組織學實驗：循環系統
Histology laboratory : Circulatory system

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Please study these slides before coming to the class!

Sources of the the Text

- **Histology: A Text and Atlas** (4th ed) , M.H. Ross & W. Pawlina
- **Wheater's Functional Histology** (5th ed), B. Young & J.W.Heath

Photomicrograph Taken by

Department of anatomy,
Kaohsiung Medical University

Learning Objective
Microscopic structure of cardiovascular system

SLIDE LIST
93W4058 Entire heart, *ls*, h&e
93W6245 Cardiac muscle, *ls & cs,* h&e
93W3533 Heart, Purkinje fibers, ih
93W4875 Trachea and esophagus *cs* h&e
93W6515 Artery *cs* v&e
93W4046 Artery, vein, nerve, elastic tissue, *cs*, v&e

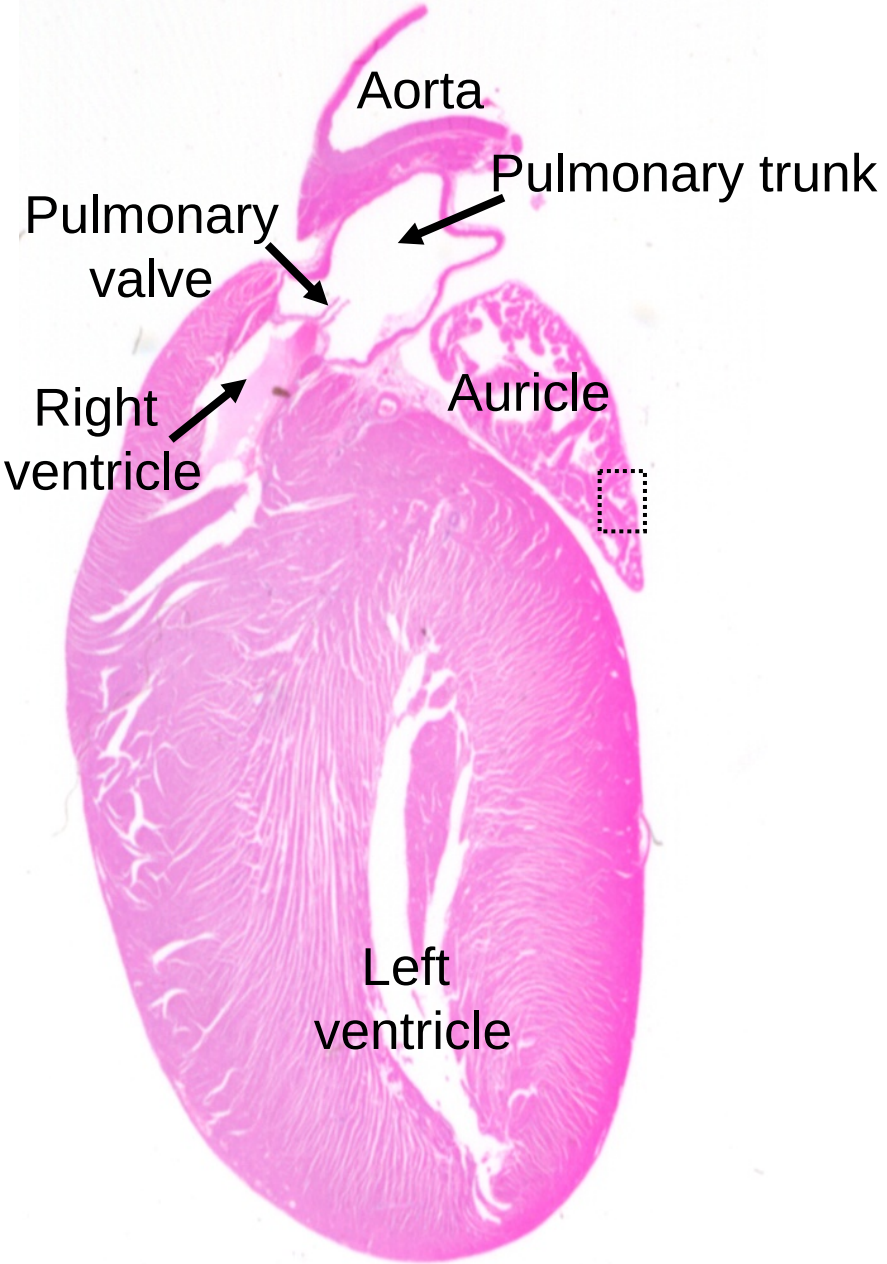


Fig.1 93W4058 Entire heart, *ls*, h&e

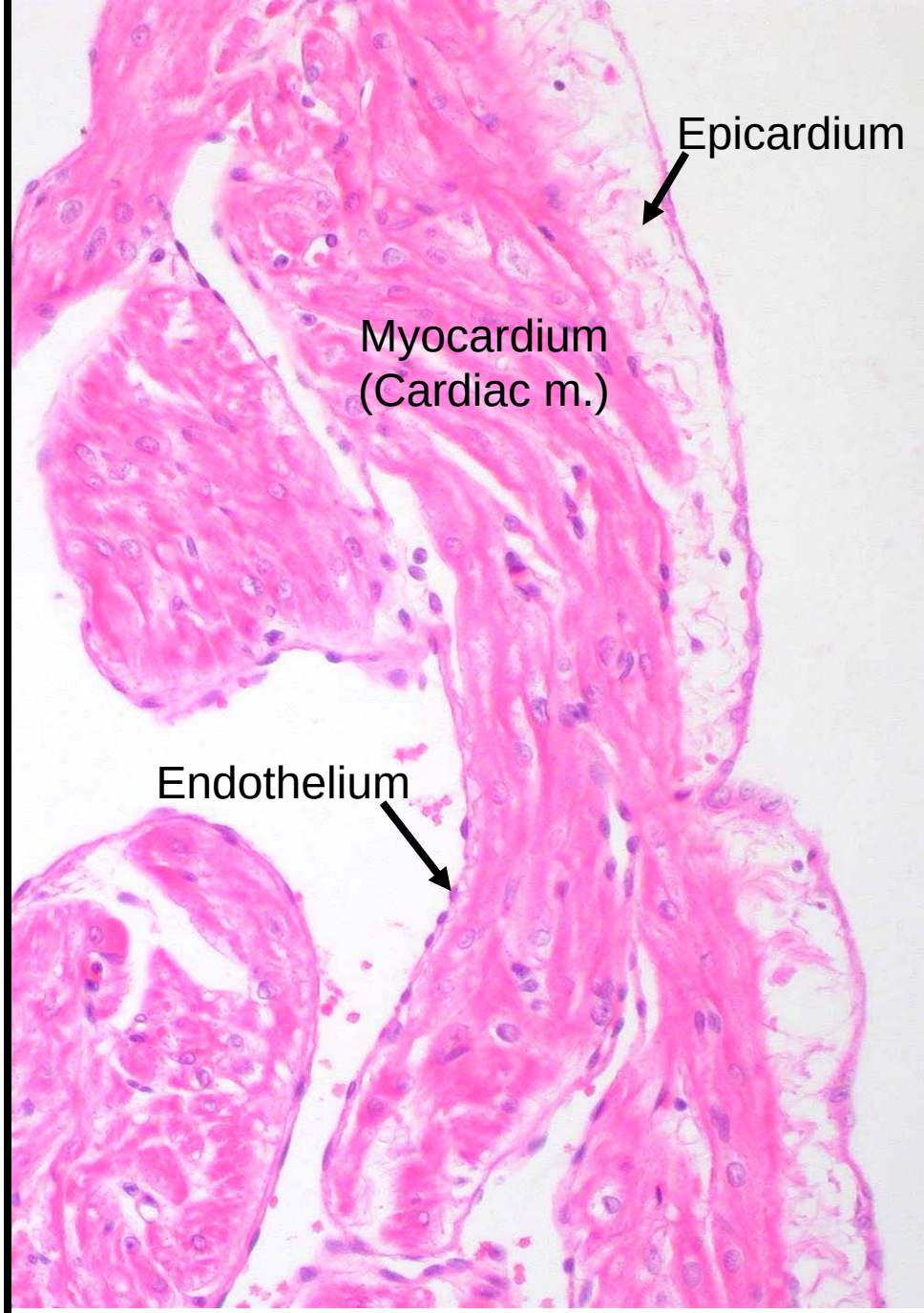


Fig.2 Auricle

Fig.1 93W4058 Entire heart, *ls*, h&e. Put the slide first on a white paper to observe the overview orientation of the section. However, every section of the slides is slightly different. Compare your slide with this figure and identify the structures in your slide.

Fig.2 Photomicrograph of auricle. The auricle is easier to demonstrate the three-layered structure of the heart wall. The endocardium has a inner surface layer of flattened endothelium. The subendothelial tissue merges with the collagen fibers surrounding outer cardiac muscle (myocardium). The outermost epicardium is composed of connective tissue and the superficial mesothelial cells (not clearly seen here) which produce the pericardial fluid.

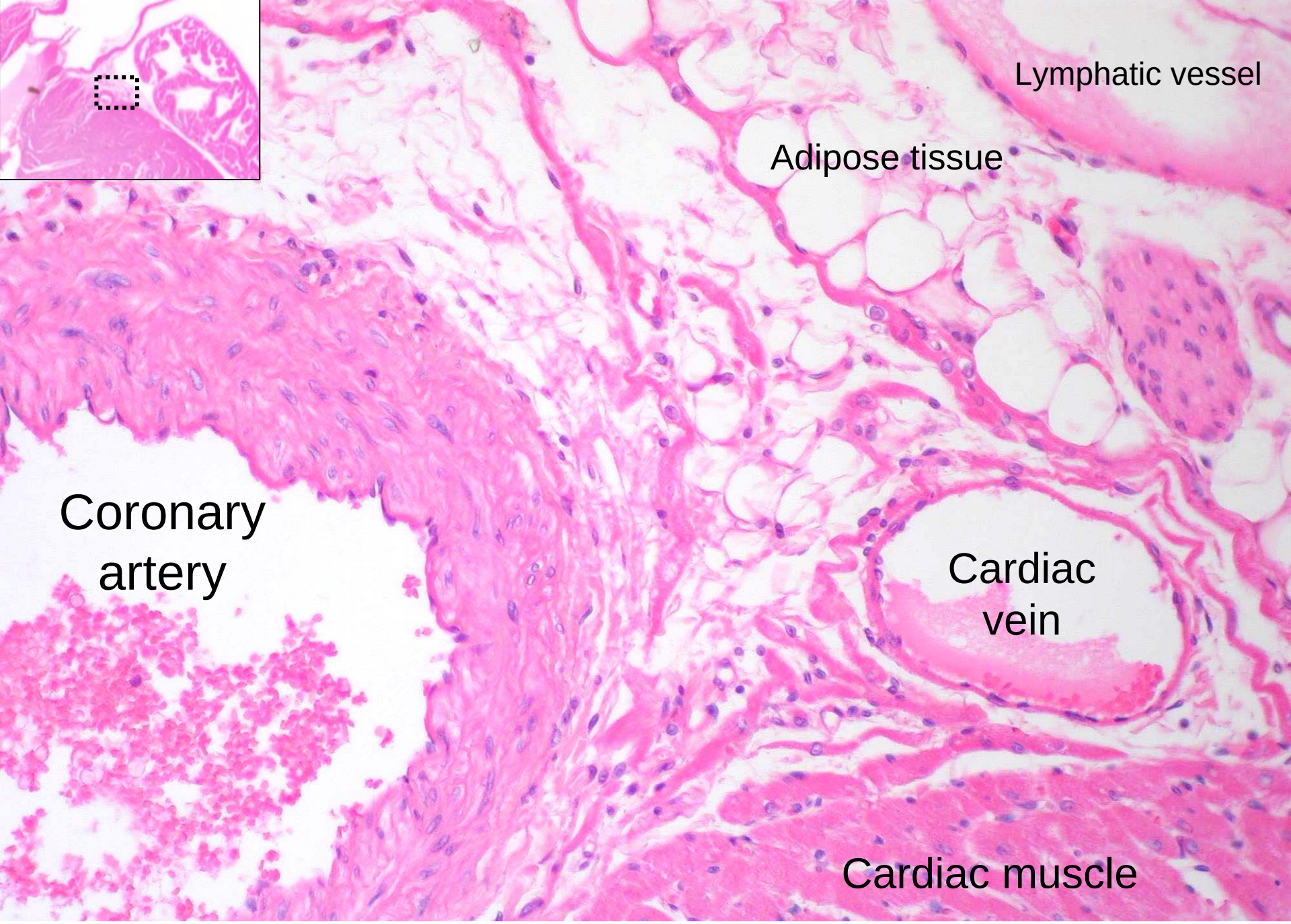


Fig.3 Epicardium

Fig.3 Photomicrograph of epicardium (visceral pericardium). Here shows an area where the epicardium contains the branches of coronary artery and the cardiac vein. There is a lymphatic vessel without blood cells inside in this slide.

The black dashed line rectangle in inset figure shows the orientation of the photomicrograph in lower magnification. No more explanation is given in the following figures.

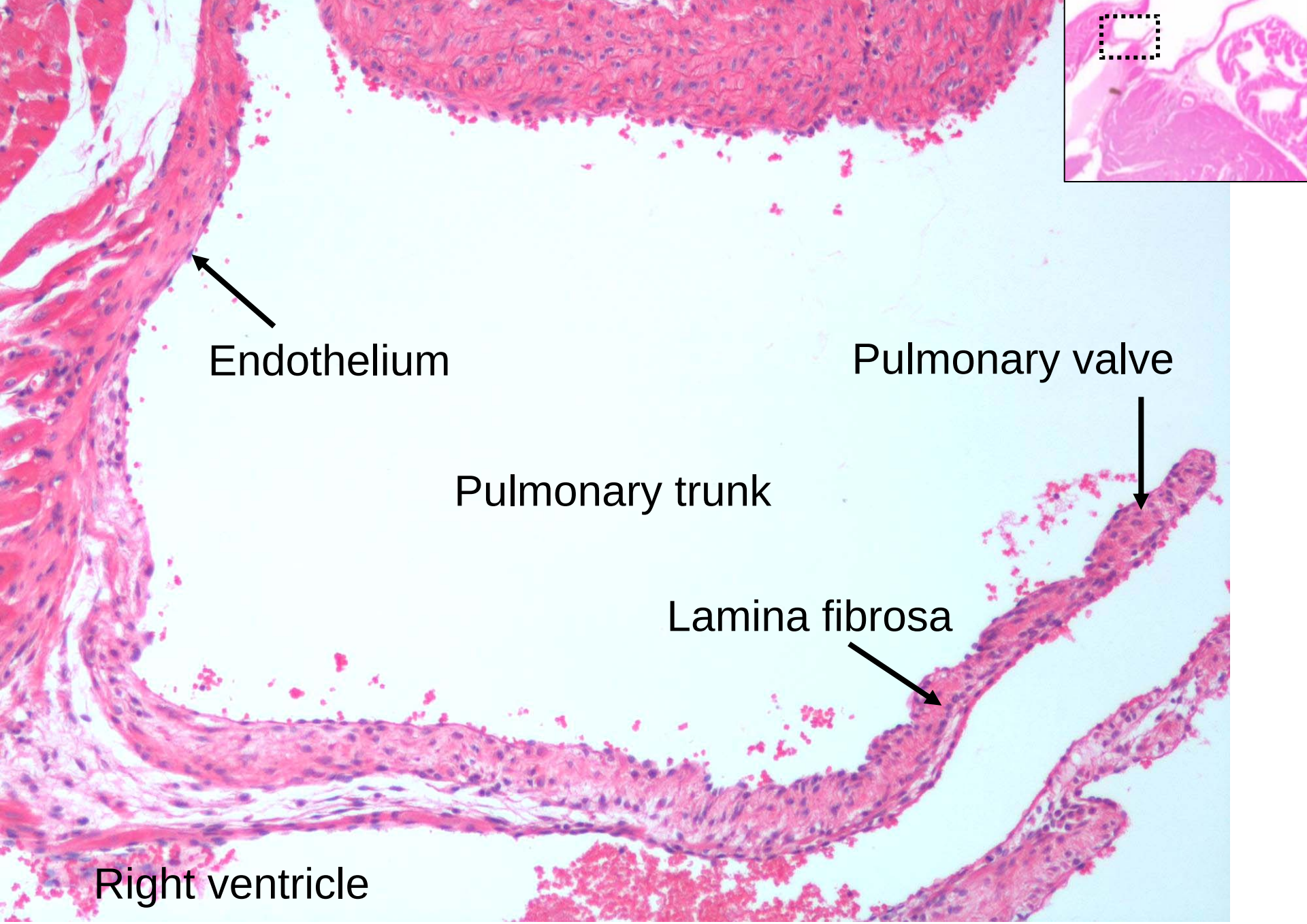


Fig.4 Pulmonary valve

Fig.4 Photomicrograph of pulmonary valve. The heart valves consist of fibroelastic tissue, the lamina fibrosa. The surfaces covered by a thin layer of endothelium continuous with the lining of both the heart chambers and great vessels. This micrograph shows the pulmonary valve arising at the junction of the walls of the right ventricle and the pulmonary trunk.

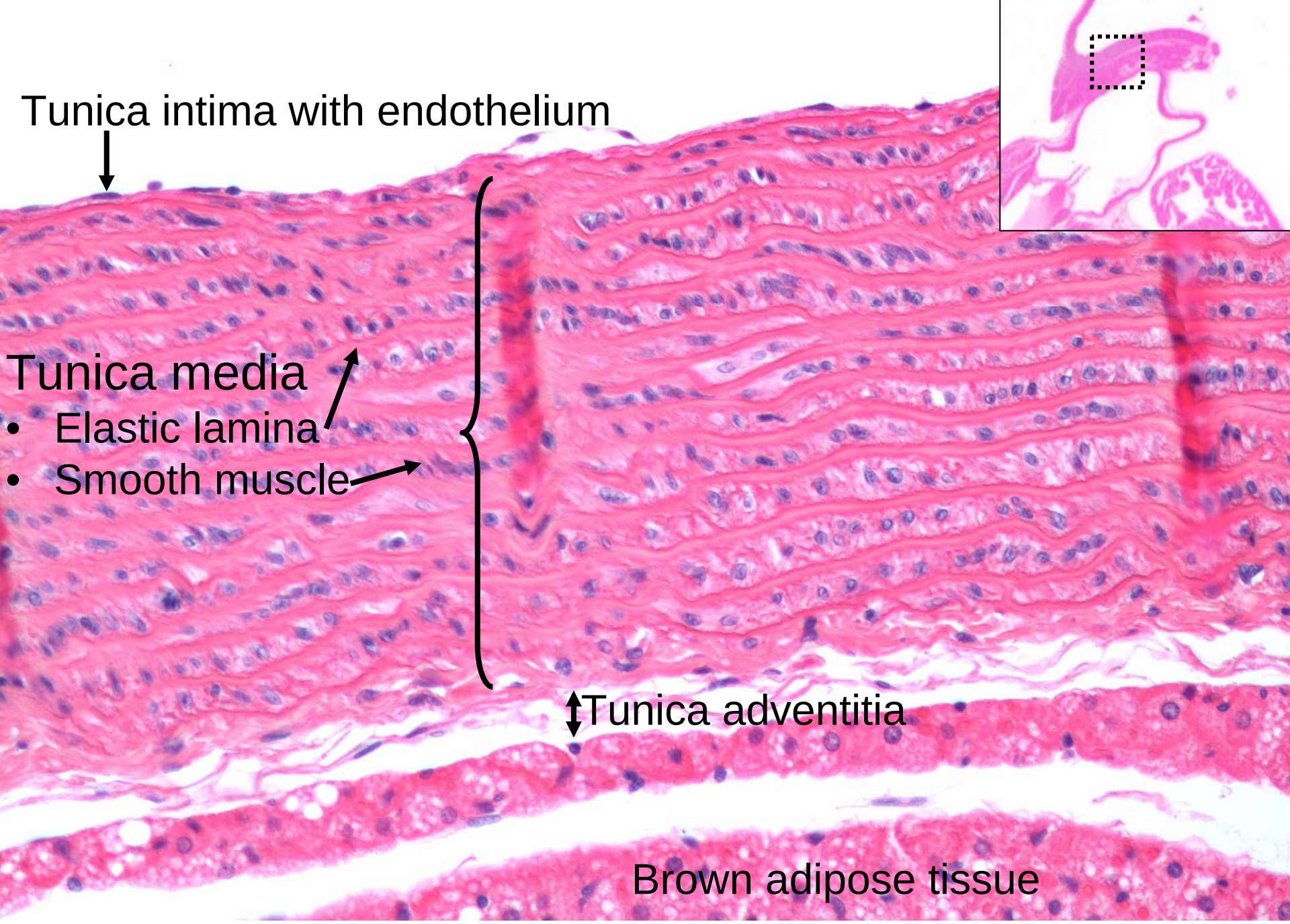


Fig.5 Aorta, large (elastic) artery, with numerous elastic membranes

Fig.5 Aorta, large (elastic) artery. Arteries are classified by the characteristics of the tunica media. The aorta is called an elastic artery because of the large amount of elastic material, arranged as lamellae, interspersed with the smooth muscle cells of the tunica media. The elastic material may be seen because of its refractivity (stained lightly with eosin) without special stains. The tunica intima consists of a lining of endothelial cells that rest on a thin layer of connective tissue. There are no elastic lamellae in the adventitia, but elastic fibers are present, though relatively few in number and can't be observed by H&E stain.

Brown adipose tissue is one of the two types of adipose tissue. Its primary purpose is to generate body heat. In contrast to white adipocytes (fat cells) which contain a single, large fat vacuole, brown adipocytes contain several smaller vacuoles and centrally located nuclei.

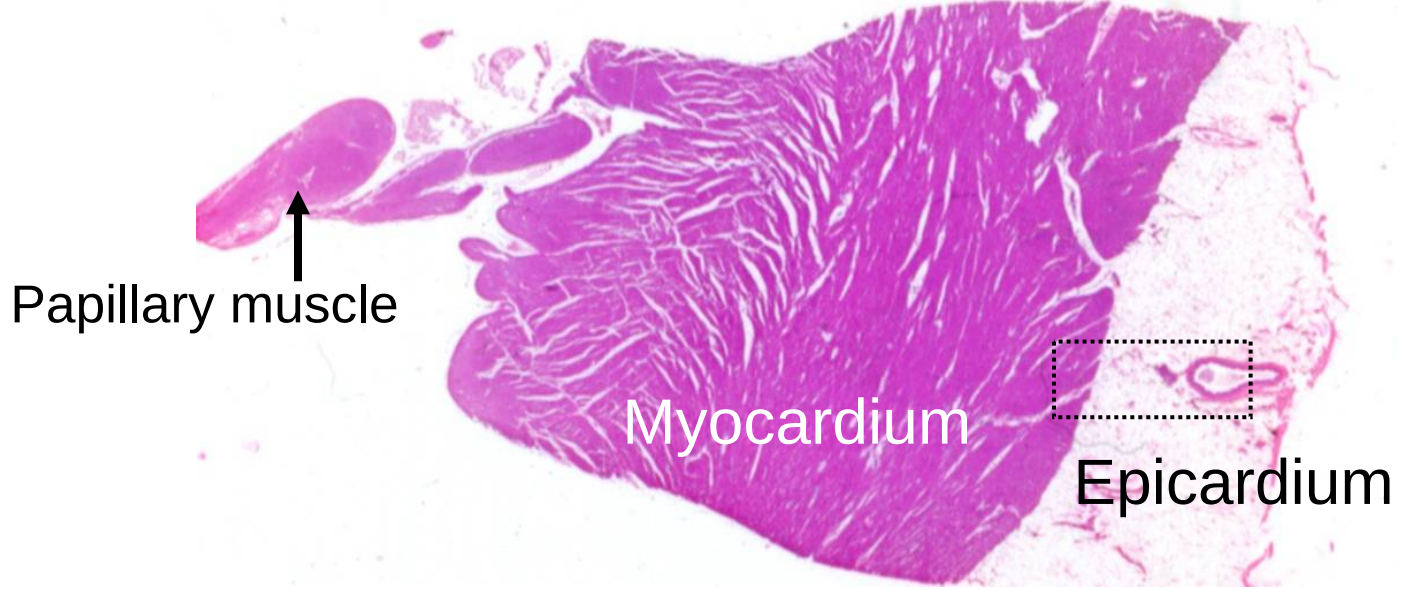


Fig.6a 93W6245 Cardiac muscle, *ls & cs,* h&e

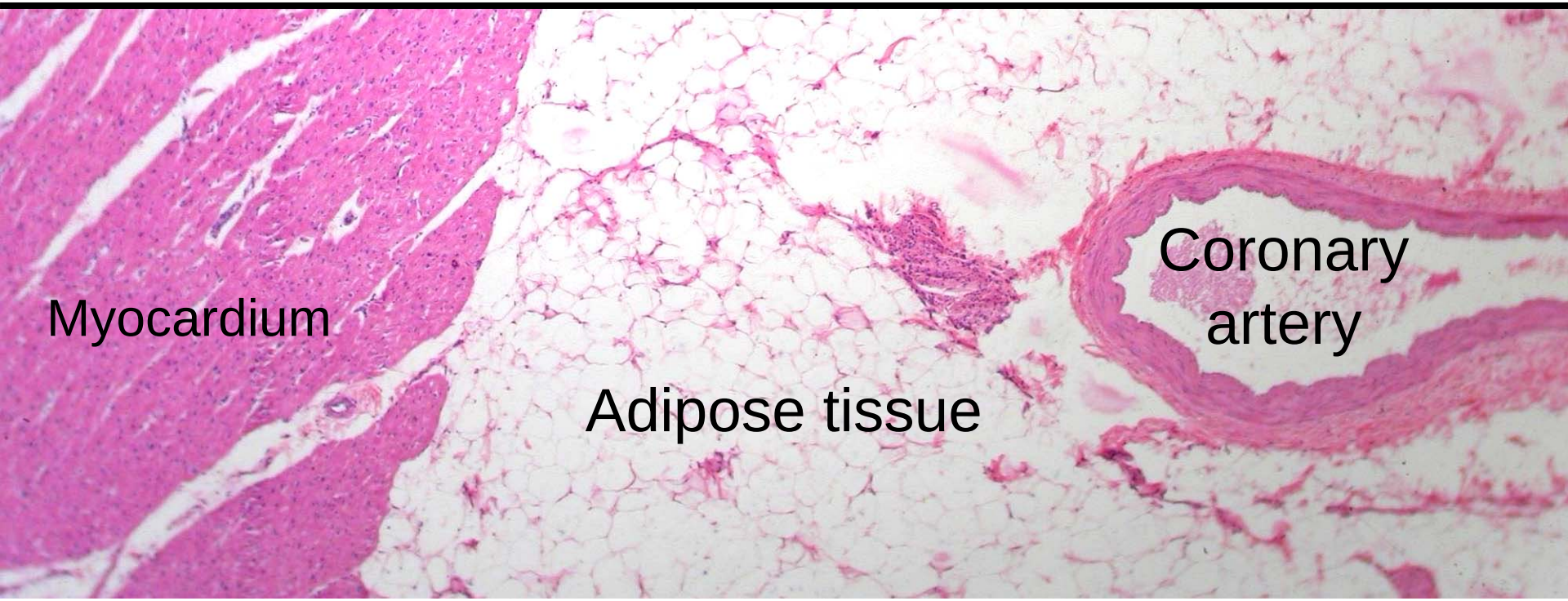


Fig.6b

Fig.6a 93W6245 Cardiac muscle, *ls* & *cs*, h&e. The small muscle bundles within the heart chambers are called papillary muscles in anatomy. They are lined by endothelium. The black dashed line rectangle shows the orientation of figure 6b.

Fig.6b The visible coronary artery surrounded by adipose tissue lies in the epicardium.

Fig.7a Cardiac muscle fiber, *ls*

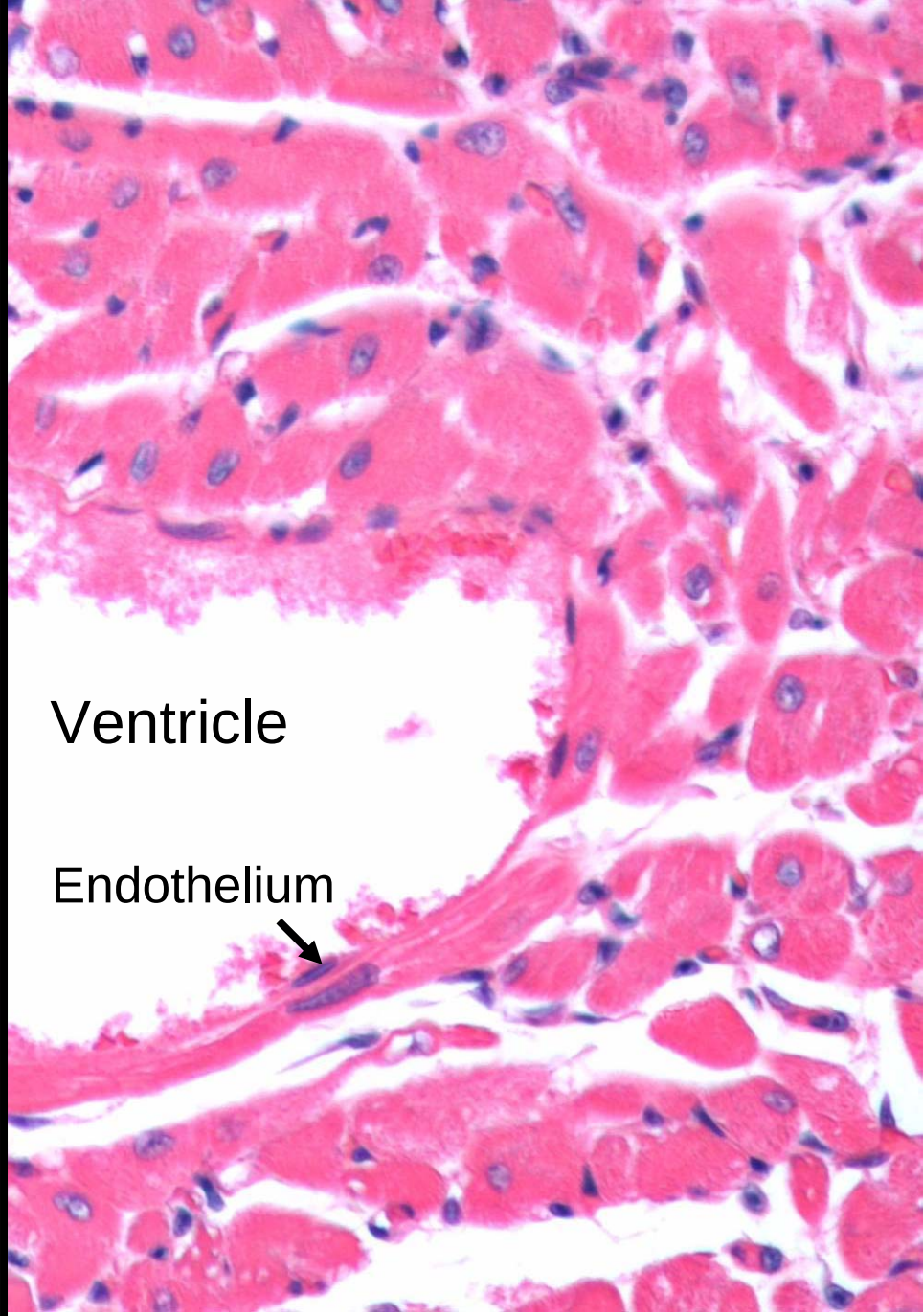


Fig.7b Cardiac muscle fiber, *cs*

Fig.7a Cardiac muscle fiber, *ls*. In longitudinal section, cardiac muscle fibers are striated and multinucleate, like skeletal muscle. Cardiac muscle cells branch to form an interconnecting network and are joined to each other by intercalated discs. The intercalated discs are specialized intercellular junctions separating adjacent cells in cardiac muscle fibers. They appear as thin, typically dark-staining lines dividing adjacent cardiac muscle cells.

Fig.7b Cardiac muscle fiber, *cs*. Photo taken from 93W4058. In cross section, the nuclei of cardiac muscle fibers are centrally located, like smooth muscle. Compare the characteristics of cardiac muscle with skeletal and smooth muscle described in block 1.

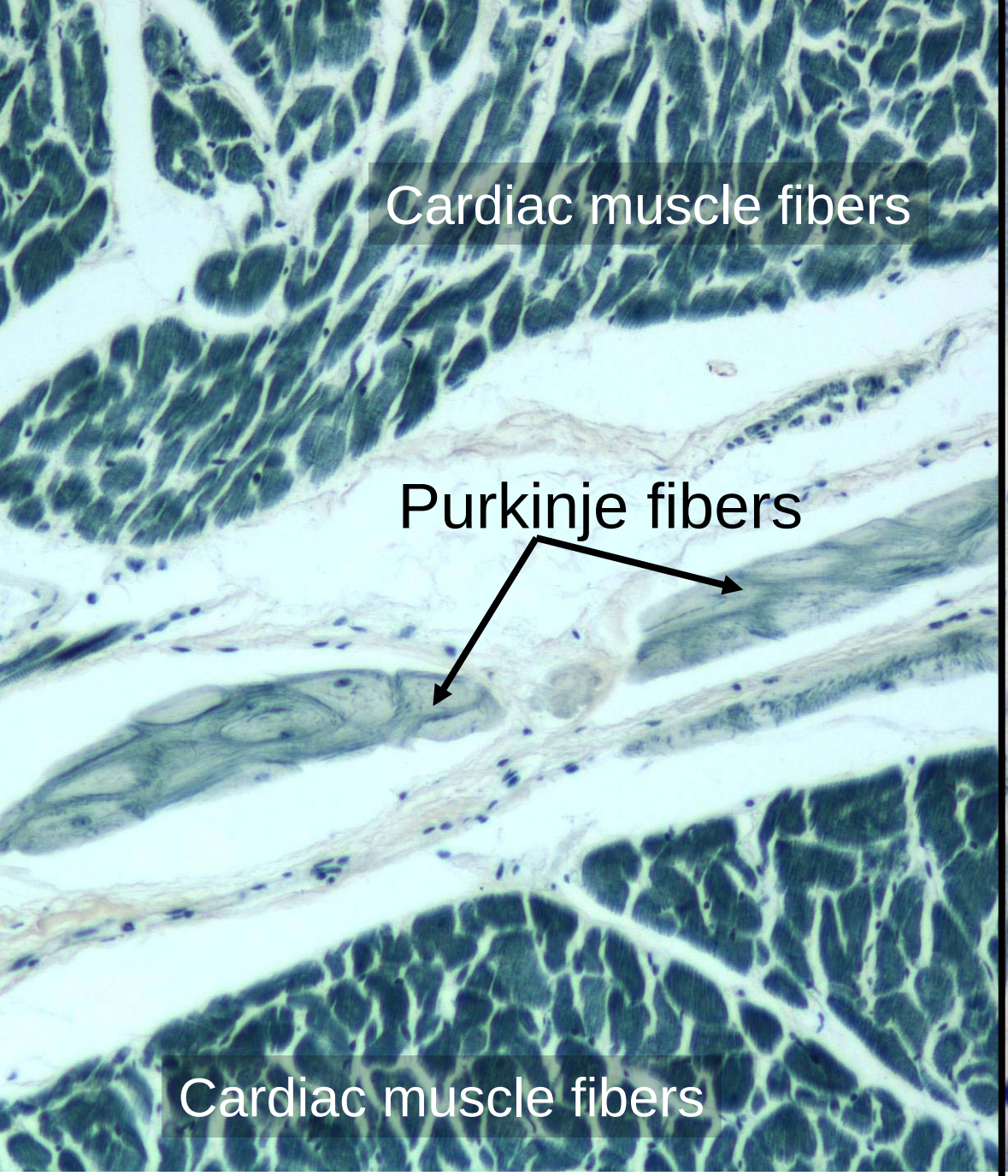


Fig.8a 93W3533 Heart, Purkinje fibers, ih

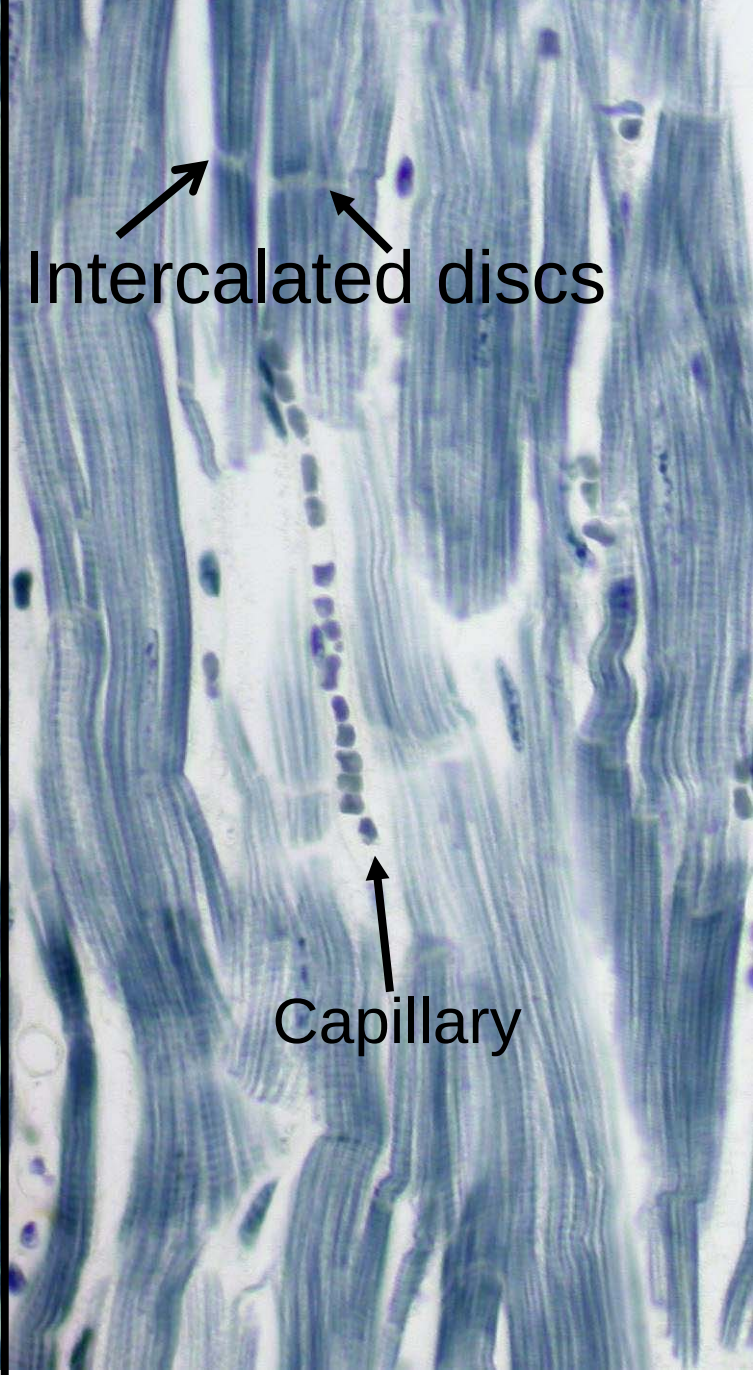


Fig.8b Cardiac muscle fiber, *ls*

Fig.8a 93W3533 Heart, Purkinje fibers, ih. Purkinje fibers are the components of the heart's conduction system. They are more easily observed in a slide stained with iron hematoxylin. While most common in the subendothelial space, they can also be observed in the myocardium. Compare Purkinje fibers with cardiac muscle fibers. Note larger numbers of myofibrils and smaller cell size in cardiac muscle fibers. The Purkinje fibers contain large amounts of invisible glycogen particles, which appear as pale-staining regions that occupy the center portion of the cell surrounded by the myofibrils.

Fig.8b Cardiac muscle fiber, *ls*. Iron hematoxylin staining of cardiac muscle highlights the cross striations and intercalated discs. The red blood cells are stained in black dots. The capillary diameter is about the same size as a red blood cell. In longitudinal section, the capillaries will look to appear as rows of red blood cells.

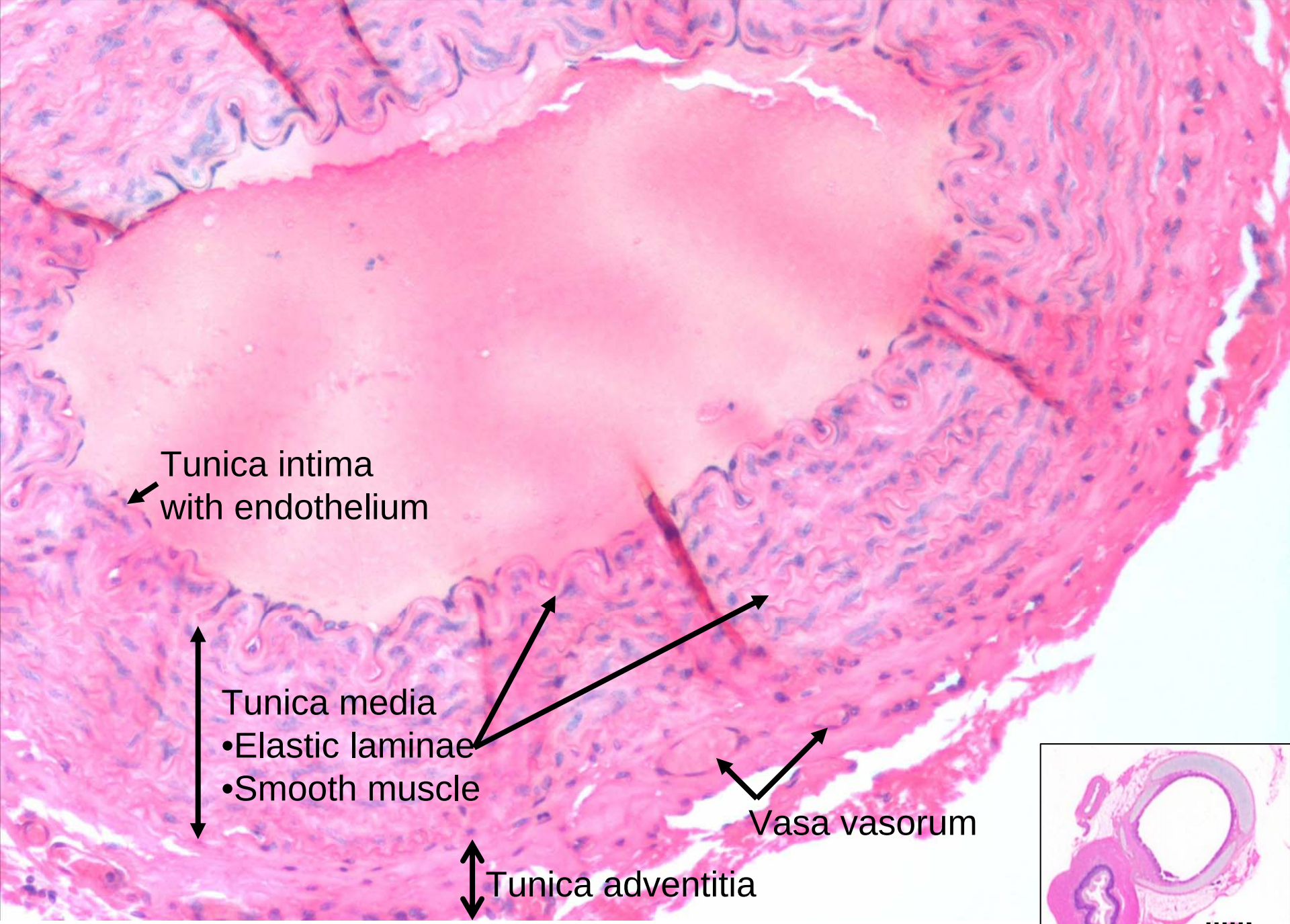


Fig.9 93W4875 Trachea and esophagus *cs* h&e

Fig.9 93W4875 Trachea and esophagus *cs* h&e. Note the elastic artery in the slide. The characteristics of the elastic arteries described in figure 5. However, the elastic lamellae are fewer and not so obvious than the lamellae in aorta. The collagen fibers and smooth muscle cells are more in the tunica media in this artery. The tunica intima consists of a single layer of endothelial cells. The tunica adventitia is the outermost part. It consists mainly of connective tissue and contains the blood vessels (vasa vasorum) that supply the arterial wall.

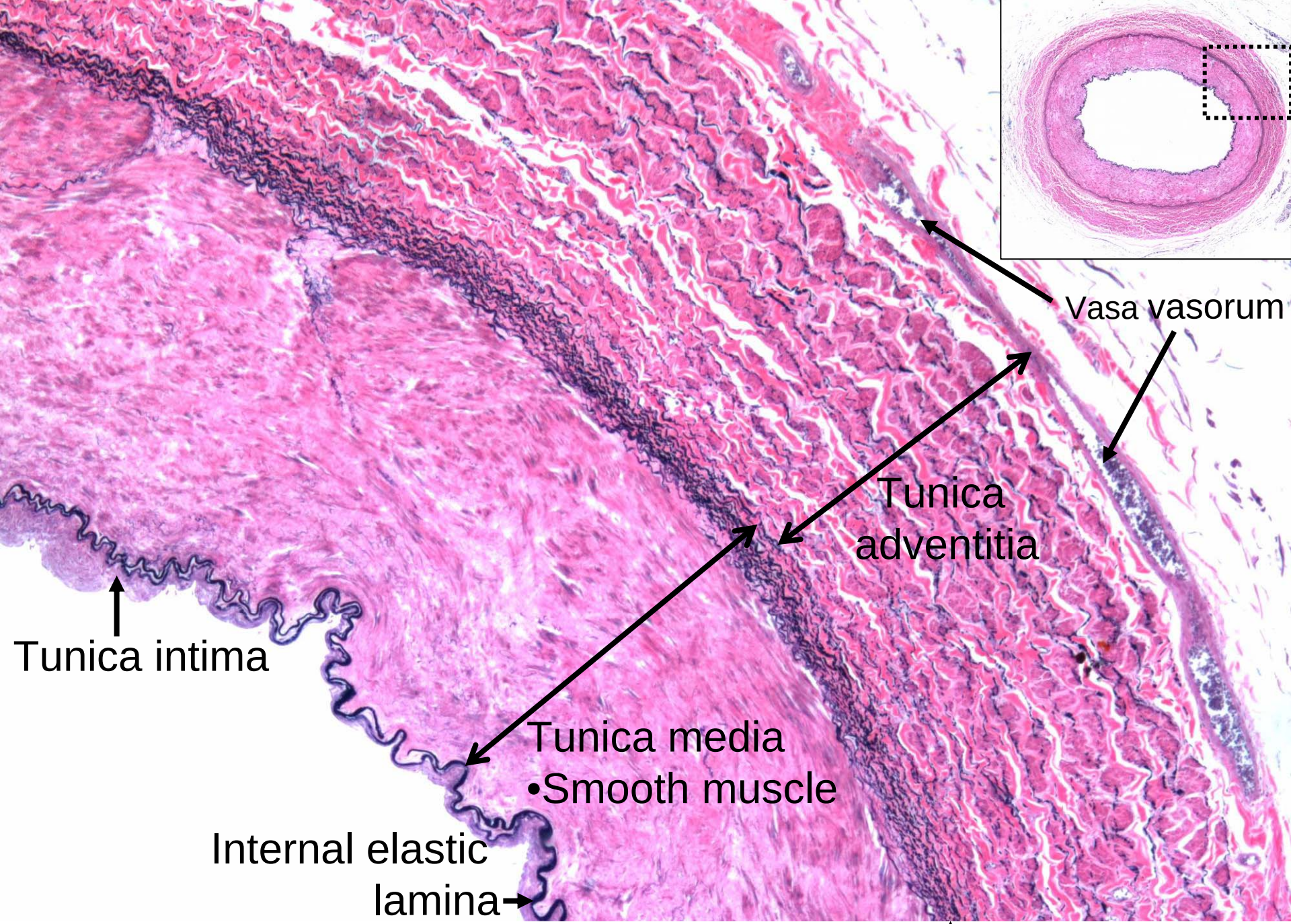


Fig.10 93W6515 Artery *cs* v&e

Fig.10 93W6515 Artery *cs* v&e. This slide is stained with Verhoeff's stain to visualize the elastic fibers, and with eosin to show the cellular structures. Muscular arteries have more smooth muscle and less elastin in the tunica media than elastic arteries. The muscular arteries are characterized by a layer of internal elastic lamina separating the tunica intima from the tunica media. The less prominent and more variable external elastic lamina lies between the tunica media and the adventitia. The tunica intima consists of an endothelial lining and a small amount of connective tissue. However, nucleus of the endothelial cells can’t be observed by the v&e staining method. The tunica adventitia is composed of collagen fibers (pink), elastic fibers (black) and vasa vasorum.

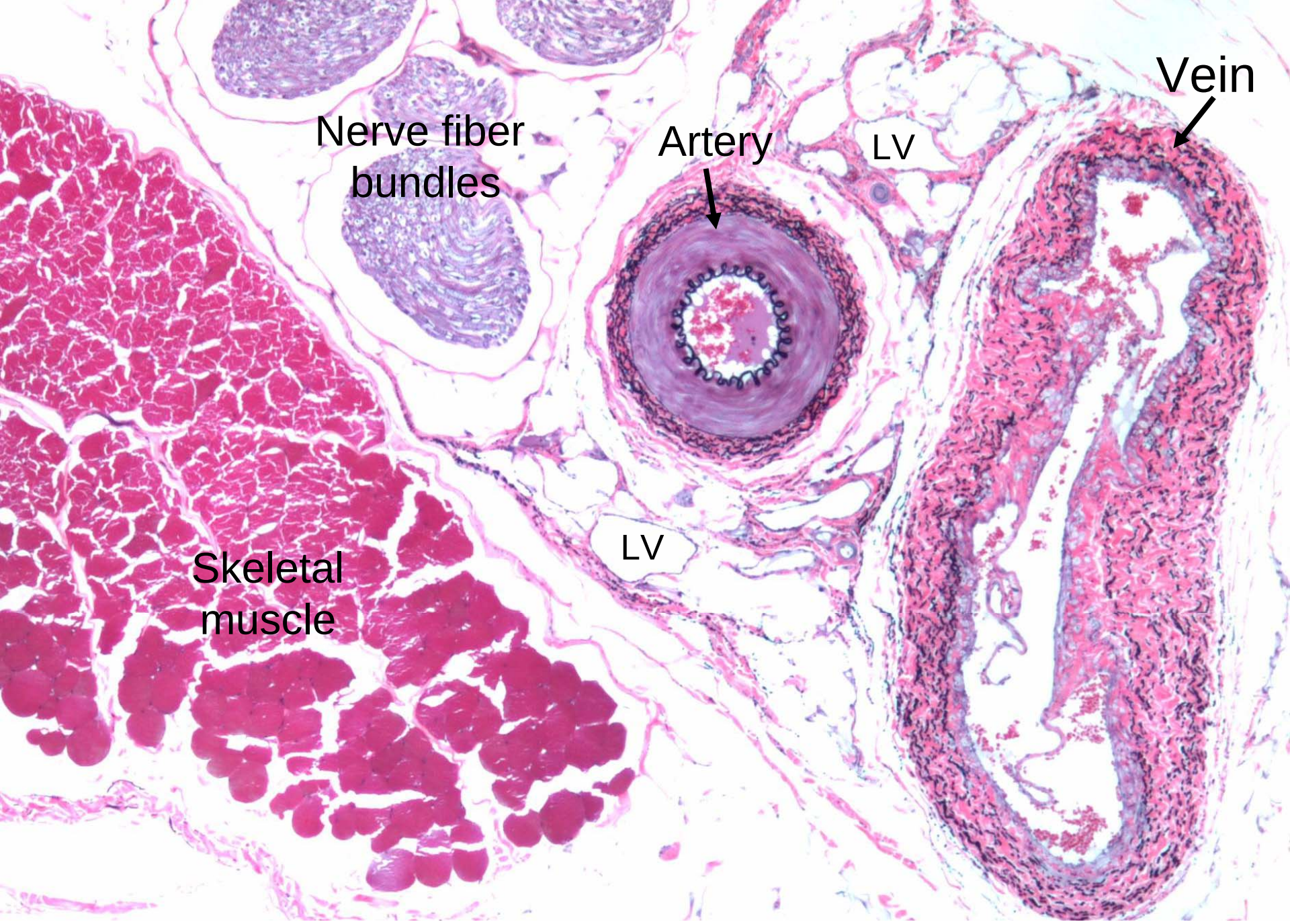
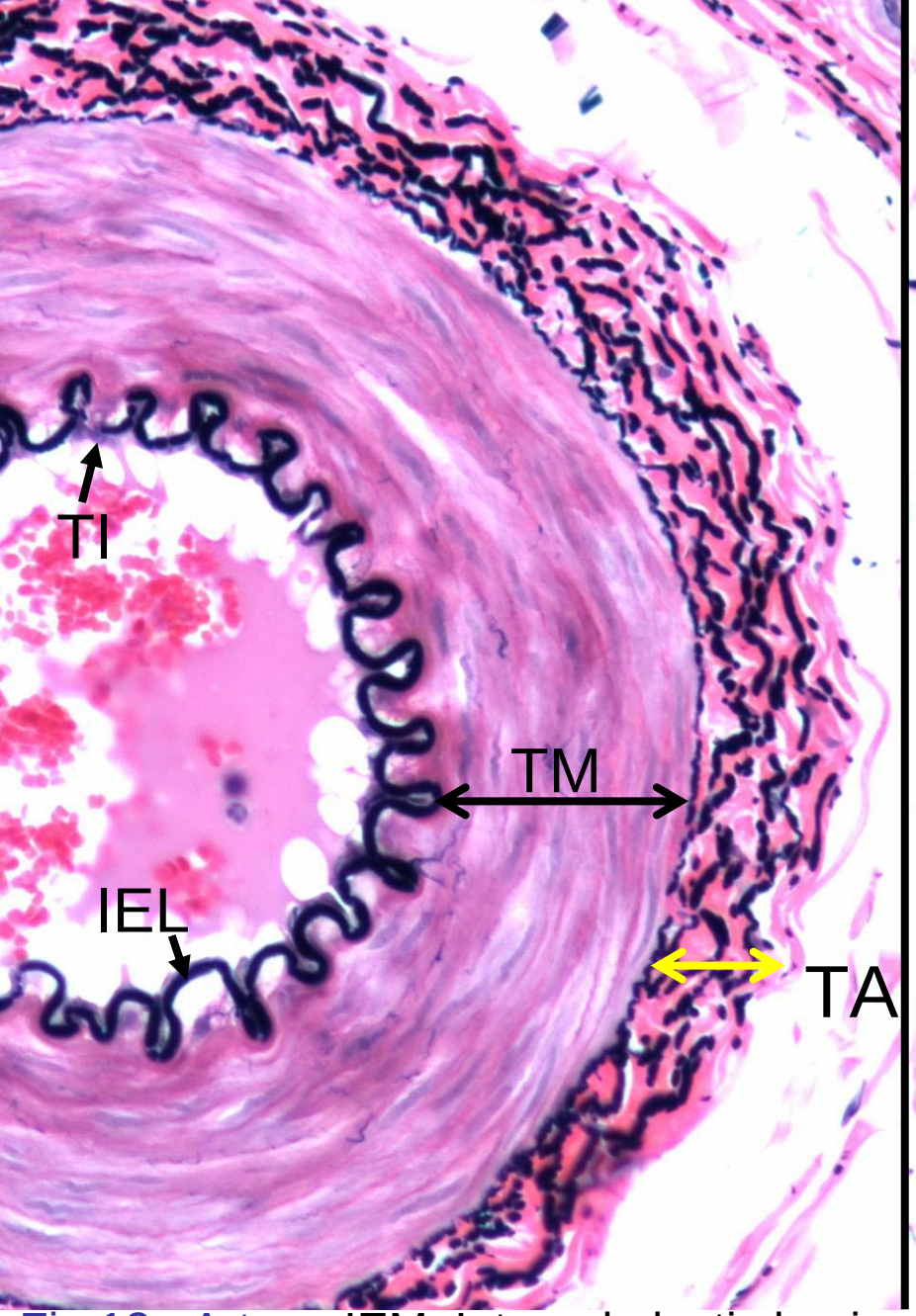


Fig.11 93W4046 Artery, vein, nerve, elastic tissue, *cs*, v&e LV: Lymphatic vessels

Fig.11 93W4046 Artery, vein, nerve, elastic tissue, *cs*, v&e.
There are many vessels: a muscular artery, a medium vein, several lymphatic vessels (LV), nerve fiber bundles, and a mass of skeletal muscle tissue in the slide. Veins usually accompany arteries as they travel in the loose connective tissue. Compare the structure of blood vessels with the one of lymphatic vessels (Review block 3). Compare the skeletal muscle fibers with the cardiac muscle fibers observed before. The structure of nerve fiber bundles will be demonstrate in block 7.



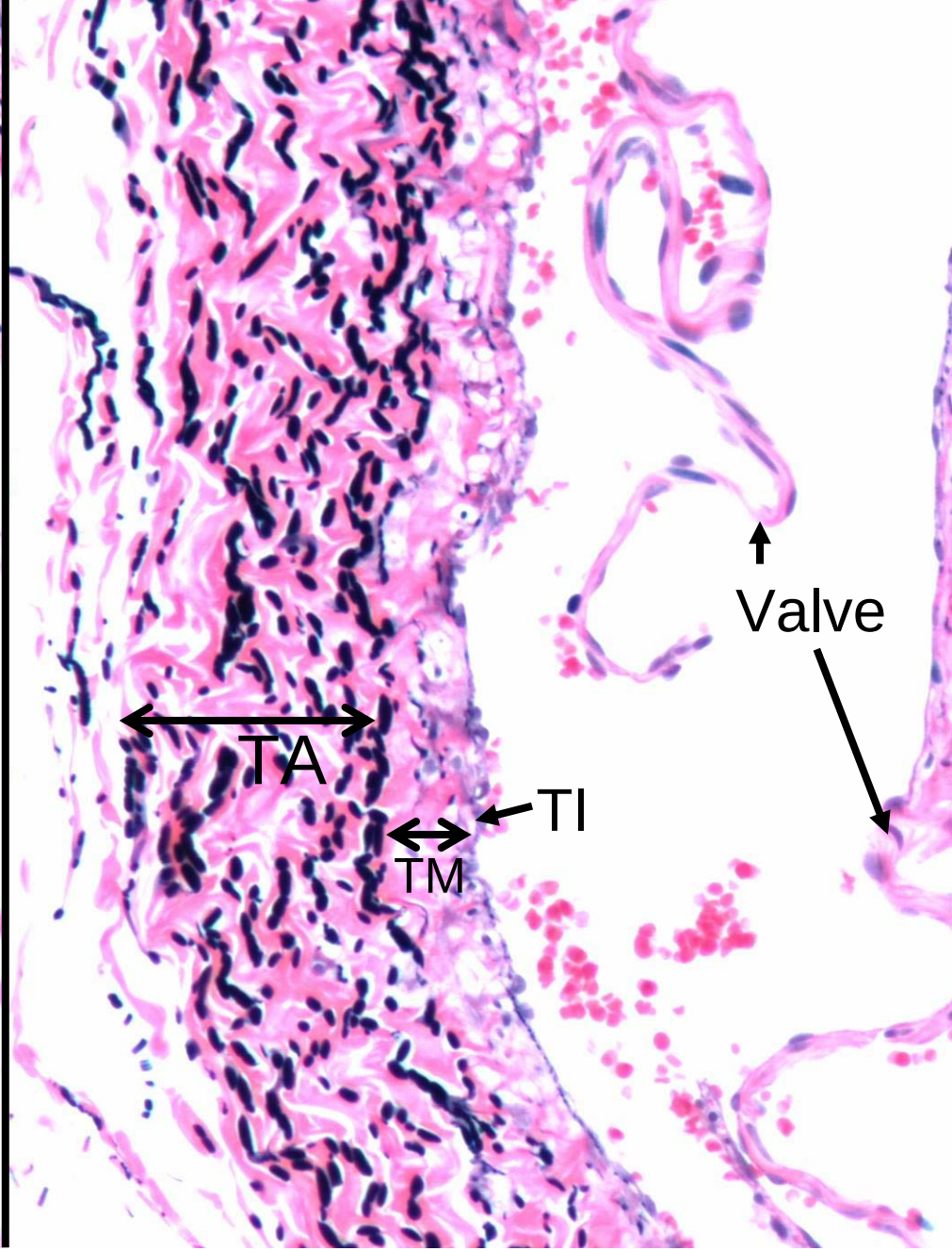


Fig.12a Artery IEM: Internal elastic lamina;

Fig.12b Vein

TI: Tunica intima; TM: Tunica media; TA: Tunica Advantitia

Fig.12a Photomicrograph of muscular artery. The artery has a thicker tunica media, a narrower lumen than the similarly sized vein, and thickened elastic laminae not present in the vein. The characteristics are described in figure 10.

Fig.12b Photomicrograph of medium-sized vein.
The vein, by contrast, has a thicker tunica adventitia, a wider lumen, and valves. The tunica intima consists of endothelium and a very thin subendothelial layer of connective tissue. The valve consists of projections of the tunica intima of the vein wall; the projections are lined on both sides by endothelium. The tunica media contains circularly and spirally arranged smooth muscle cells. The tunica adventitia contains an abundance of collagen (pink) and elastic fibers (black).

Summary

93W4058 Entire heart	Epicardium, Myocardium, Endocardium, Endothelium, Pulmonary valve, Lamina fibrosa, Aorta, Pulmonary a. *(Elastic artery)* , Coronary vessels *(artery, vein)* , Tunica intima, Tunica media, Elastic membrane, Tunica adventitia, Capillaries

Summary

93W6245 Cardiac muscle	Identify the cardiac muscle fiber, Intercalated discs
93W3533 Heart, Purkinje fibers	Purkinje fibers, Intercalated discs, Capillaries
93W4875 93W6515 Artery *cs*	Elastic artery, Muscular artery, Internal & external elastic lamina, Vasa vasorum *(Arteriole, Venule)*

Summary

93W4046 Artery, vein, nerve, elastic tissue	Muscular artery, Internal elastic lamina, Medium vein, Valve, Nerve fiber bundles, Skeletal M.

- Identify the cardiac muscle fiber
- Compare the difference between the arteries and the veins
- Compare the different sizes of the arteries and the veins