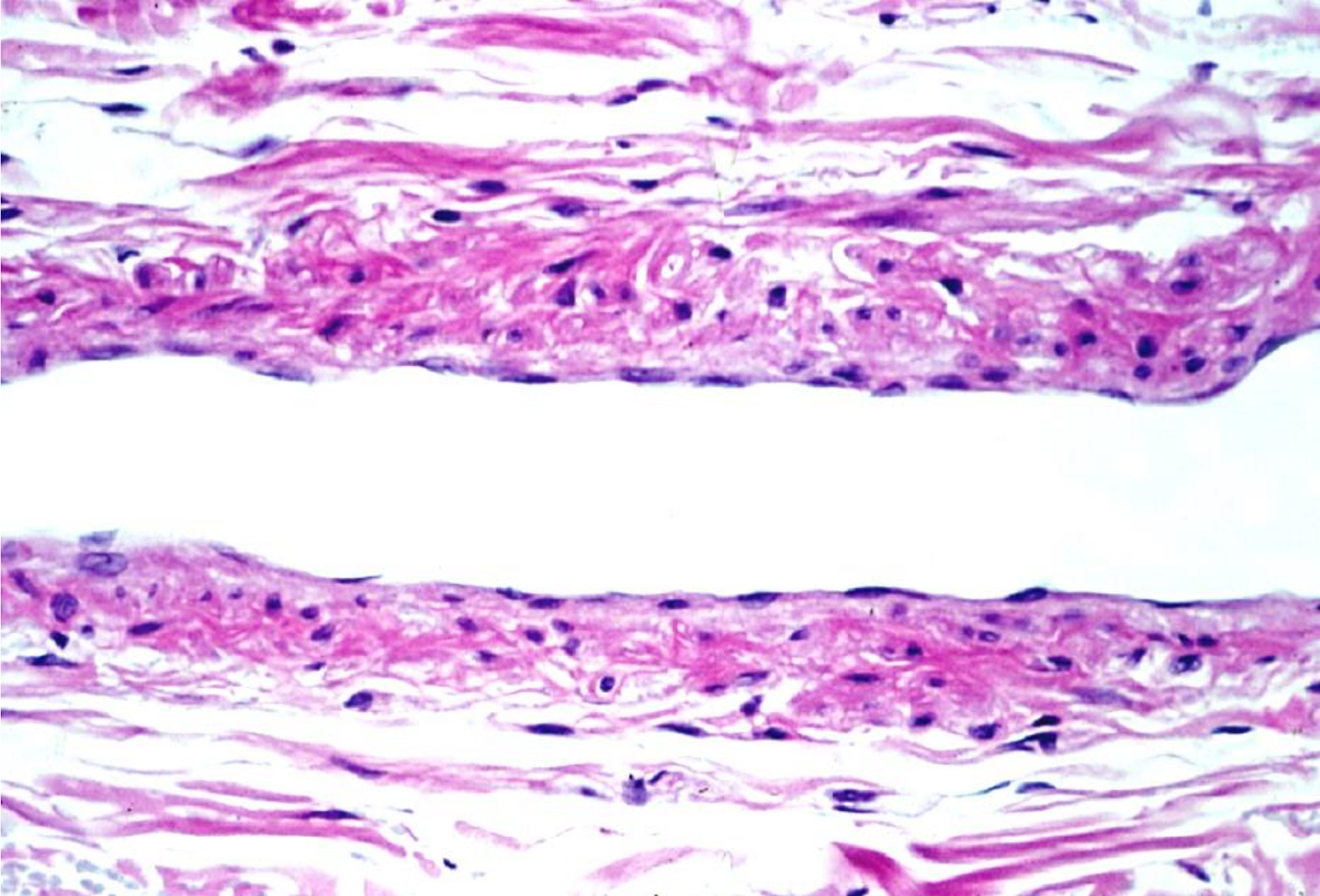
06-19 Small vein, transverse section. Human, H-E stain, x 160.





06-20 Small vein, transverse section. Human, H-E stain, x 64.



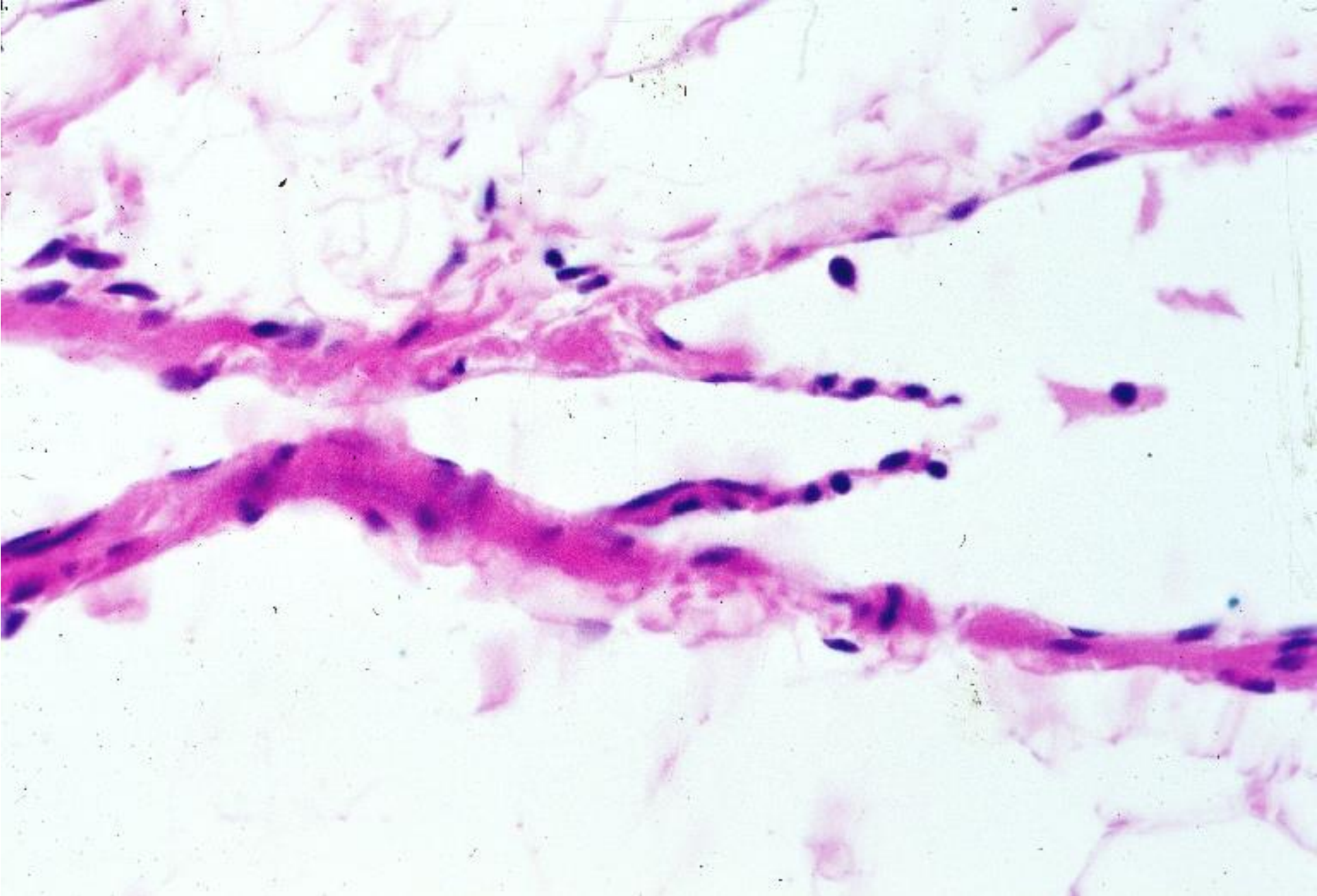


06-21 Small vein, longitudinal section. Human H-E stain, x 100.

# 06-002

# Valves of Veins



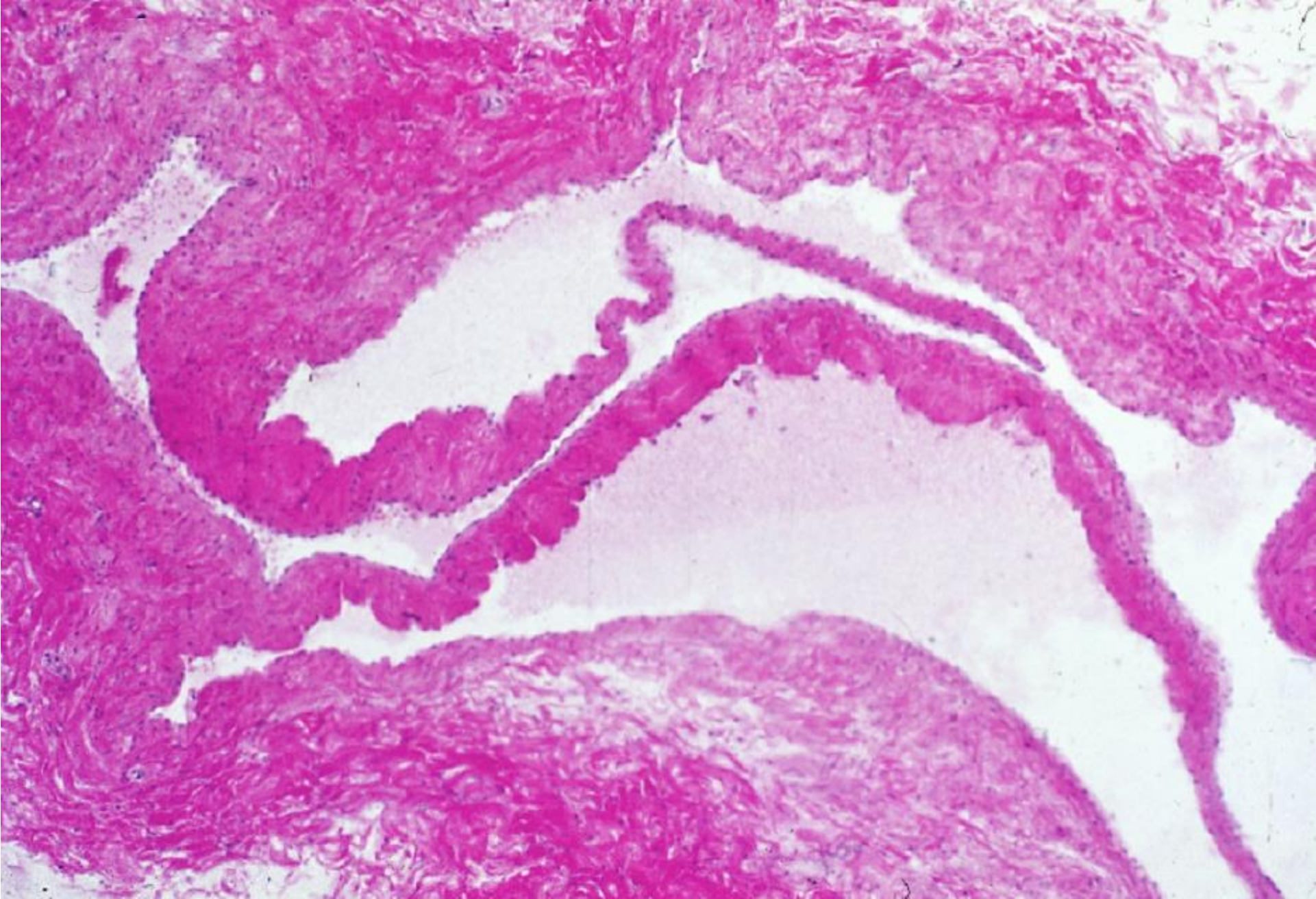


06-22 Valves of small vein, longitudinal section. Monkey, H-E stain, x 160.



06-23 Valves of femoral vein 1. Human, H-E stain, x 2.5.





06-24 Valves of femoral vein 2. Human, H-E stain, x 25.

# 06-003

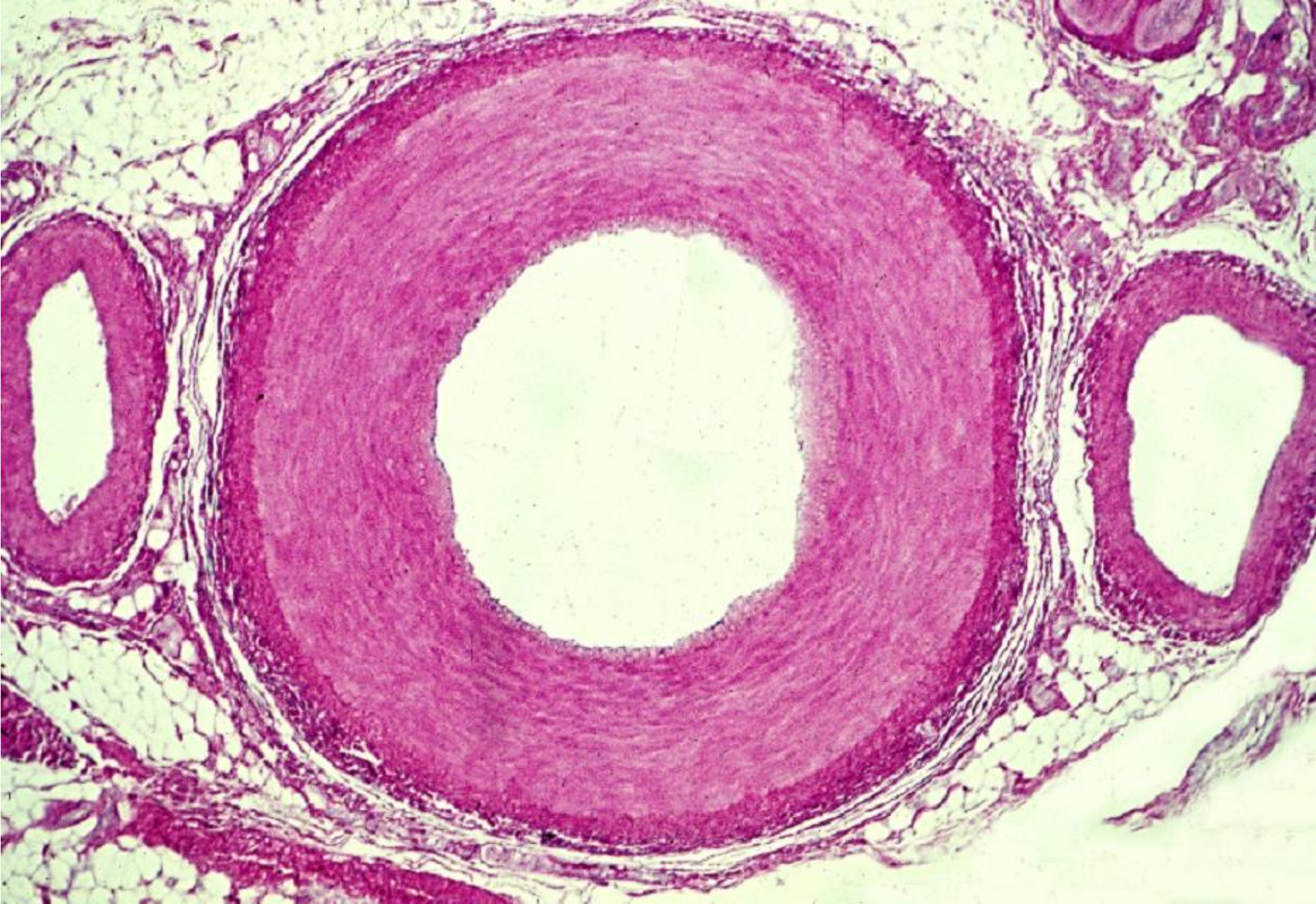
# Arteries





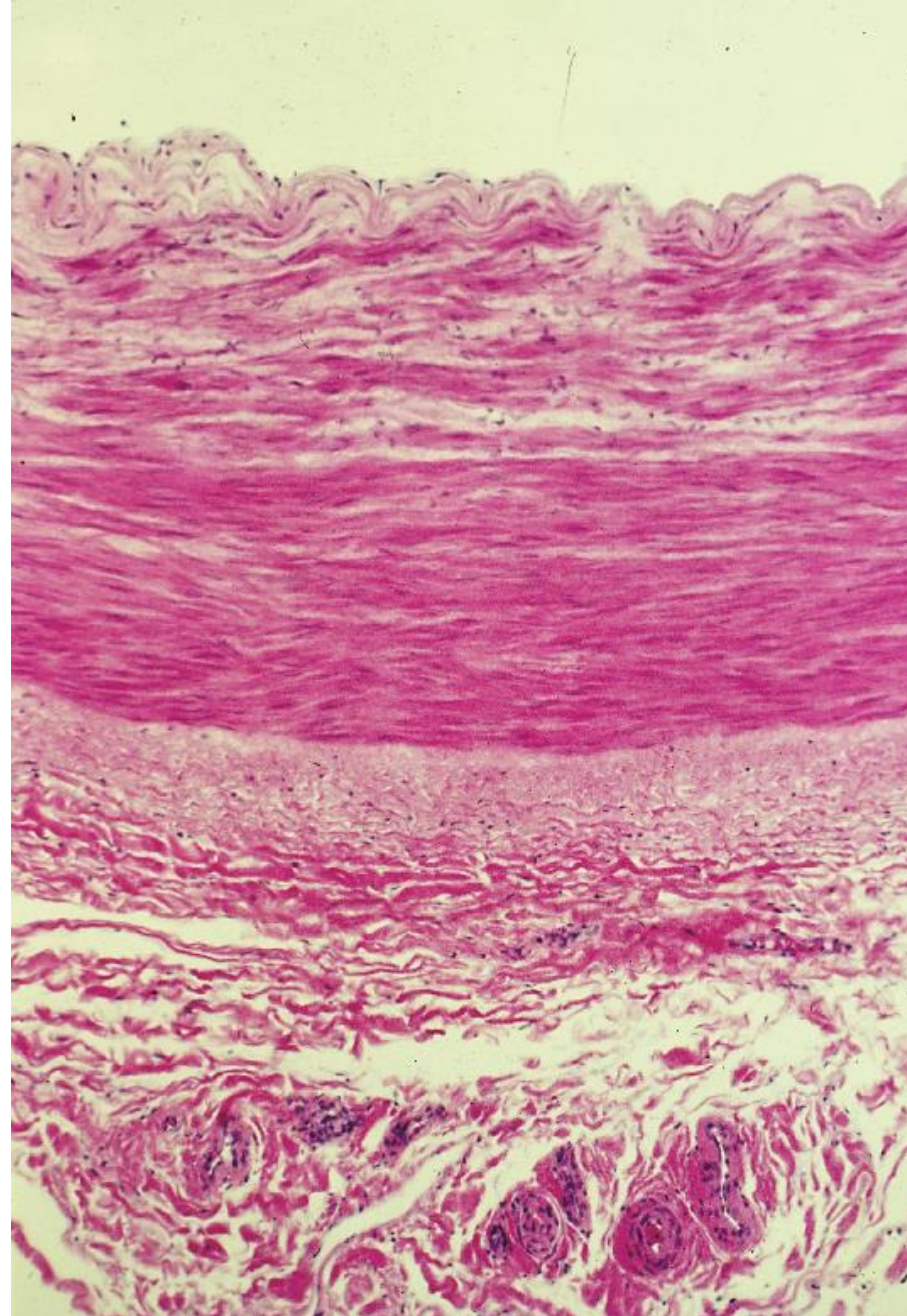
06-25 Artery of muscular type, transverse section. Monkey, H-E stain, x 30.





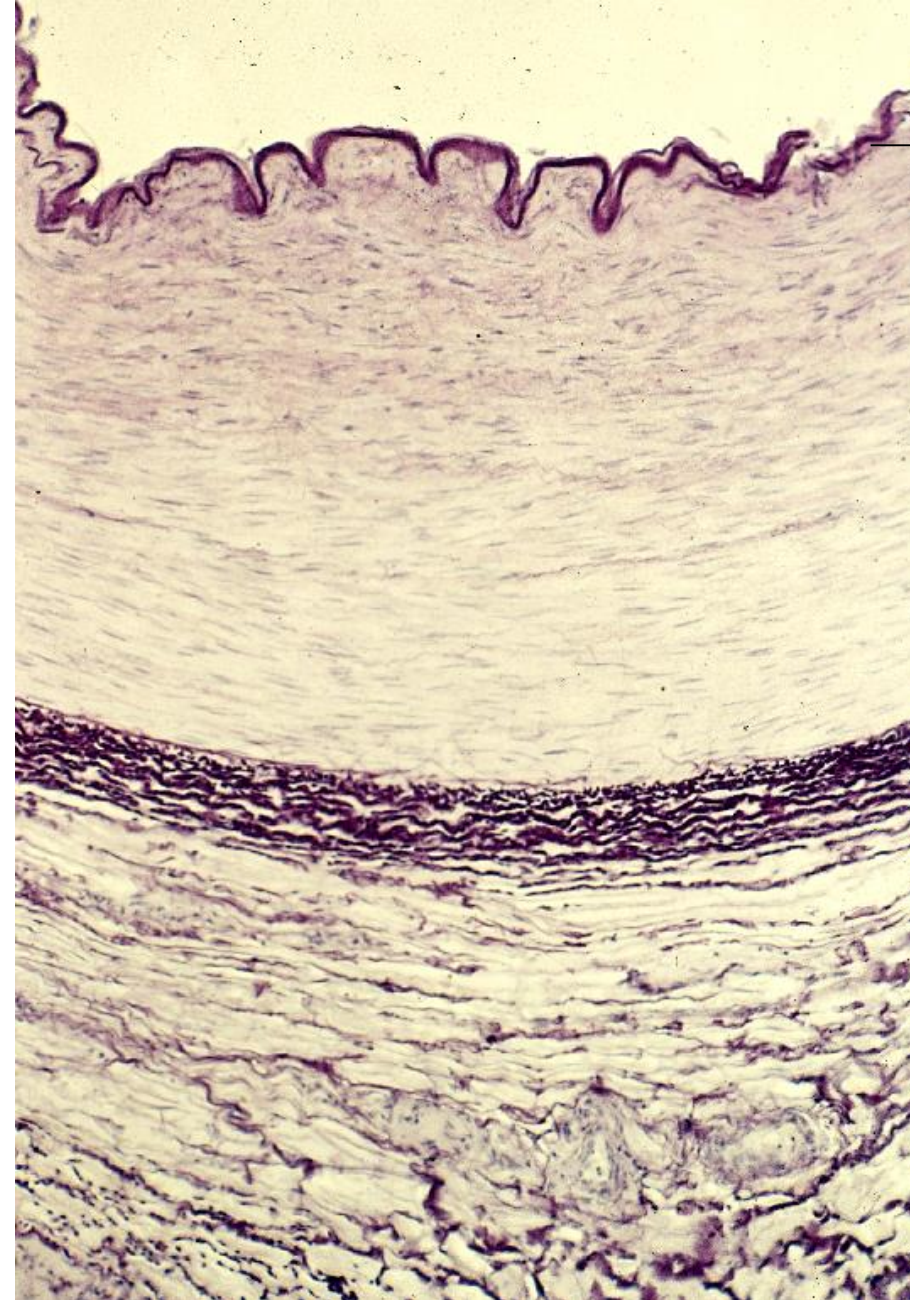
06-26 Arteria radialis, transverse section. Human, H-E stain, x 10.





← Lamina elastica interna

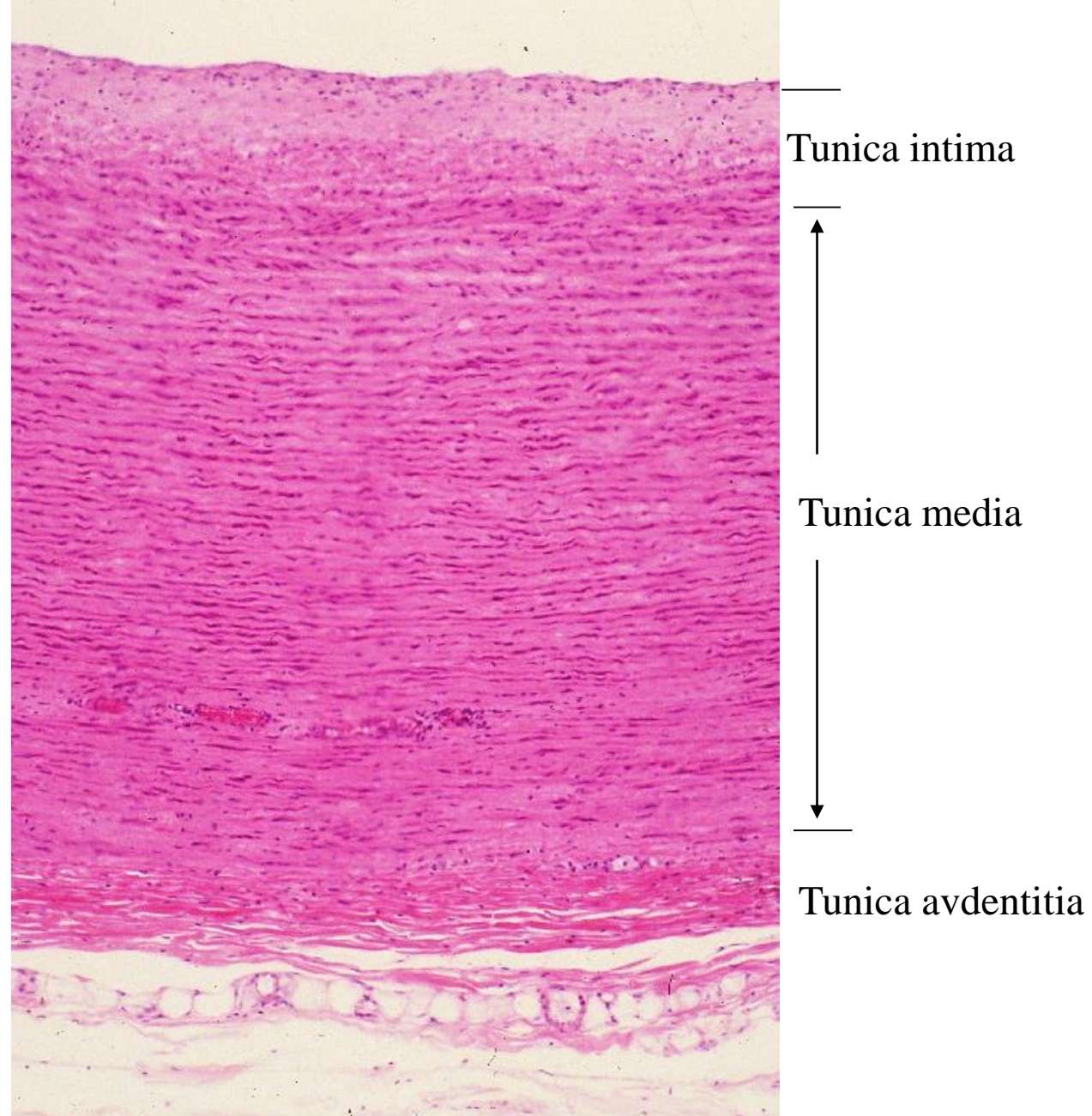
Lamina elastica  
externa

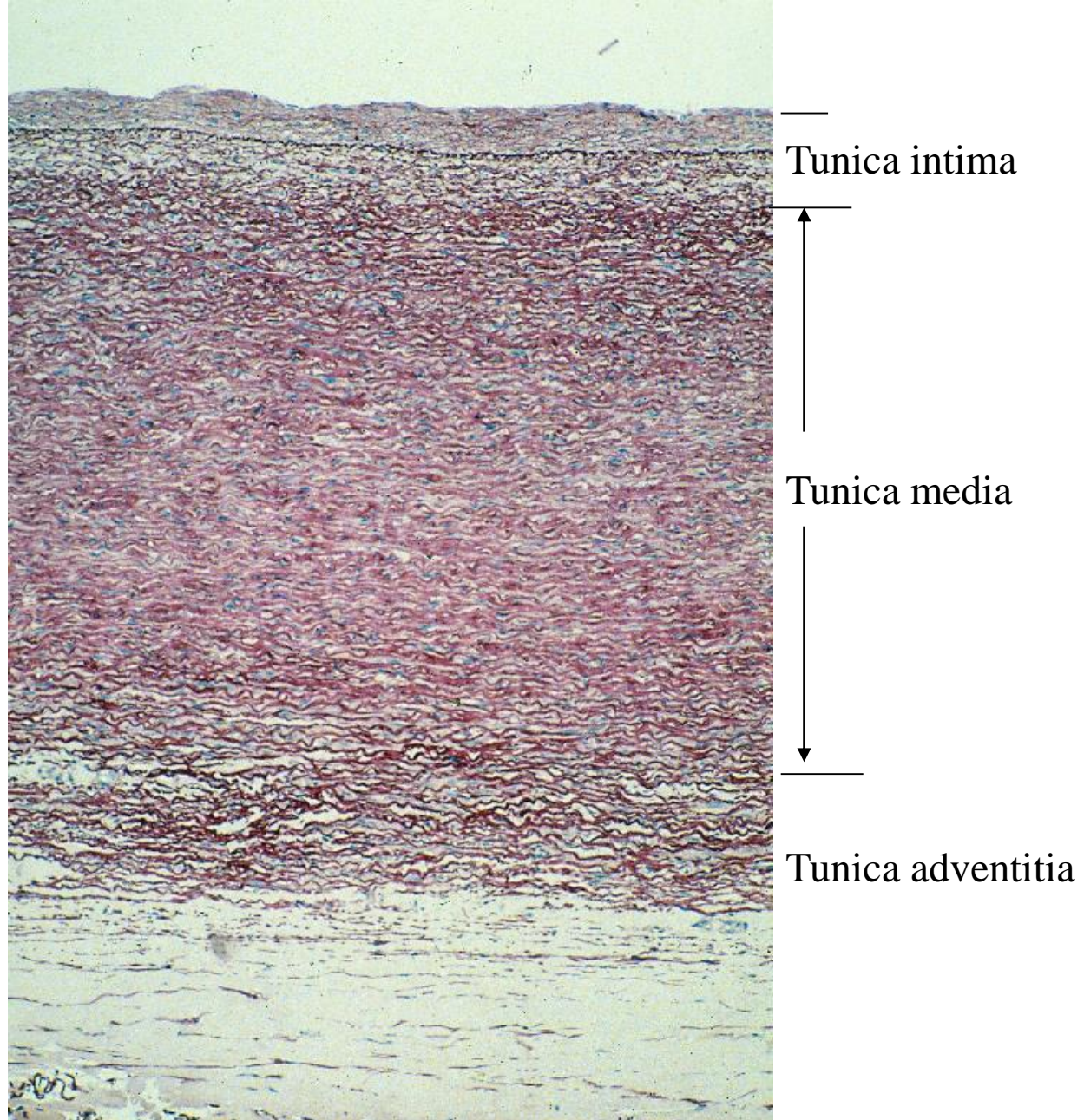


Lamina elastica interna

Lamina  
elastica  
externa



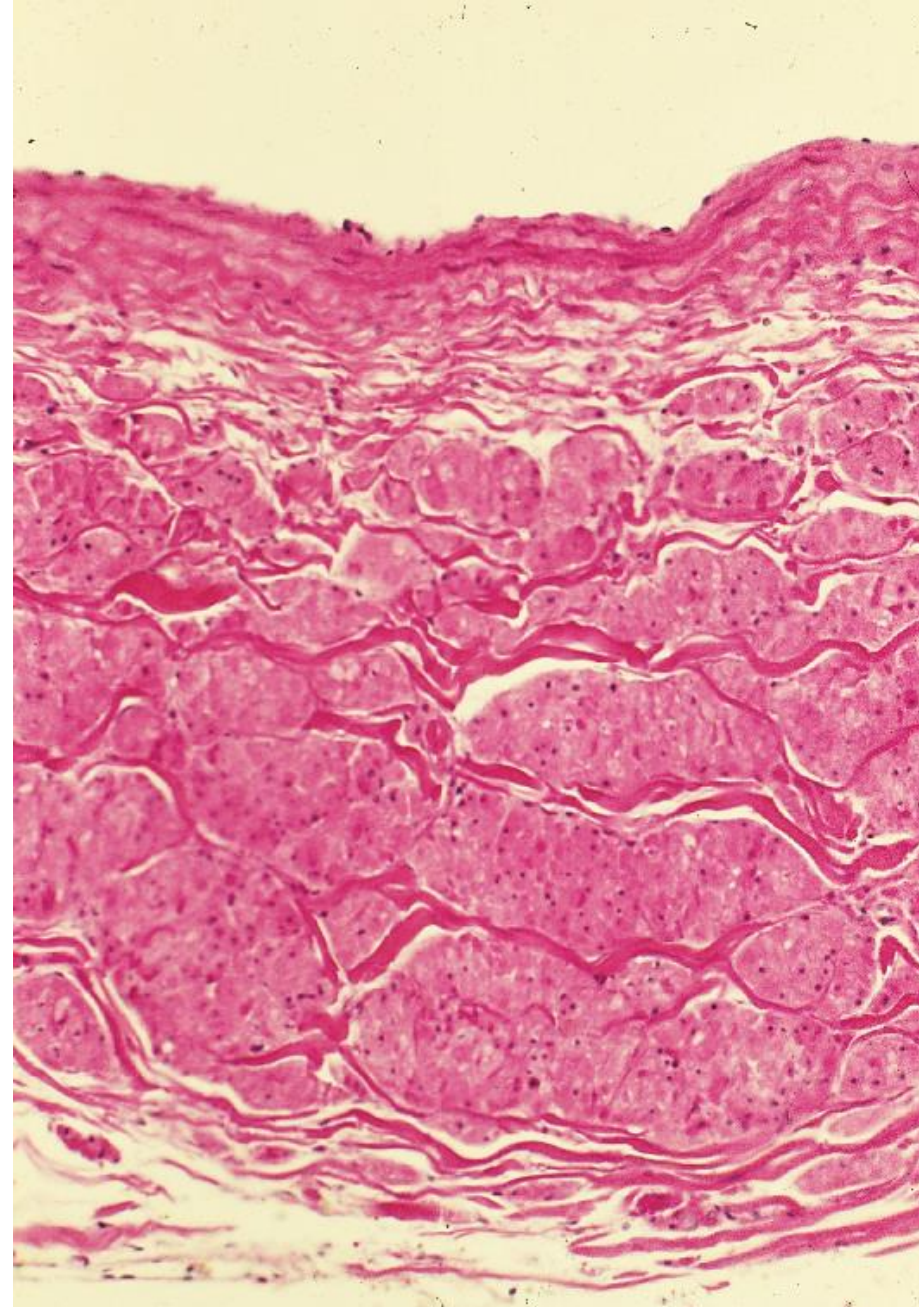




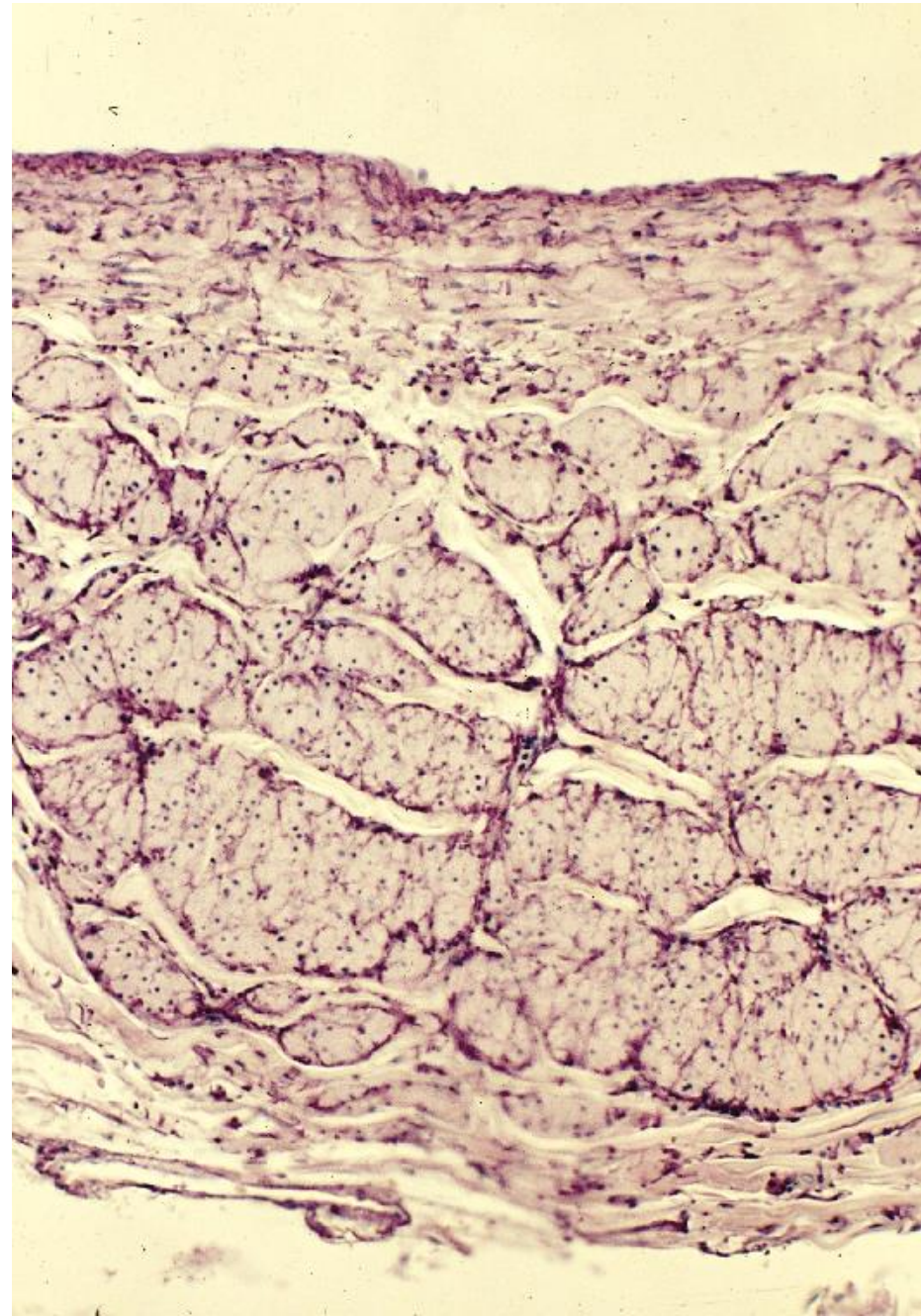
# 06-004

## Veins



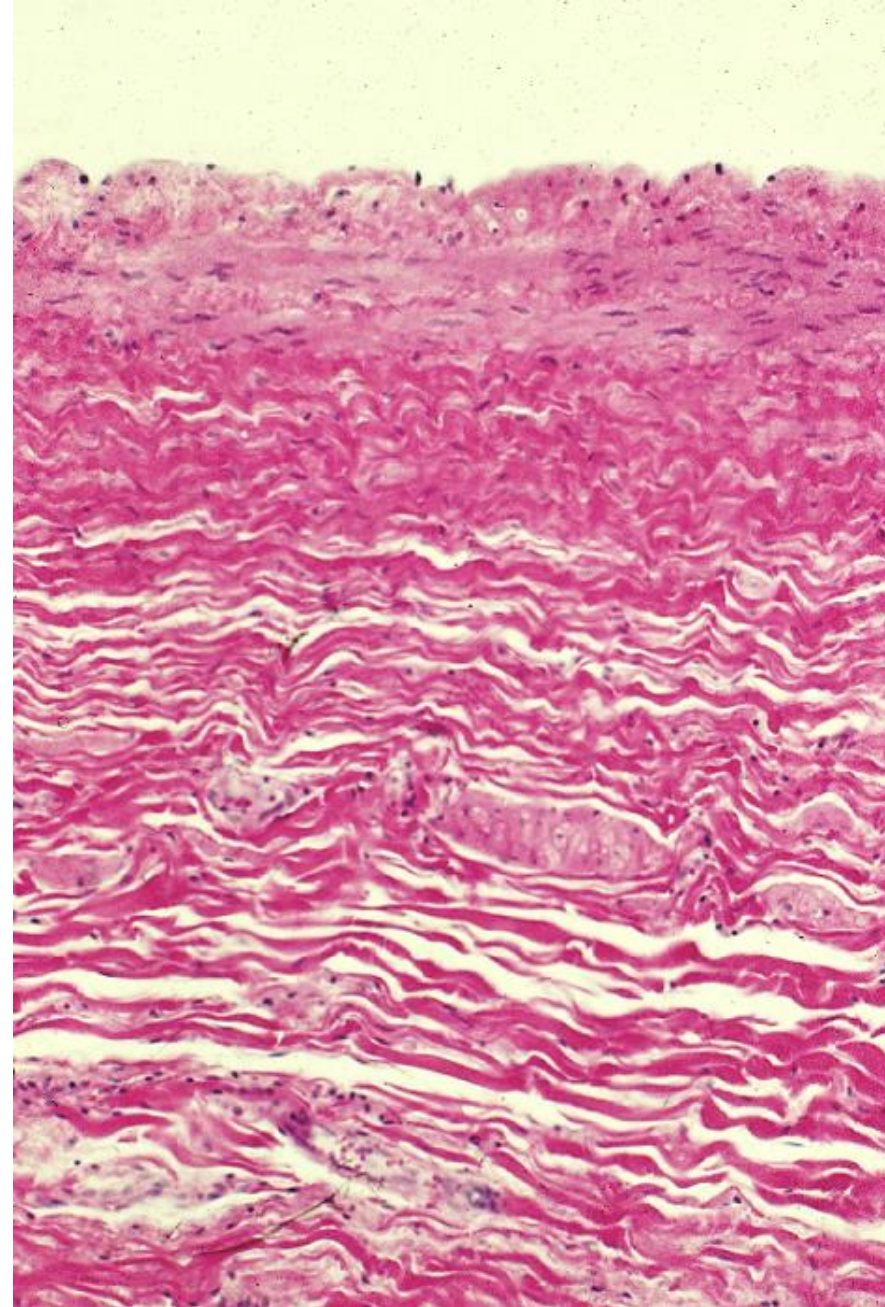


Tunica adventitia

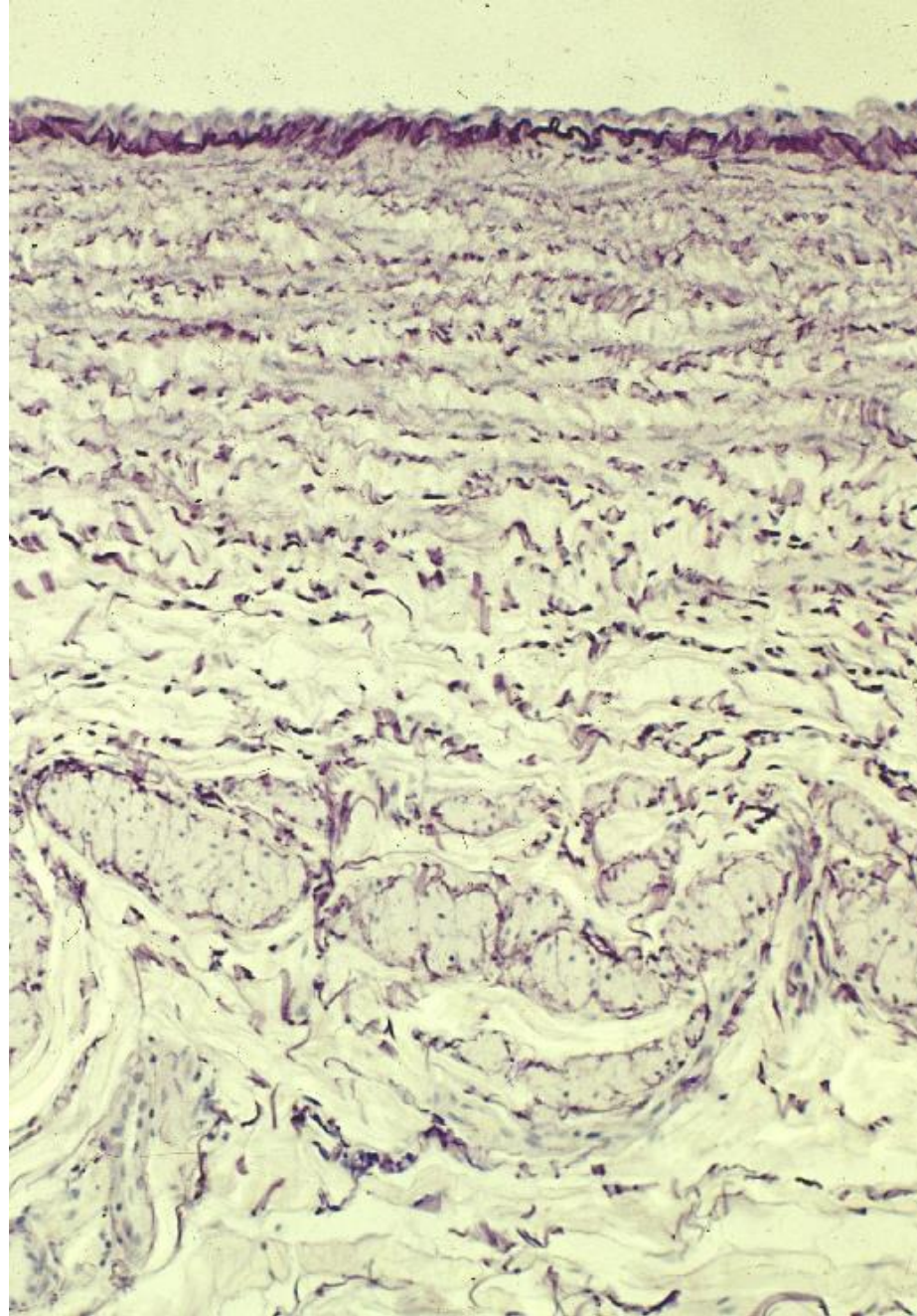


Tunica adventitia





Tunica adventitia

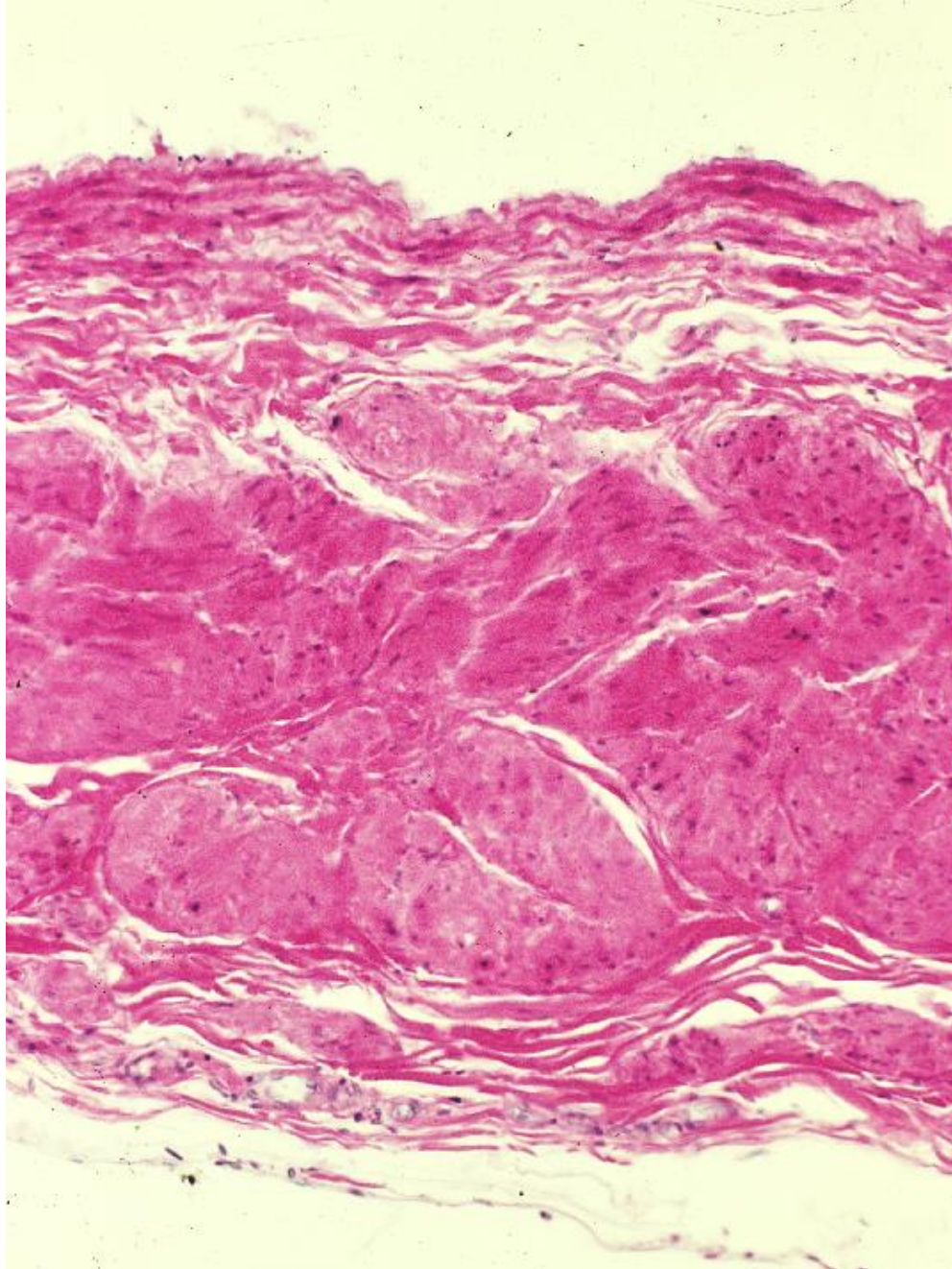


06-34 V. cava superior, 2. Human, resorcin-fuchsin stain, x 40.



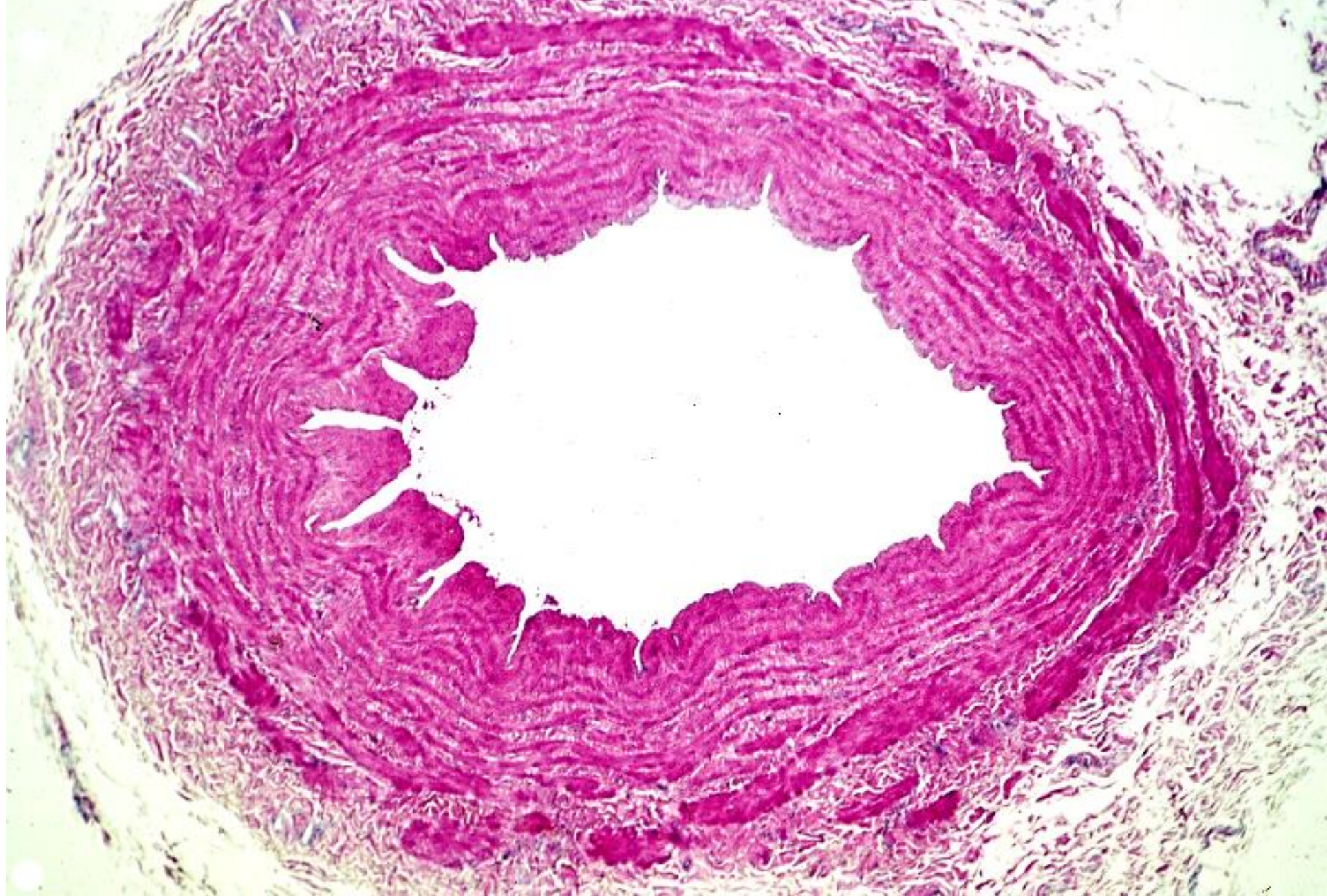


06-35 *V. portae*, transverse section, 1. Human, H-E stain, x 2.6.



06-36 V. portae, transverse section, 2. Human, H-E stain, x 40.





06-37 V. basilica, transverse section. Human, H-E stain, x 10.





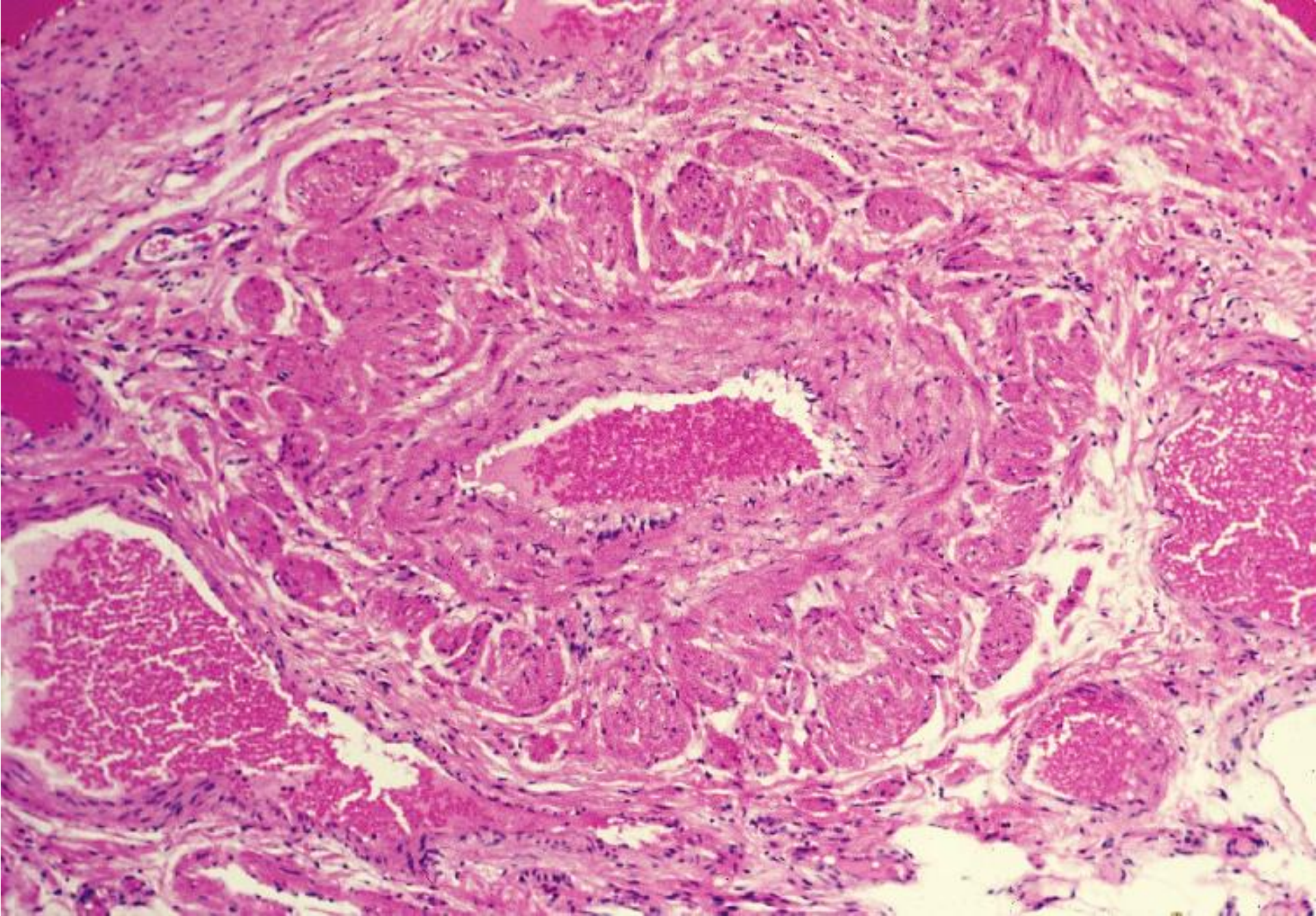
06-38 V. cephalica, transverse section. Human, H-E stain, x 10.





06-39 V. saphena magna, transverse section. Human, H-E stain, x 10.





06-40 Vein in the spermatic cord, transverse section. Human, H-E stain, x 25.



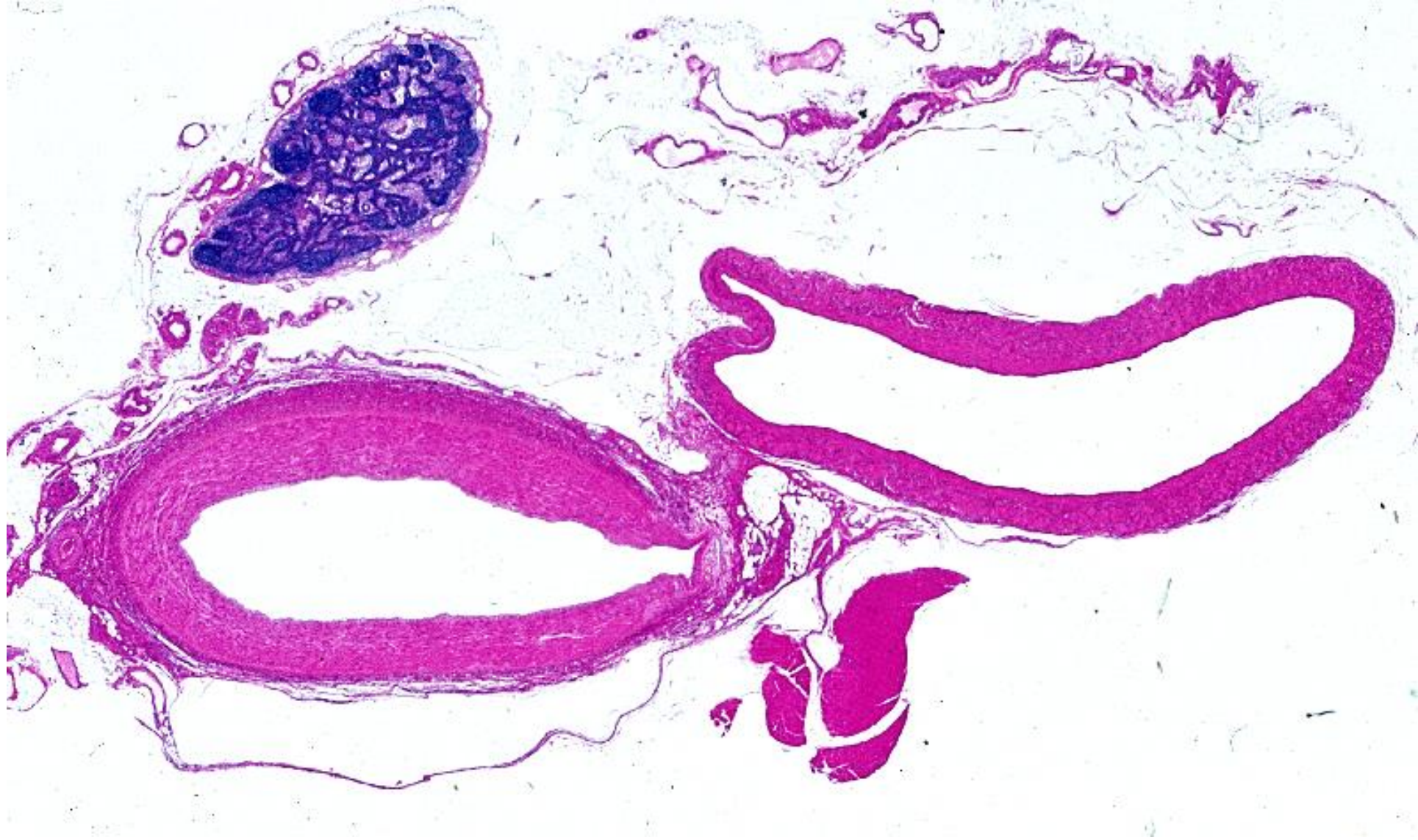
# 06-005

## Large arteries and veins



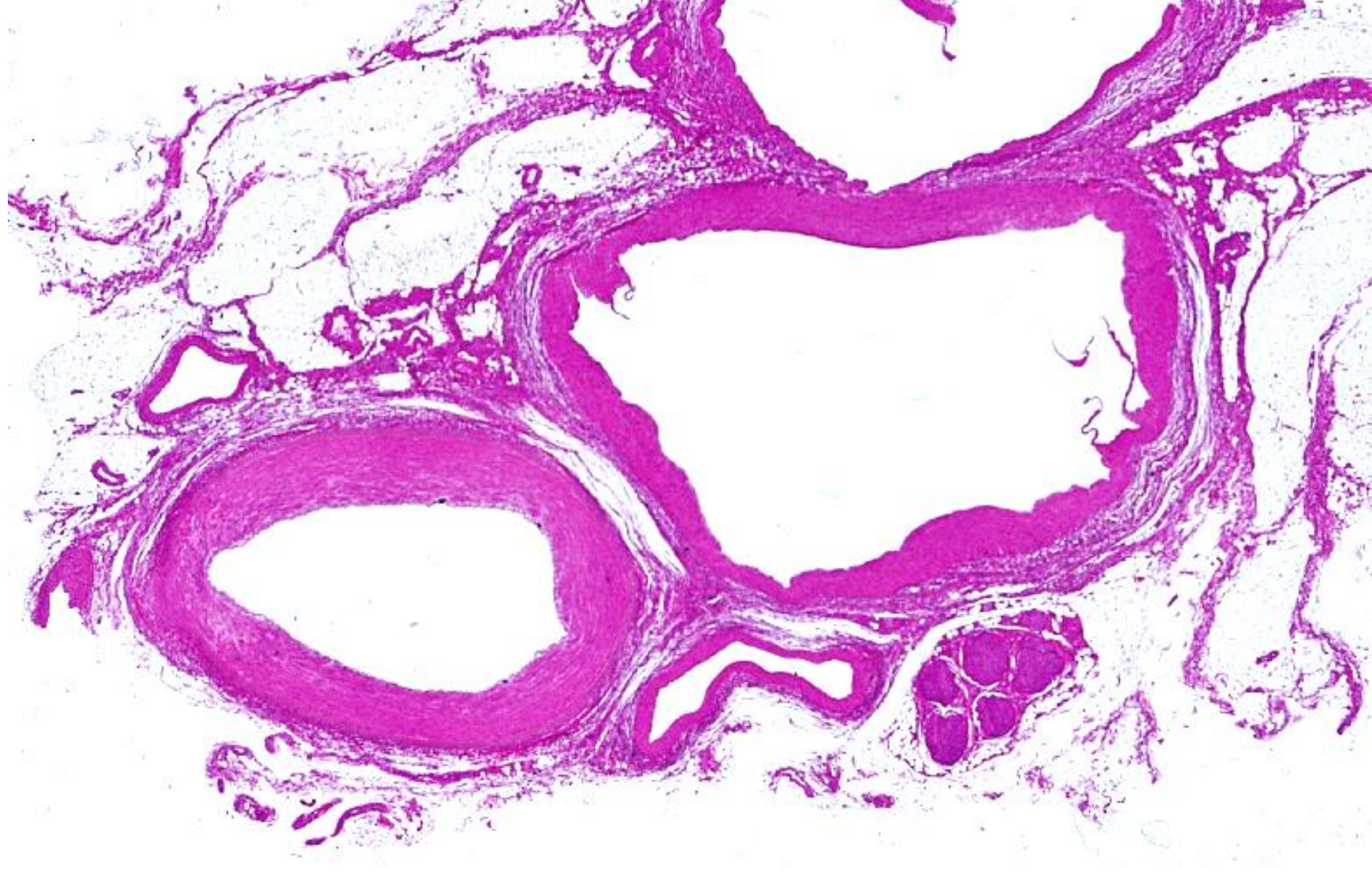
06-41 A. carotis interna and V. jugularis interna, transverse section. Human, H-E stain, x 2.3.





06-42 A. iliaca externa and V. iliaca externa, transverse section. Human, H-E stain, x 2.3.



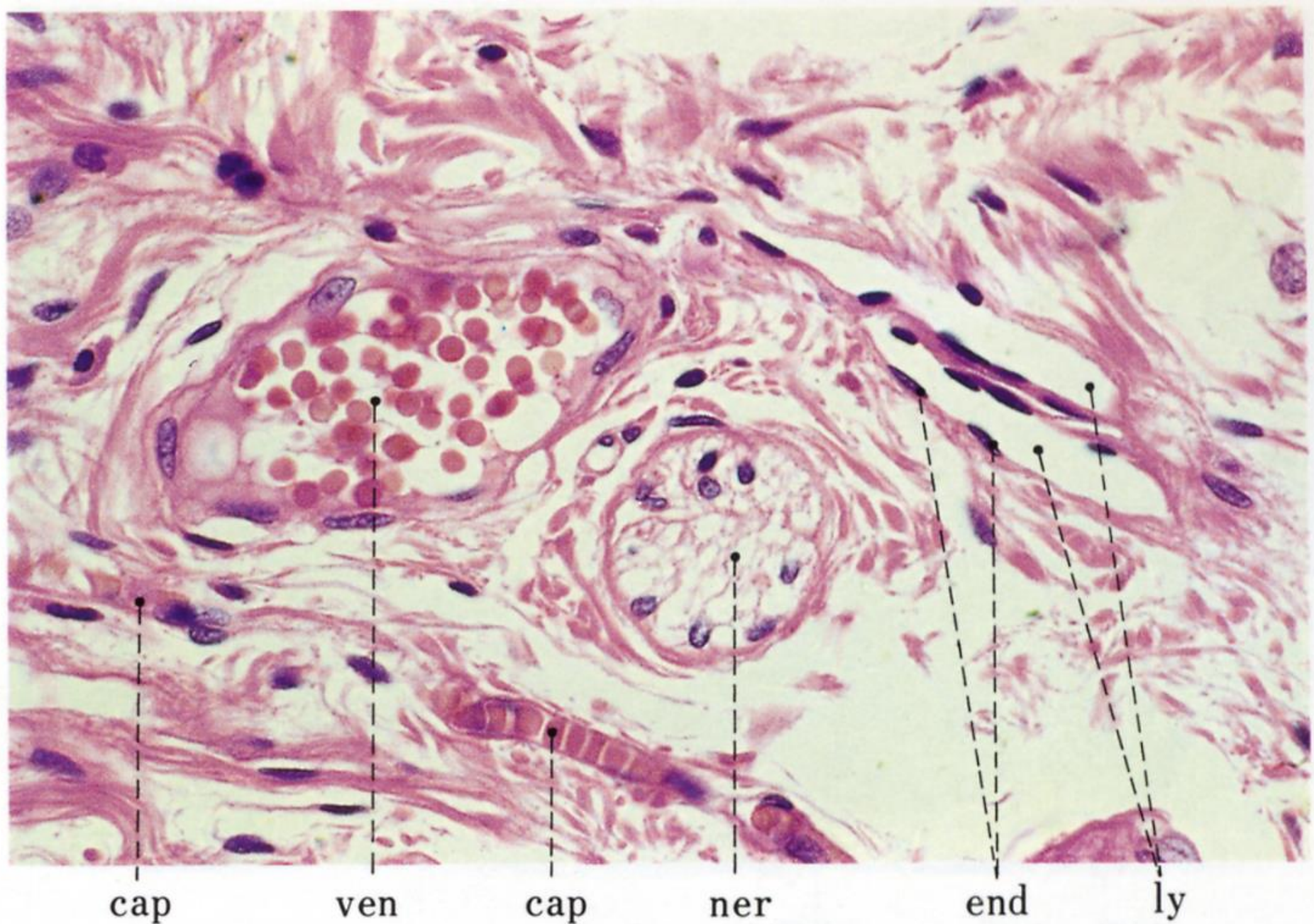


06-43 A. femoralis and V. femoralis, transverse section. Human, H-E stain, x 2.3.



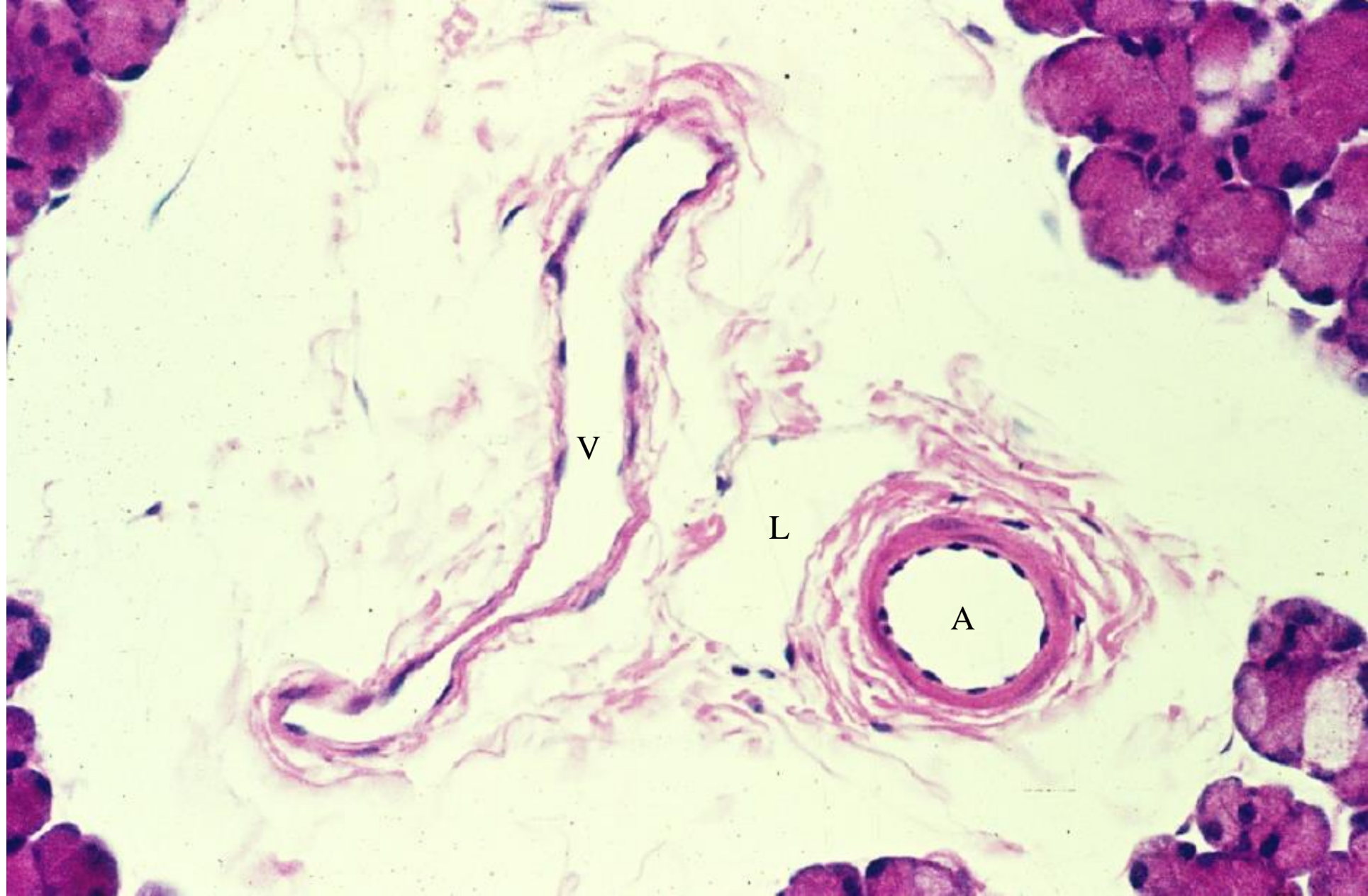
# 06-006

# Lymphatics

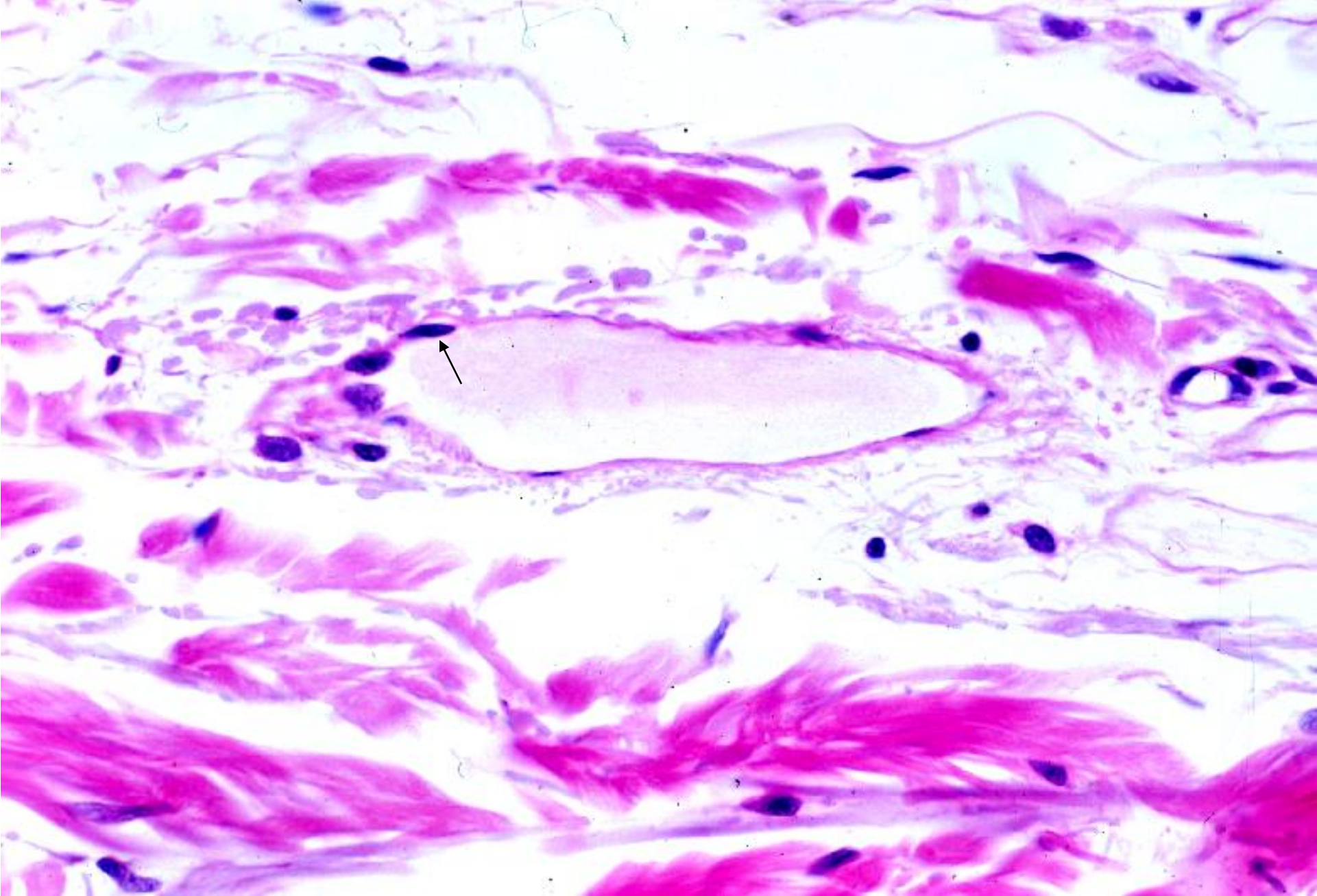


06-44 Lymphatic capillaries. Human, H-E stain, x 160.





06-45 Artery, vein and lymphatic vessel. Monkey, H-E stain, x 100.

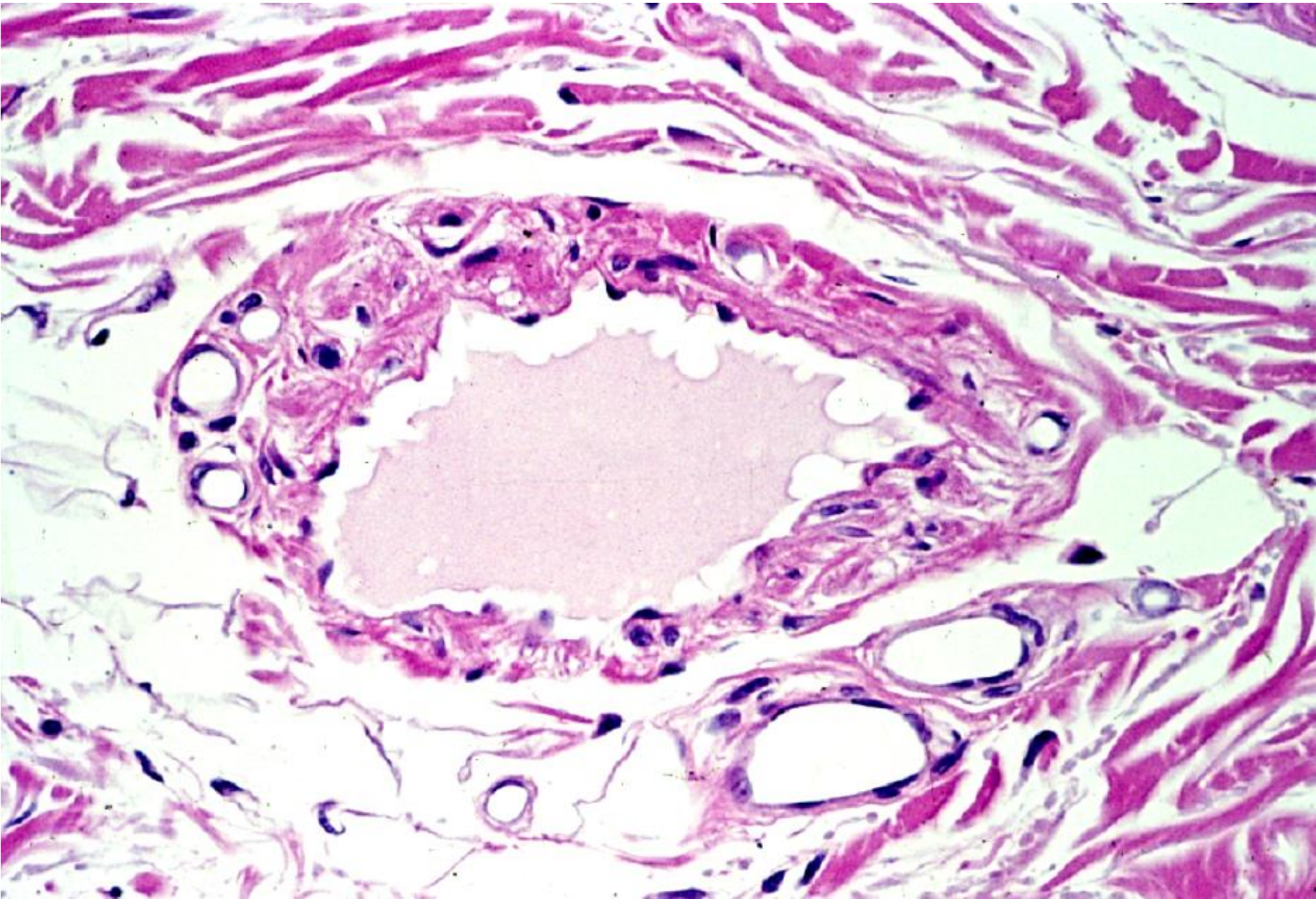


06-46 Small lymphatic vessel. Human, H-E stain, x 160.



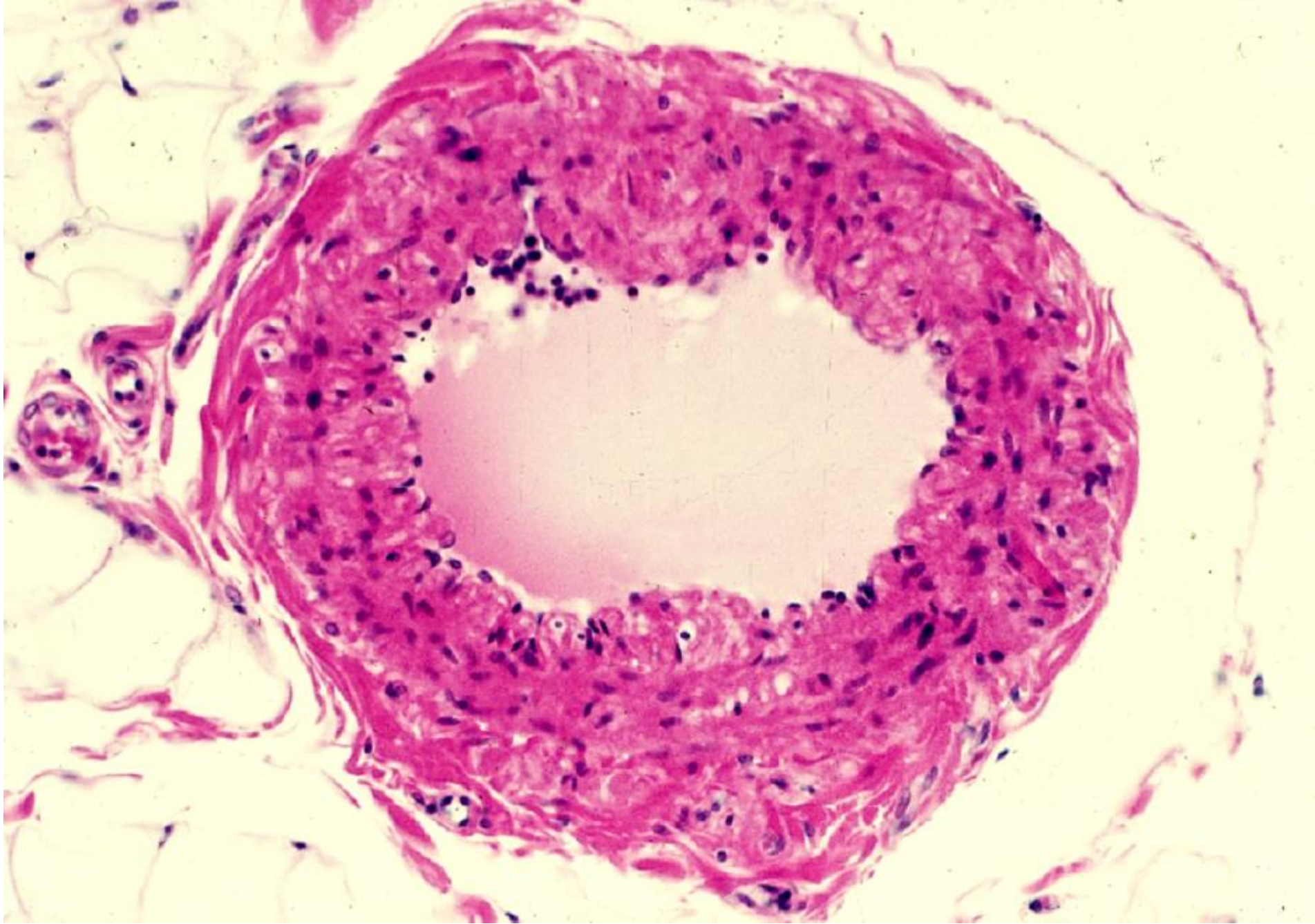


06-47 Valves of a small lymphatic vessel. Human, H-E stain, x 64.



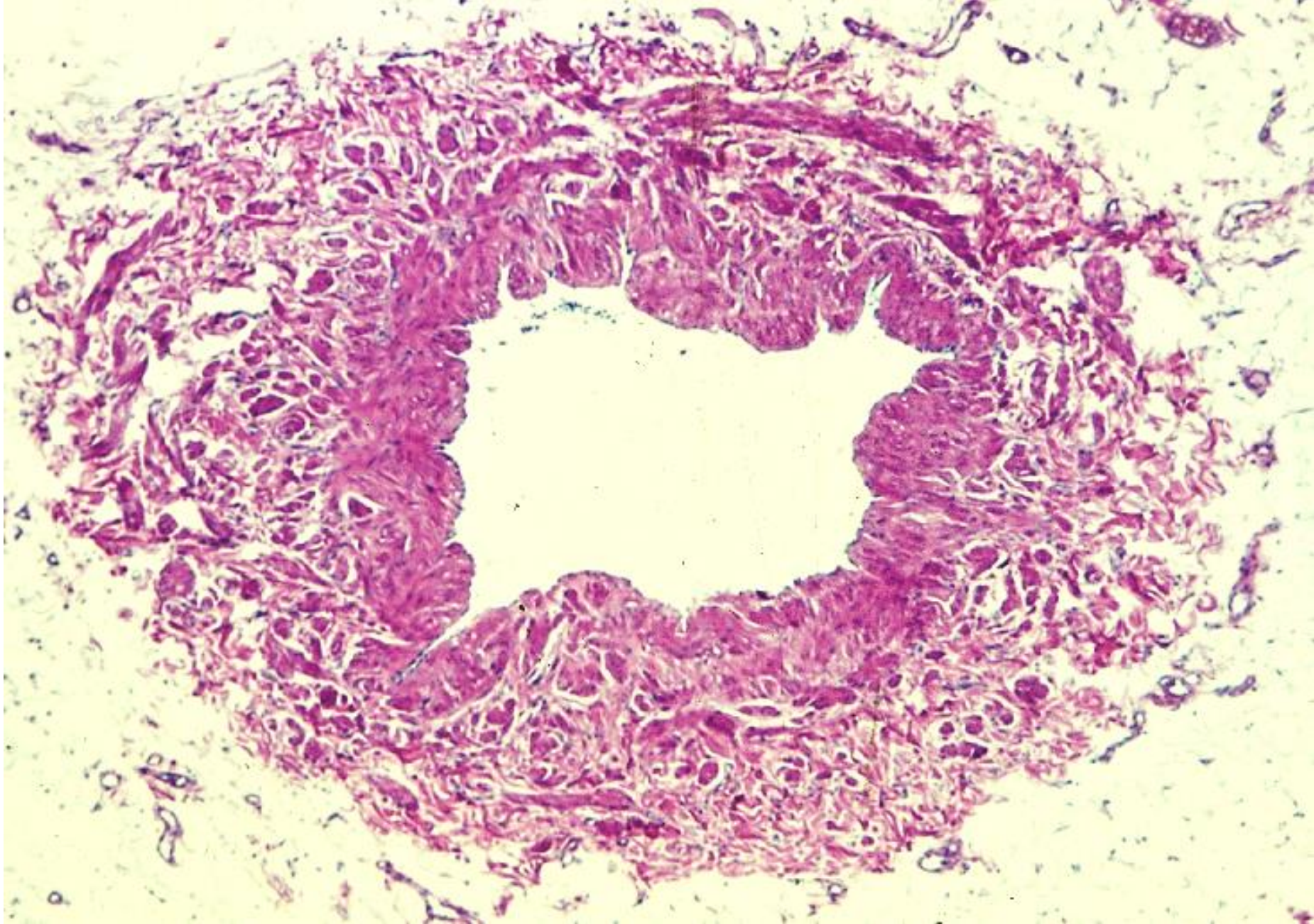
06-48 Lymphatic vessel, transverse section, 1. Human, H-E stain, x 100.





06-49 Lymphatic vessel, transverse section, 2. Human, H-E stain, x 64.



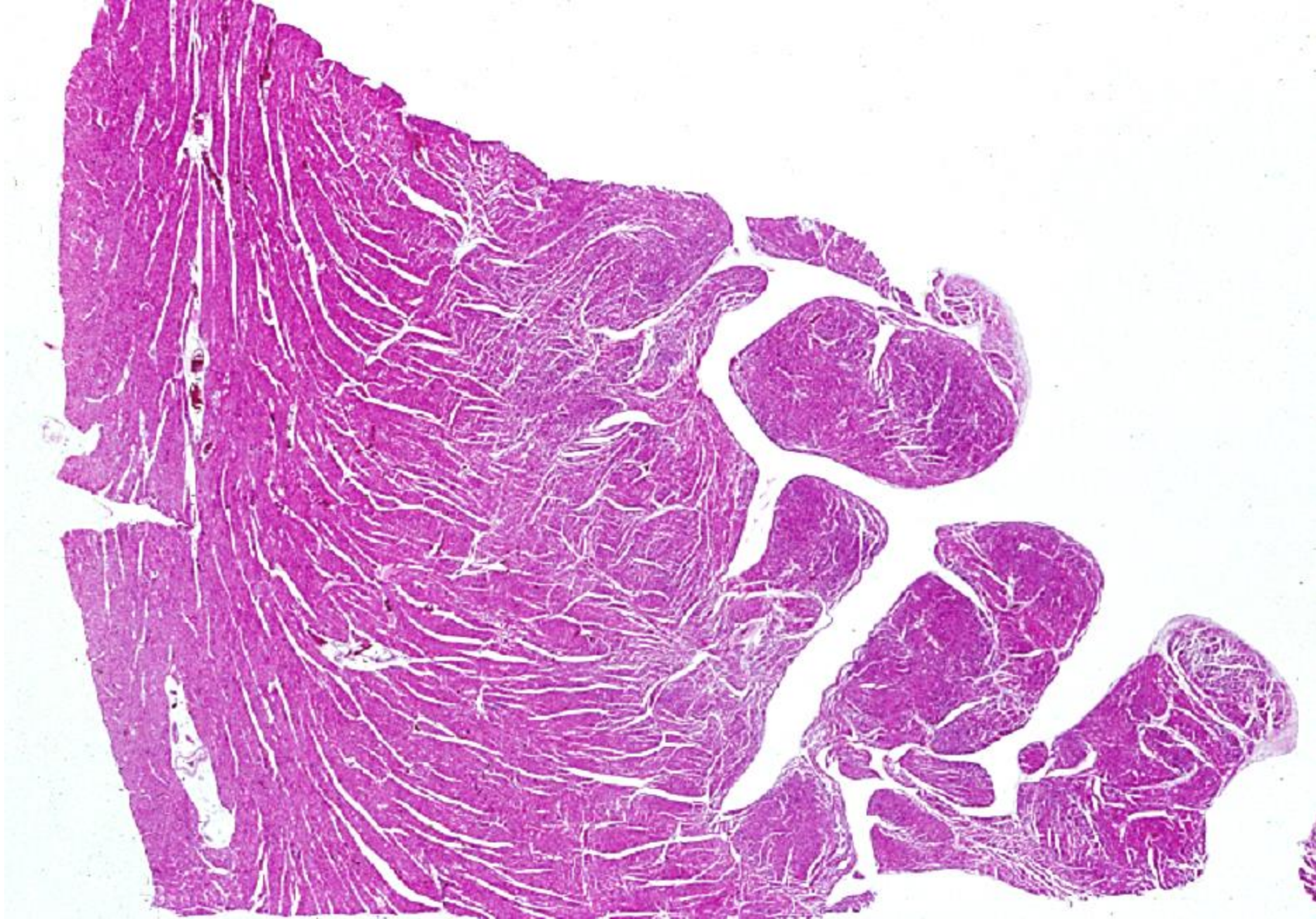


06-50 Ductus thoracicus, transverse section. Human, H-E stain, x 15.



# 06-007

# Heart



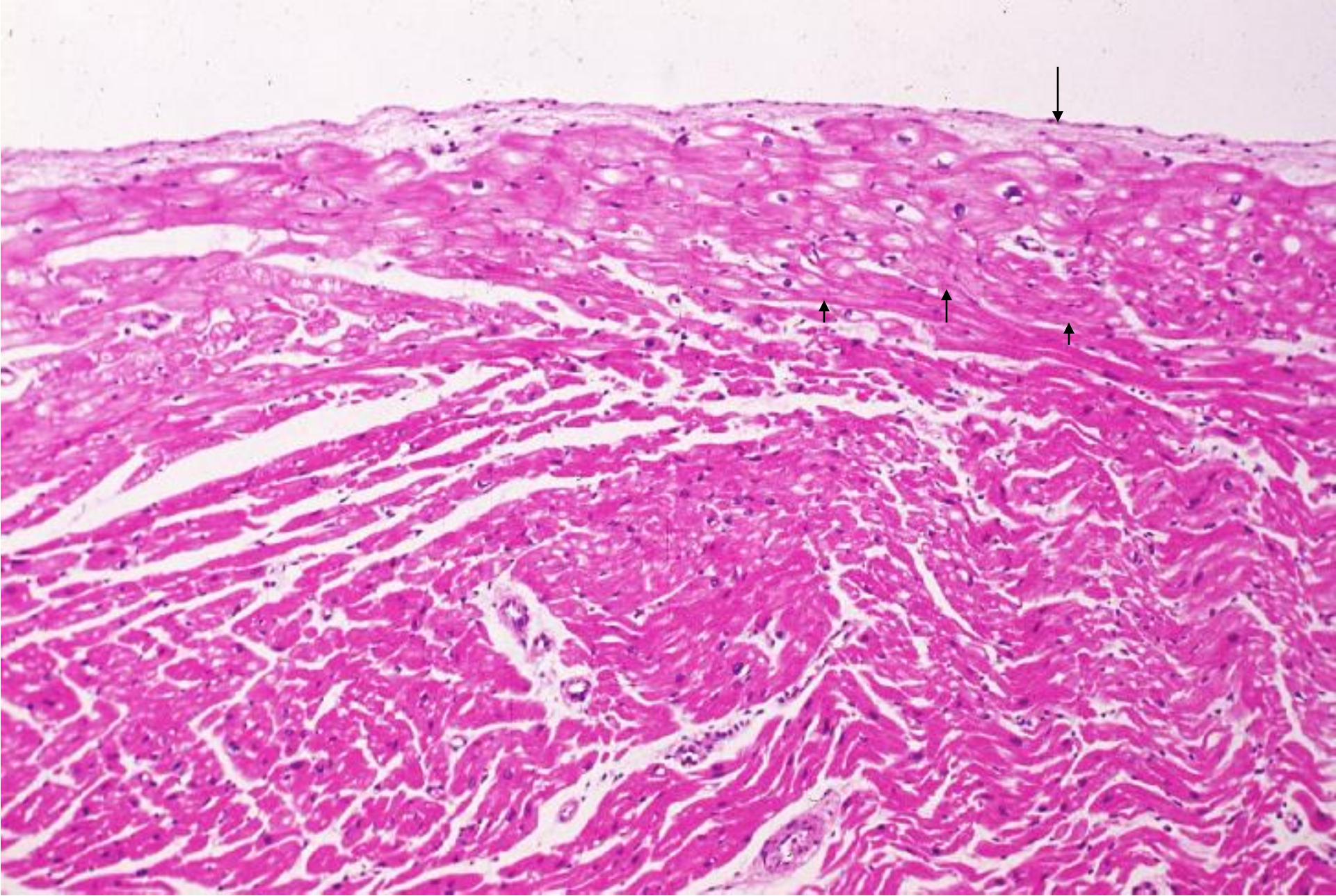
06-51 Wall of the left ventricle. Human, H-E stain, x 1.5.





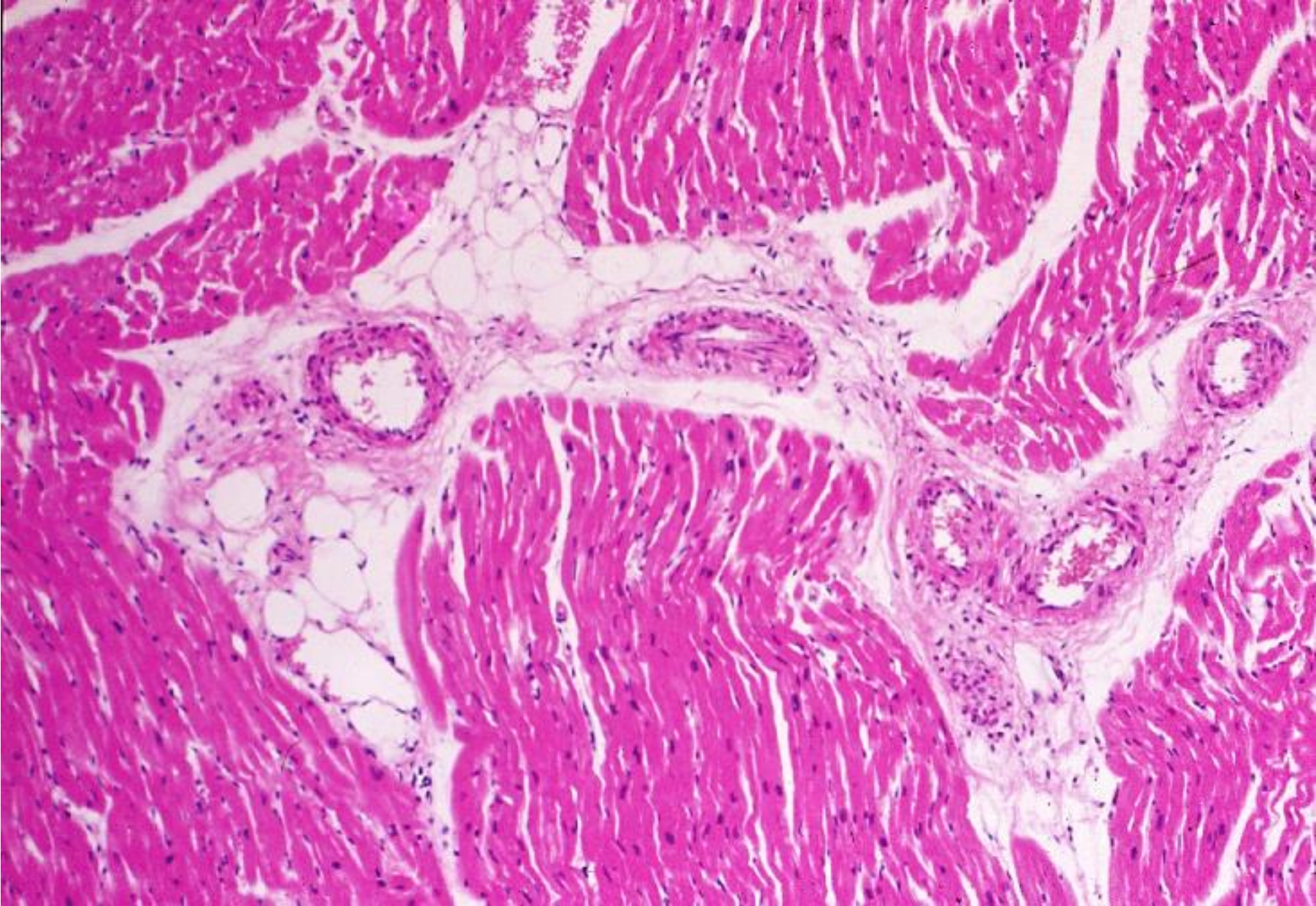
06-52 Wall of the right atrium. Human, H-E stain, x 2.5.





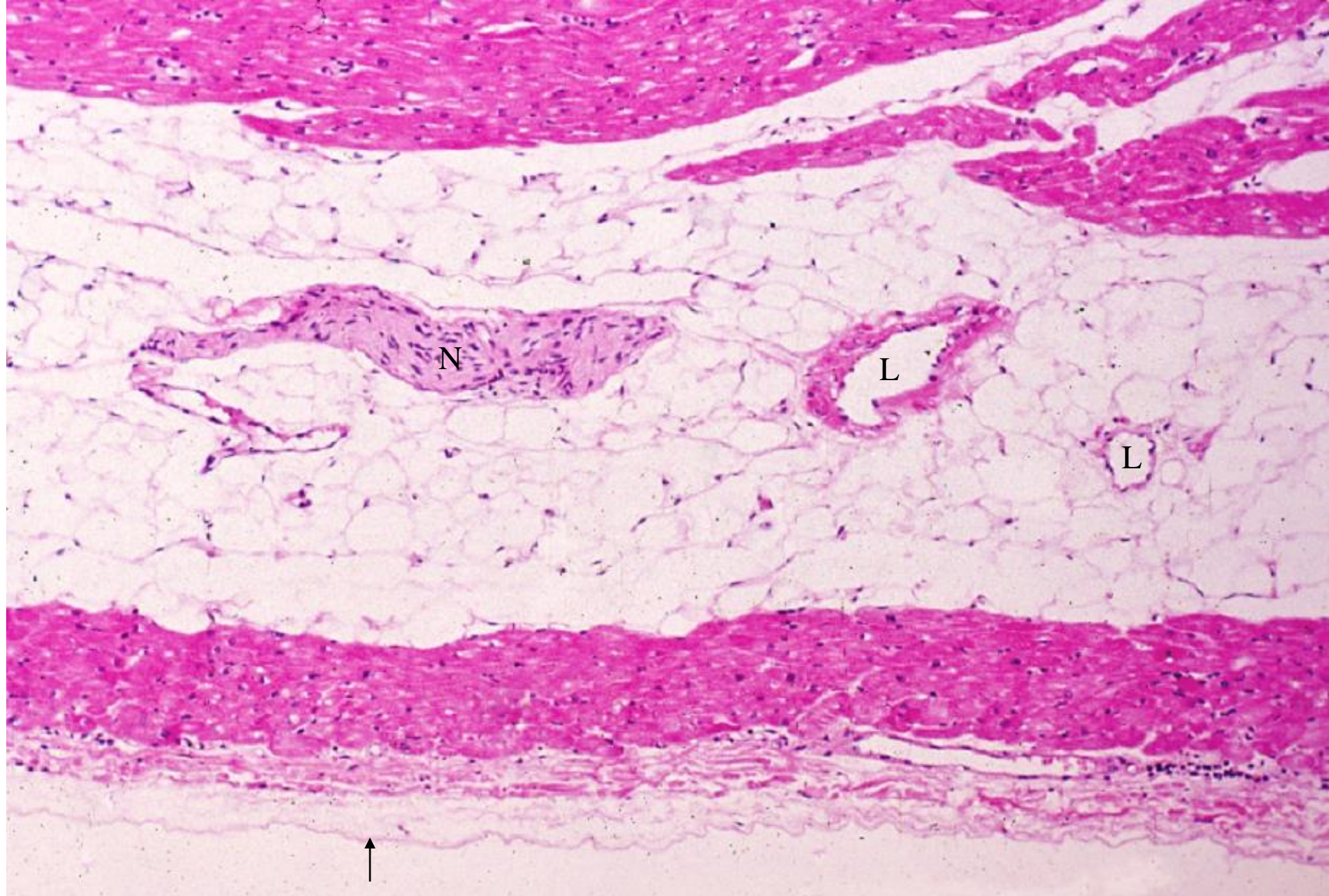
06-53 Endocardium and myocardium. Human, H-E stain, x 25.





06-54 Myocardium. Human, H-E stain, x 25.





06-55 Epicardium and myocardium. Human, H-E stain, x 25.



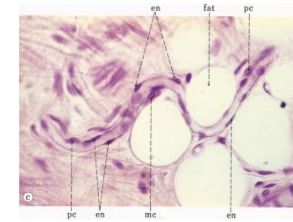


06-56 Sinus node. Human, M-G stain, x 4.0.

- The vascular system circulates the blood throughout the whole body and through this carries oxygen, nutritive materials, hormones, and other signaling molecules to the tissues and collects from them carbon dioxide and other metabolic waste products to be transported to the excretory organs for elimination. This system is made up of muscular pump, the heart and two vascular systems. The one is pulmonary circulation, which carries blood to and from the lung, where the exchange oxygen and carbon dioxide between blood and air takes place. The other is the systemic circulation, which distributes the blood to and collects from all of the other tissues and organs of the body.
- In both of these circulation the blood is pumped from the heart, passes successively through large arteries, small arteries, arterioles capillaries, venules, small veins, and large veins, and back to the heart. The actual exchange between the blood and the tissues takes place in the minute thin-walled capillaries and venules.
- The liquid component of the blood partly exudes from the capillaries and becomes lymph filling the tissue space and enters in the lymph capillaries.

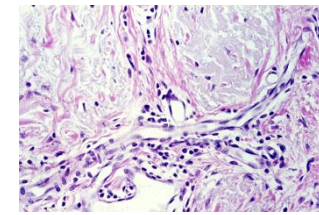


06-001 Blood Vessels. Capillaries, Arterioles, Venules, Small arteries and small veins.

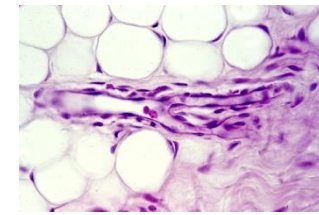


- This is a longitudinally sectioned capillary found in the subcutaneous connective tissue. The capillaries are about  $8\mu\text{m}$  in caliber and its wall consists exclusively of the endothelial cells, whose cytoplasm is extremely attenuated looking in sections as a thin line and nuclei ( en ) are fusi-form or long elliptic in shape and extrude outside as well as inside. Here and there capillaries are encircled by pericytes ( pc ). The empty circles in the right half of this figure are fat cells ( fat ).



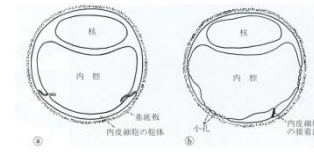


- This is an arteriole passing into the capillaries found in the dermis of human lip. An arteriole goes from bottom left of this figure right upward and at the arrow, the last smooth muscle fiber of the arteriole, passes into a capillary running right ward and dividing two and each arriving at the top right corner and bottom right corner of this figure respectively. The arteriole has transversely enclosing smooth muscle fibers, whereas the capillaries have not.



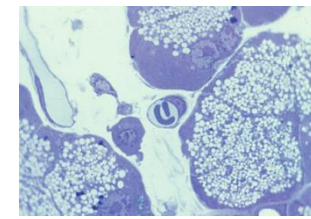
- Here three capillaries, being in the right half of the figure, meet together and become a venule with about double caliber (in the left half of the figure). The capillaries are encircled exclusively by the endothelium but around the venule beside the endothelium some pericytes are seen. Empty circles are fat cells.





- In the electron micrographs two types of capillaries are identified.
  - ①. Capillaries without fenestration: In this type cytoplasm of the endothelial cells has no pores, fenestrations, and encloses the lumen completely. Capillaries of this type are found in the pulmonary alveoli and in the brain.
  - ②. Capillaries with fenestration: In this type cytoplasm of the endothelial cells has large number of minute pores, fenestrations. The caliber of the pores vary greatly according to the organs. Capillaries of this type are found in the renal glomeruli, in the endocrine glands, and in the intestinal villi.

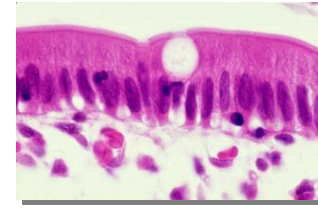
06-05 Capillaries, transverse and longitudinal sections. Rat, epon section, toluidin-blue stain, x 400.



- In this figure a transverse section ( center ) and a longitudinal section ( upper left corner ) of capillary, found in the rat pancreas, are shown. The transverse section, containing two erythrocytes, shows the nucleus extruding out side and very thin cytoplasm enclosing the lumen. The longitudinal section shows a long lumen limited by the thin cytoplasm and a very elongated nucleus.

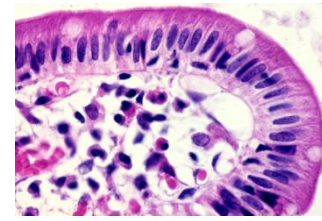


06-06 Capillaries in the subepithelial connective tissue of the intestinal vilus.  
Human, H-E stain, x 400.



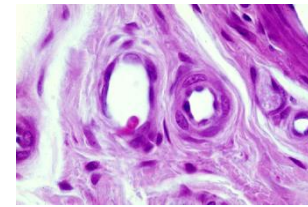
- In this figure, directly beneath the epithelium, simple columnar with striated border, two capillaries ( arrows ) are seen. The right one containing one erythrocyte consists of a single endothelial cell, nucleus of which extrude downwards and the cytoplasm encloses the lumen as a thin faint circle. The left one containing four erythrocytes consists of two endothelial cells and their nuclei locate at the bottom and top of the lumen, respectively. These capillaries are surrounded by a very loose connective tissue.

06-07 Capillaries beneath the intestinal epithelium. Human, H-E stain, x 160.



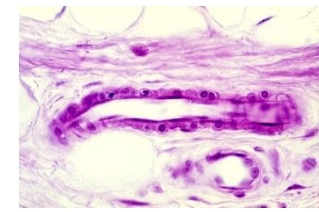
- Beneath the intestinal epithelium there is a very dense capillary network to provide the nutriment to the epithelium and at the same time to accept glucose and amino acids from the epithelium. This figure shows the dense network of the capillaries at the tip of an intestinal vilus. Numerous capillaries ( arrows ) line the epithelium.





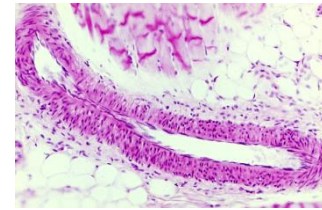
06-08 Arteriole and venule, transverse section. H-E stain, x 250.

- These arteriole (A) and venule (V) are found in the subcutaneous tissue of human thumb tip. The wall of the arteriole consists of endothelial cells, transversely sectioned, four smooth muscle cells, encircling the endothelium, and some fibroblasts, surrounding the arteriole. The lumen of the venule is wide and encircled by endothelial cells, nuclei of which are flat fusiform, and collagenous fibers containing some pericytes.



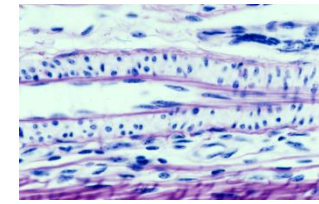
- This is a longitudinally sectioned arteriole, of about the same caliber with 06-08.
- The lumen is limited by the endothelial cells. Their nuclei appear flat and long spindle-shape, with long axis coincide with that of the arteriole. The endothelial cells are encircled by a single layer of smooth muscle cells, sectioned transversely, and further outside wrapped by a thin layer of longitudinally running collagenous fibers.





- This is a longitudinal section of a small artery, of about 0.1 mm in caliber, which shows already the typical structure of three layers: tunica intima, tunica media and tunica adventitia.
- The tunica intima consists of endothelial cells and a small amount of subendothelial connective tissue. The endothelial cells are flat long spindle-shaped and arrange their long axis coinciding with that of the vessel.
- The tunica media consists of smooth muscle cells, encircling the lumen and making a thick layer. In this small artery, number of muscle cell layers is about ten.
- The tunica adventitia is a layer of collagenous fibers running longitudinal and spiral.

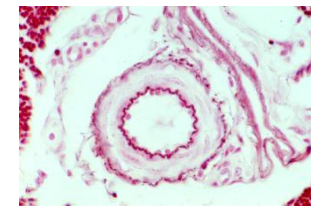
06-11 Small artery, longitudinal section. Bovine, resorcin-fuchsin and hematoxylin stain, x 160.



- This is a longitudinally sectioned small artery. Resorcin-fuchsin stained elastic fibers deep violet and hematoxylin nuclei deep blue. The longitudinal arrangement of the endothelial nuclei is evident. Beneath the endothelium there is a thin layer consisting of elastic fibers, running loose spiral. This is called lamina elastica interna ( arrows ).
- The tunica media consists of smooth muscle cells, encircling the lumen, and contains elastic fibers very few. The nuclei of smooth muscle cells are sectioned transversely.
- The tunica adventitia consists of loose connective tissue, whose fibers run longitudinal or loose spiral. Directly neighboring with the media there is a thin layer of longitudinally running fine elastic fibers. This is called lamina elastica externa ( arrow heads ).

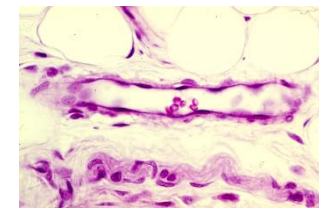


06-12 Small artery, transverse section. Bovine, orcein and Kernechtrot stain, x 160.



- This is a transversely sectioned small artery. Orcein stains elastic fibers deep brown and Kernechtrot nuclei light pink.
- As a post mortem phenomenon, smooth muscle fibers of the media contract, so that the lumen and the intima are compressed, resulting in the zigzagging of lamina elastica interna ( arrow ). As to the lamina elastica extern such zigzagging is not conspicuous.

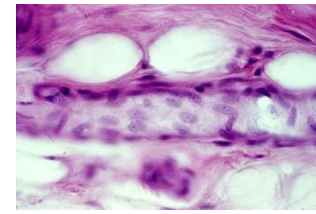
06-13 Venule, longitudinal section. Human, H-E stain, x 160.



- This is a longitudinally sectioned venule found in the subcutaneous tissue. The wall of this venule consists of only endothelial cells and a few pericytes. The connective tissue coat is only faint. At the left extremity of this venule, three endothelial nuclei show the surface view ( arrow ). At lowermost part of this figure a thin nerve runs winding horizontally.

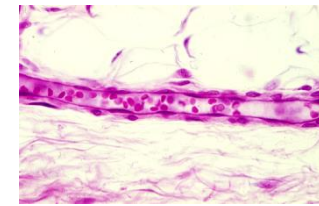


06-14 Venule, surface view of the endothelial cells. Human, H-E stain, x 160.



- This is the surface view of the endothelial cells of a venule. Nuclei of the endothelial cells appear lightly stained oval with the long axis roughly coincide with that of venule, and cell boundary shows long hexagon.

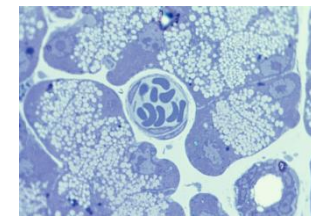
06-15 Venule, longitudinal section. Human, H-E stain, x 160.



- This is a venule of about  $20\mu\text{m}$  in caliber, whose wall is a little thicker than 06-13, but consists of mainly connective tissue. Attaching to the endothelium several pericytes are recognized.

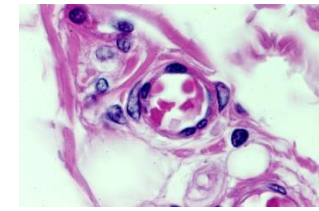


06-16 Venule, transverse section. Rat pancreas, epon section, toluidinblue stain, x 400.



- This is a transversely sectioned venule found in the pancreas, of about  $30\mu\text{m}$  in caliber. The lumen is encircled by two endothelial cells and a conspicuous pericyte surrounds the lower half of this venule. Around this venule are the pancreatic acini, filled with secretion granules.

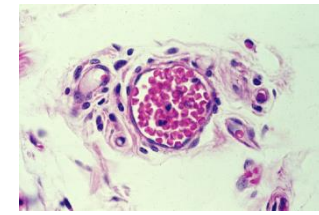
06-17 Small vein, transverse section. Human, H-E section, x 400.



- This is a higher magnification of a small vein, of about 50 $\mu$ m in caliber, whose wall consists of only endothelium, two pericytes and a very thin layer of collagenous fibers.

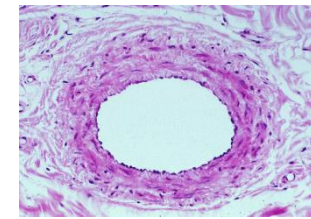


06-18 Small vein, transverse sectioned. Human, H-E stain, x 160.



- This is a small vein of about  $80\mu\text{m}$  in caliber, whose wall is still very thin consisting of only endothelium, several pericytes and thin wrapping of collagenous fibers. Around this vein several capillaries or venules are following.

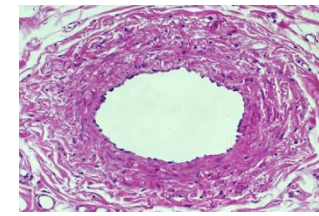
06-19 Small vein, transverse section. Human, H-E stain, x 160.



- This is a small vein of about  $150\mu\text{m}$  in caliber found in the subcutaneous tissue of human lip. The wall of this vein consists of three layers, namely tunica intima, tunica media and tunica adventitia. The intima consists of the endothelium and underlying scant connective tissue. The media is composed of loosely arranged circular smooth muscle cells, each of which is separated by the connective tissue fibers. The adventitia is a relatively thick layer of collagenous fibers running loosely spiral. Neither lamina elastica interna nor lamina elastica externa exist.

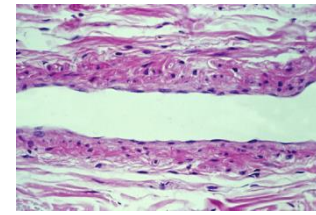


06-20 Small vein, transverse section. Human, H-E stain, x 64.



- The wall of this vein is apparently densely composed but its constituents are mainly collagenous fibers and circular smooth muscle fibers are scant.

06-21 Small vein, longitudinal section. Human H-E stain, x 100.

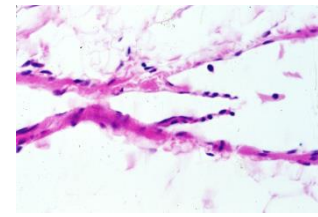


- This is a longitudinally sectioned small vein, of about the same caliber of 06-20. The apparently thick composed wall consists mainly of collagenous fibers running loosely spiral and the circular smooth muscle fibers are only scattered.



- Venous flow toward the heart is derived by the negative pressure caused by the diastole of the right atrium. To facilitate this flow, medium-sized veins have numerous valves that prevent flow of blood away from the heart. Each of the two opposing semilunar valve leaflets is a thin fold of the intima, consisting of endothelium and underlying connective tissue. The free margins of valves project in the direction of blood flow. When blood is flowing toward the heart, the cusps of the valves are flattened against the vessel wall, but if the blood flows backward, the edges of the valve leaflets come into close apposition, preventing backflow. Valves are especially numerous in the veins of the lower extremity where they facilitate venous return. Valves are not formed in minute veins or in the very large veins.

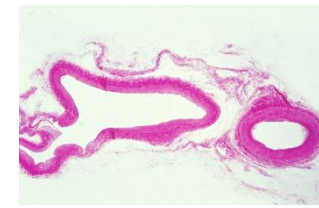
06-22 Valves of small vein, longitudinal section. Monkey, H-E stain, x 160.



- This is the longitudinally sectioned valves found in the intestinal submucosa. Two valve leaflets are thin folds of the vein wall, consisting of connective tissue covered by endothelium, starting from opposite regions. The space between the valve leaflet and vein wall is called sinus of the valve, where the wall is thin and often distended.

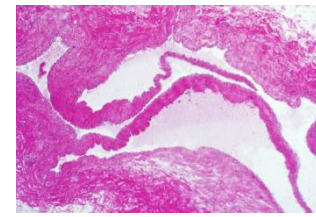


06-23 Valves of femoral vein 1. Human, H-E stain, x 2.5.



- This figure shows the femoral artery ( right ) and femoral vein ( left ). At lower left corner two smaller veins confluent to the femoral vein, one of which has typical valves ( arrow ). Higher magnification of these valves is shown in 06-24.

06-24 Valves of femoral vein 2. Human, H-E stain, x 25.

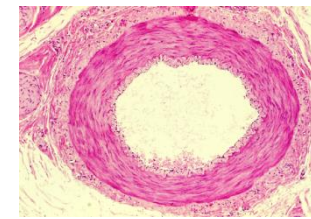


- Two thick valve leaflets consisting of connective tissue covered by endothelium project long into the lumen from the opposite regions of the vein wall. The connective tissue of the valves continues directly with that of the intima of the vein..



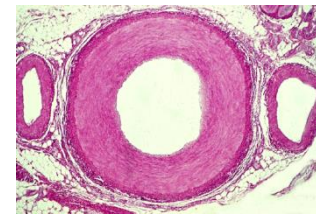
## 06-003 Arteries

06-25 Artery of muscular type, transverse section. Monkey, H-E stain, x 30.



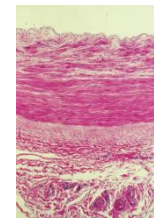
- This is a transversally sectioned artery of 0.5 mm in caliber showing typical structure of the muscular type artery. The wall of this artery consists of concentric three layers: tunica intima ( I ), tunica media ( M ), and tunica adventitia ( A ).
- Tunica intima consists of endothelium and thin subendothelial connective tissue. Beneath the endothelium there is a distinct refractive zizag line, lamina elastica interna ( 1 ).
- Tunica media consists of densely packed circular smooth muscle fibers. The thickness of this layer thickens roughly according to the caliber. Tunica media contain scant elastic fibers.
- Tunca adventitia consists of collagen fibers running loose longitudinal spiral.
- In the innermost region elastic fibers intermingle with collagen fibers and this region is called lamina elastica externa ( 2 ). This is not conspicuous. Around the adventitia collagen fibers gradually merge with the surrounding connective tissue.





06-26 Arteria radialis, transverse section. Human, H-E stain, x 10.

- In this figure Arteria radialis and two concomitant veins are shown. Arteria radialis, of muscular type, consists of three layers: tunica intima ( I ), tunica media ( M ) and tunica adventitia ( A ). In this low magnification tunica intima is difficult to perceive; tunica media is a thick layer of very densely packed circular smooth muscle fibers; tunica adventitia consists of inner and outer sublayers: the inner sublayer contains fine elastic fibers among collagenous fibers and shows in this figure reddish hue; the outer sublayer consists of collagenous fibers showing dark reddish hue.

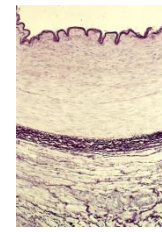


06-27 A. femoralis, transverse section 1. Human, H-E stain, x 30.

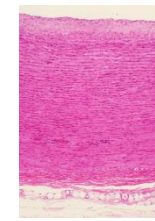
- This is a part of wall of the A. femoralis sectioned transversally. Tunica intima consisting of the endothelium and scant subendothelial connective tissue. Directly beneath the endothelium there is the distinctly refractive lamina elastica interna ( arrow 1 ). Tunica media is a thick layer of densely packed circular smooth muscle fibers. In the internal half of the tunica adventitia fine elastic fibers intermingle with collagenous fibers, so that this portion shows light pink hue ( 2 ). The outer half of the tunica adventitia consists of collagenous fibers oriented loose longitudinal spirally and gradually merge into the surrounding connective tissue.



06-28 A. femoralis, transverse section 2. Human, resorcin-fuchsin stain, x 30.



- This is the same specimen with 06-27, but stained the elastic fibers with resorcin- fuchsin. Both lamina elastica interna ( 1 ) and lamina elastica externa ( 2 ) are very conspicuous. In the tunica media only very fine elastic figers are seen, on the contrary, in the tunica adventitia there are numerous elastic fibers beside the lamina elastica externa.



- This is a part of wall of the transversely sectioned aorta. Aorta is the representative of the elastic arteries. Their walls appear distinctly yellow in the fresh state due to the abundance of elastin. The wall consists of also three layers: tunica intima, tunica media and tunica adventitia.
- Tunica intima ( I ) consists of endothelium and underlying subendothelial connective tissue, which is relatively thick and contains many medium sized elastic fibers and in the deeper half longitudinally oriented smooth muscle fibers. Because of these muscle fibers lamina elastica interna is difficult to perceive. Arrow 1 indicates the endothelium and arrow 2, the border between tunica intima and tunica media.
- Tunica media ( M ) is very thick and made up of multiple concentric, fenestrated lamellae of elastin alternating with thin layers of circularly oriented smooth muscle fibers. Compare with 06-30. .
- Tunica adventitia ( A ) is relatively thin and consists of collagenous fibers and elastic fibers. Lamina elastica interna ( 3 ) is not conspicuous.



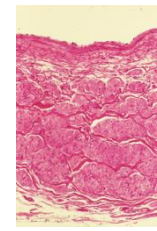
06-30 Aorta, transverse section, 2. Human, resorcin-fuchsin stain, x 25.



- This is the same specimen with 06-29, but resorcin-fuchsin stained. Tunica intima ( I ) contains many fine elastic fibers. Tunica media ( M ) is composed so densely of elastin lamellae, that the space of each smooth muscle fiber is hardly recognized. Tunica adventitia ( A ) contains many coarse elastic fibers and lamina elastica externa is not evident.

- Blood is carried back from the capillaries to the heart in veins. Veins normally accompany the corresponding arteries, and as they progress toward the heart they increase in diameter and their walls become thicker. The walls of veins are thinner, more supple, and less elastic than those of arteries. Veins show greater variations in their structure than do arteries, and the same vein may vary in the wall of veins: tunica intima, tunica media and tunica adventitia. But the boundaries of the layers are often indistinct. The muscular and elastic components are not well developed in veins and connective tissue components are more prominent.

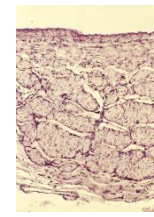




06-31 V. cava inferior, transverse section, 1. Human, H-E stain, x 40.

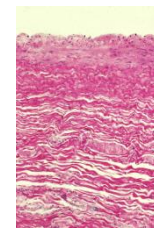
- V. cava inferior is the largest vein and locates directly beneath the heart. The wall of this vein is thick enough and consists of very thin tunica intima and tunica media and very thick tunica adventitia. Tunica intima (I) consists of endothelium and scant subendothelial connective tissue. Tunica media (M) is thin and consists mainly of connective tissue intermingled with several circularly oriented thin smooth muscle fiber bundles. Tunica adventitia (A) is, on the contrary, very thick and consists of mainly longitudinally and spirally oriented collagenous fibers and numerous longitudinally oriented thick smooth muscle fiber bundles.

06-32 V. cava inferior, transverse section, 2. Human, resorcin-fuchsin stain, x 40.



- This is the same section as 06-31, but the elastic fibers are visualized by resorcin- fuchsin stain. The elastic fibers are in general fine and evenly distributed throughout the wall, but directly beneath the endothelium they are somewhat densely accumulated. The thick smooth muscle fiber bundles in the tunica adventitia are each enclosed by elastic fibers.





- Vena cava superior locates just up the heart and blood comes into the right atrium derived by the force of gravity. The wall is apparently thick but consists of mainly thick collagenous fiber bundles intermingled with a few smooth muscle fiber bundles. Tunica intima consists of the endothelium and scant underlying connective tissue and continues without distinct boundary with tunica media in which several thin smooth muscle fiber bundles are seen. Tunica adventitia is very thick consisting mostly of circularly or spirally oriented thick collagenous fiber bundles intermingled with a few spirally oriented smooth muscle fiber bundles. Arrow indicates the boundary between tunica media and tunica adventitia.

06-34 V. cava superior, 2. Human, resorcin-fuchsin stain, x 40.



- The same specimen as 06-33, but stained with resorcin-fuchsin. In the tunica intima there is a layer of densely composed elastic fibers. Between the tunica media and tunica adventitia no distinct boundary is recognized and both consist of thin smooth muscle fibers enclosed by thin elastic fibers. In the outer half region of tunica adventitia there are several spirally oriented thick smooth muscle fiber bundles.

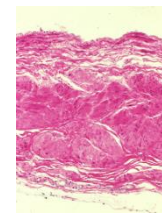


06-35 *V. portae*, transverse section, 1. Human, H-E stain, x 2.6.



- This is the transversely sectioned *V. portae*. The wall shows local variation of thickness caused by the varying volume of smooth muscle fibers. At lower left corner there is a small lymph node.

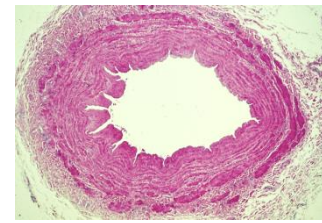
06-36 V. portae, transverse section, 2. Human, H-E stain, x 40.



- In this figure no distinct boundary between tunica intima and tunica media is seen. Directly beneath the endothelium there are thin smooth muscle bundles oriented spirally. These continues with the tunica media consisting of loosely arranged similar thin smooth muscle bundles. On the contrary to these, tunica adventitia consists of densely arranged coarse collagenous fibers and a thick layer of longitudinally oriented smooth muscle fiber bundles.

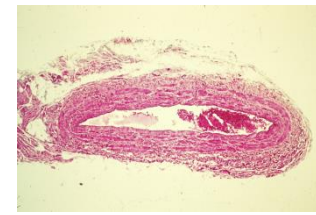


06-37 V. basilica, transverse section. Human, H-E stain, x 10.



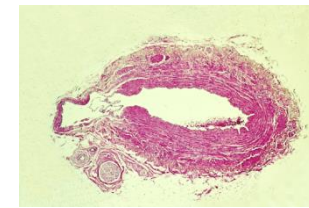
- In the wall of this vein there are numerous thin smooth muscle fibers arranged loosely circular-spirally. Further outside thick smooth muscle fibers run spirally and outermost encircle the collagenous fibers. The tunica intima consisting of endothelium and scant underlying connective tissue encircles the lumen with irregular contour caused by the contraction of the smooth muscle fibers of tunica media.

06-38 V. cephalica, transverse section. Human, H-E stain, x 10.



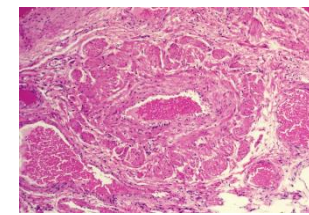
- The wall of this vein consists of loosely spirally oriented thin smooth muscle fiber bundles and collagenous fibers.





- In the wall of V. saphena magna tunica media develops well and consists of relatively densely arranged thin smooth muscle fiber bundles oriented spirally. Tunica adventitia consists of collagenous fiber bundles oriented mainly longitudinally and of a few number of relatively thick smooth muscle fiber bundles oriented longitudinally. Tunica intima is very thin consisting endothelium and scant underlying connective tissue.
- At the left extremity of this vein a small vein comes into this vein, where valves are conspicuous. The upper and lower wall of this region wall is very thin and consists of only thin connective tissue.

06-40 Vein in the spermatic cord, transverse section. Human, H-E stain, x 25.



- Through this vein blood flows against the force of gravity from the testis upward. The wall of this vein is specifically composed, namely, out side of thin tunica media (M), consisting of mainly circularly oriented smooth muscle fibers, there is very thick tunica adventitia (A) consisting mainly of longitudinally oriented thick smooth muscle fiber bundles, that facilitates the upward blood flow by contraction of these muscle fiber bundles.



## 06-005 Large arteries and veins

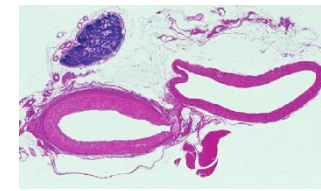
06-41 A. carotis interna and V. juglaris interna, transverse section. Human, H-E stain, x 2.3.



- This figure shows A. carotis interna (A) and V. juglaris interna (V). A. carotis interna is an elastic type artery, consisting of a very thick and compact tunica media. V. juglaris interna has a relatively thin wall. At the middle of the upper wall, a large vein comes to join, where no valves are seen.

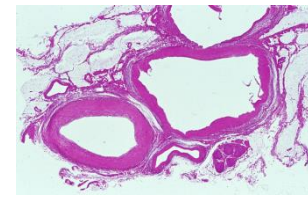


06-42 A. iliaca externa and V. iliaca externa, transverse section. Human, H-E stain, x 2.3.



- This figure shows A. iliaca externa (A), of muscular type, and V. iliaca externa (V) having thick wall. In the upper region of this field, in the fat tissue, a small lymph node and numerous thin lymphatics (arrows) are recognized.

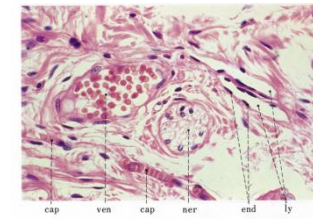
06-43 A. femoralis and V. femoralis, transverse section. Human, H-E stain, x 2.3.



- This figure shows A. femoralis (A) and V. femoralis (V). A. femoralis is of muscular type. The wall of V. femoralis shows irregularity in thickness caused by the irregular distribution of smooth muscle fiber bundles in tunica media and tunica adventitia. At the right and left side of this wall valves are seen. In the surrounding fat tissue numerous lymphatics, thick and thin, are recognized.

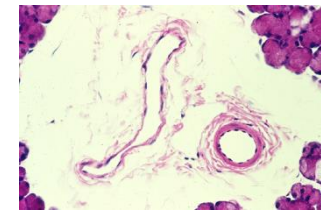


- The lymphatics are the vessels, that accept the tissue fluid and send back to the heart, composing independent tubular system beside the blood vessel system. On the course of lymphatics many lymph nodes are inserted.



- The smallest lymphatic vessels are called lymphatic capillaries and are thin walled, blindly ending tubules, which form a dense network in most of tissues of the body. They collect tissue fluid, which is called lymph as soon as it enters these capillaries. Lymphatic capillaries consist only of endothelium and not accompanied by pericyte. Lymphatic capillaries are often mistaken as rents of tissue.
- This figure shows the interlobular connective tissue of sublingual gland, containing two lymphatic capillaries ( ly ), blood capillaries ( cap ), a small vein ( ven ) and a thin nerve ( ner ).

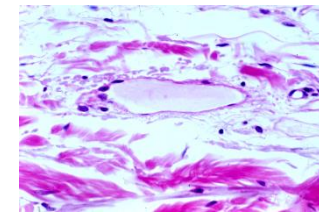
06-45 Artery, vein and lymphatic vessel. Monkey, H-E stain, x 100.



- These artery (A), vein (V) and lymphatic vessel (L) are found in the interlobular connective tissue of the submandibular gland. This figure shows very well the structural differences of the wall of artery, vein and lymphatic vessel.

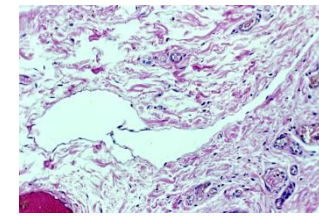


06-46 Small lymphatic vessel. Human, H-E stain, x 160.



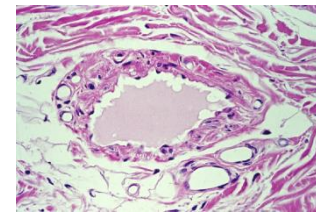
- The wall of this small lymphatic vessel, found in the subcutaneous connective tissue, consists of only endothelium ( arrow ) accompanying scant connective tissue. This vessel is filled with faintly pink stained substance, this is a characteristic of the small lymphatic vessels.

06-47 Valves of a small lymphatic vessel. Human, H-E stain, x 64.



- This is found in the interlobular connective tissue of the submandibular gland. A thin lymphatic vessel comes from top right to down leftward and there provides the valves. Two valve leaflets are thin, consisting endothelium and scant connective tissue. Distal portion of the valves lumen of the lymphatic vessel is dilated.

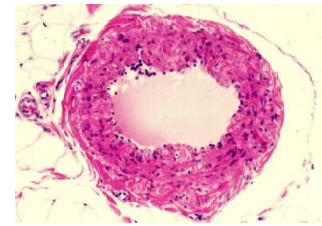
06-48 Lymphatic vessel, transverse section, 1. Human, H-E stain, x 100.



- This small lymphatic vessel is found in the subcutaneous connective tissue of the lip, having a little thicker wall and containing the homogeneously light pink stained substance. The wall consists of the endothelium and connective tissue.

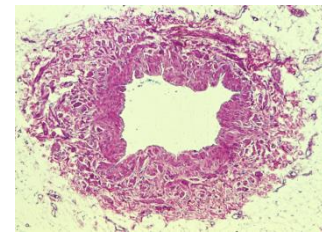


06-49 Lymphatic vessel, transverse section, 2. Human, H-E stain, x 64.



- This is found in the fat tissue surrounding the A. iliaca externa of 06-42. The wall of this lymphatic vessel consists of three layers, i.e. tunica intima, tunica media and tunica adventitia. Tunica intima consists of endothelium and underlying connective tissue, tunica media of circularly oriented smooth muscle fibers, and tunica adventitia of longitudinally and circularly oriented collagenous fiber bundles.

06-50 Ductus thoracicus, transverse section. Human,  
H-E stain, x 15.

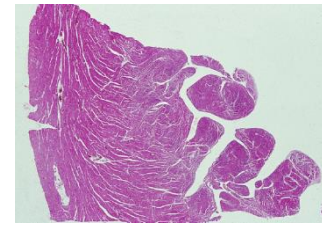


- This is the transverse section of human ductus thoracicus. The lumen shows irregular contour. The wall is irregularly composed: tunica intima consists of the endothelium and scant connective tissue, tunica media of mainly longitudinally oriented smooth muscle fiber bundles, and tunica adventitia of mainly longitudinally and spirally oriented smooth muscle fiber bundles and coarse collagenous fiber bundles.

- The heart is a muscular pump, which drives blood to circulate through the vessel system. The heart consists of four chambers: a right and left atrium and a right and left ventricle. The venous blood comes into the right atrium through the superior and inferior vena cava and from there passes to the right ventricle, then is sent to the lung and aerated. The blood is brought then to the left atrium, and from there to the left ventricle and then distributed throughout the body by the aorta and its branches.
- The wall of the heart, in both the atria and the ventricles, consists of three layers: the internal, endometrium, the intermediate, myocardium, and the external, epicardium. The endocardium is in immediate contact with the blood; the myocardium is the contractile layer; and the epicardium is the visceral layer of the pericardium.

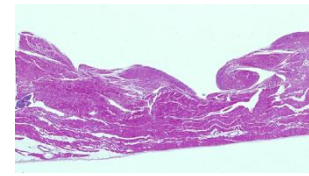


06-51 Wall of the left ventricle. Human, H-E stain, x 1.5.

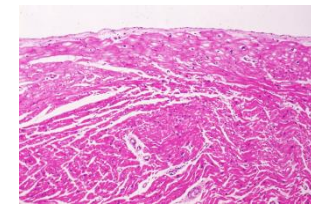


- This is the transverse section of the left ventricle. Among the three layers the myocardium is very thick, composing mostly the cardiac wall, and consists exclusively of the meshworks of cardiac muscle fibers and very loose connective tissue filling the meshes. The endocardium, contour at right, and the epicardium, contour at left, are not perceived in this magnification. The thick round sections at the right end of the wall are transverse sections of papillary muscles.

06-52 Wall of the right atrium. Human, H-E stain, x 2.5.



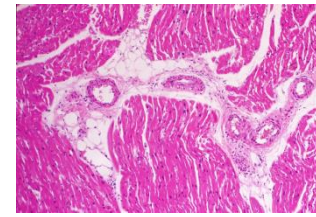
- This is the transverse section of the right atrium. The upper contour is the endocardium and lower contour is the epicardium. The myocardium occupies the wide space between the endocardium and the epicardium. The thickness of the wall of the atrium is much thinner than that of the ventricle.



- Except for the endocardium ( upper limit of this figure, indicated by a large arrow), all of this figure is occupied by the myocardium, upper one third of which is composed of the specialized conducting fibers. At right several conducting fibers are connecting with the normal working cardiac muscle fibers ( small arrows ). The lower two thirds of this figure consists of the working cardiac muscle fibers.

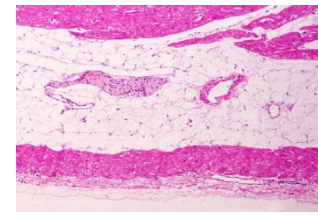


06-54 Myocardium. Human, H-E stain, x 25.



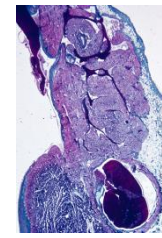
- This figure shows the myocardium consisting of thick muscle fiber bundles, among which in the fat tissue an artery runs tortuously.

06-55 Epicardium and myocardium. Human, H-E stain, x 25.



- The undermost limit of this figure, indicated by an arrow, is the endocardium, and the upper portion is myocardium, containing a thick fat tissue layer in which a nerve and several lymph vessels ( L ) are seen.

06-56 Sinus node. Human, M-G stain, x 4.0.



- In the center the sinus node, occupying almost the whole thickness of wall, is shown.