

Co and Benjamin
Laboratory Manual in Animal Histology
2nd Ed

Laboratory Manual in Animal Histology (Biology 134)



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EXERCISE 7: CARDIOVASCULAR SYSTEM

Introduction

The cardiovascular system consists of the heart, blood vessels, and the blood. Together, these three allow the precise delivery of nutrients, gases and other substances to the different organs of our body. The heart pumps the blood containing vital substances into a series of blood vessels which convey them into the various organs. The efficient transport of vital substances in our body is made possible by the elegance of the structural framework that constitutes the organs of the cardiovascular system.

Objectives

At the end of the exercise, the students should be able to:

1. differentiate the atria from the ventricles of the heart;
2. identify the Purkinje cells in the ventricle; and,
3. identify the different layers comprising the blood vessels.

I. The Parts of the cardiovascular system.

A. Heart - small, slightly conical organ that pumps the blood to the aorta.

Longitudinal section of the heart is so large that a scanner would suffice to identify the different parts of the organ. Bear in mind that the section is oriented opposite you, a mirror-image, hence, your right is the left of the organ and vice-versa. Note the difference between the left and right chambers as well as between the atria and the ventricles.

The Chambers of the Heart:

1. Atria - the upper chambers of the heart that receive the blood. These are small, ear-like and somewhat displaced to the periphery by the large aorta and pulmonary vessels. The large cavity is very evident here than in the ventricles. At the junction of atria and the ventricles, look for the valves w/c appear like an inverted V-shaped structure. From where did they originate? Trace these valves to the inner layer of the heart. They have a thin core of fibro-elastic connective tissue. They are in the open configuration in the slide.

2. Ventricles- massive bundles of cardiac muscle fibers that taper toward the lowermost part of the organ. The cavities of the ventricles appear narrower and confined to the upper region close to the atria.

Whatever the region is, there are three layers in the heart:

a. Epicardium – the outermost layer of the heart composed of mesothelium,

simple squamous epithelium. Note that it is much thicker in the atria and a subepicardium is evident where adipose tissue, blood vessels and nerves are found.

b. Myocardium – constitute the bulk of the heart where interlacing fibers of cardiac muscles are located. Under LPO, observe that the muscles are arranged in three planes: longitudinal, transverse and oblique and are tightly packed as to form a spiral configuration. The cardiac muscles appear as crisscrossed separated only by thin whitish connective tissue septa. **Do you find nerves and small blood vessels?**

c. Endocardium – innermost layer composed of endothelium and a subendothelium containing collagen and elastic fibers. A loose connective tissue next to the myocardium can be seen in the atria.

- ❖ **Subendocardium** - thick and light region where the modified cardiac muscles, the Purkinje fibers can be seen. Look for this layer in the region of the ventricles. Using HPO, examine the Purkinje fibers and note that the nuclei are peripheral in position. **Why?** Also you can find some bi-nucleated Purkinje fibers.

B. Blood Vessels - tube-like organs that convey blood from the heart to the tissues and back to the heart. They constitute a series and continuous set of vessels to and from the heart. Recall that there are three types of blood vessels which differ in their relative size, shape and thickness of the layers.

A transverse section of the blood vessels show that they are composed of three layers surrounding a lumen. They usually appear round if it is an artery or oval, if it's a vein. Oftentimes, they are found side by side.

a. Adventitia – outermost thick layer composed of connective tissue mainly collagen fibers associated with blood vessels and nerves. This is usually thin in the artery but thicker in the vein of the same size. Large vessels may have a distinct external elastic lamina between the muscle layer and this layer.

b. Media – composed of smooth muscles with elastic fibers. This layer is thicker and more prominent in the artery than in the vein. The thickness varies depending upon the size of the arteries and their distance from the heart. In the aorta, a fenestrated elastic laminae form concentric bands among the smooth muscles. A thin internal elastic lamina may be found in large arteries. This lamina appears as “wave-like” and dark between the layers of intima and media.

c. Intima – innermost layer of simple squamous epithelium called an endothelium. It is so attenuated that it is seen simply as a thin line around the lumen. A few small round structures along the “line” are actually the nuclei of the endothelium. These nuclei appear to perch on the “lines”

which are adjacent cytoplasm of the cells. At times, a few spindle-shaped nuclei may be observed facing the lumen.

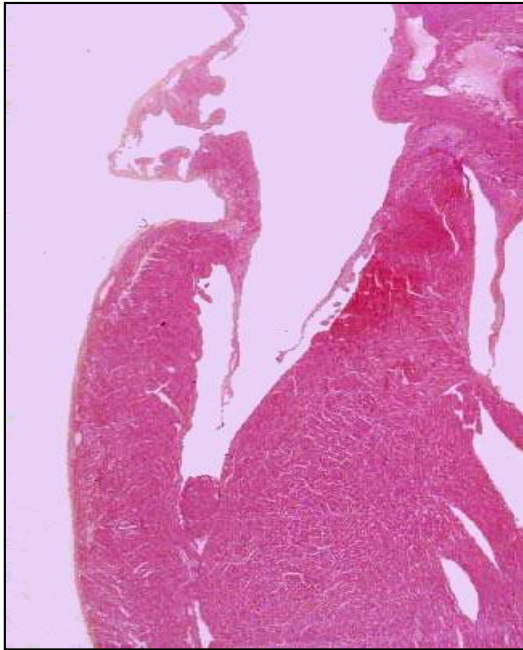
Veins – similar to arteries in having the three layers but have a thicker adventitia, irregular or wavy lumen containing many blood cells and oval shape.

Capillaries- smallest and thinnest among the three types with only one layer, the intima. They appear round with one or two nuclei that maybe flattened or round jutting into the lumen. The cytoplasm is so flat and thin, often indistinct.

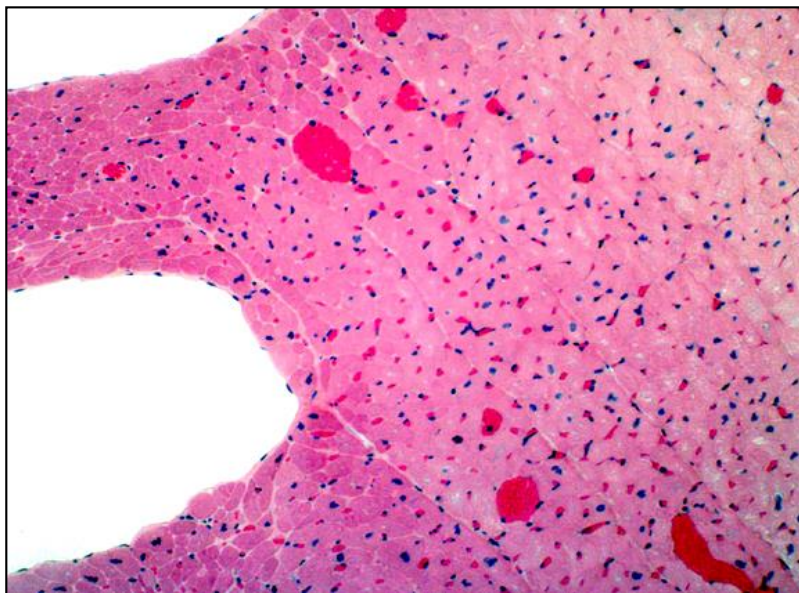
Lymphatic vessels- one-way flow vessels that return tissue fluid into the systemic veins. They have similar wall components as the blood vessels but are very thin and indistinguishable. They are most evident in the lamina propria of the small intestine where they are visible as highly irregular “white spaces” containing the absorbed fats.

Vasa Vasorum - small blood vessels located in the tunica media of the large arteries or in the intima of the veins. They are branch of large blood vessels in the tunica adventitia.

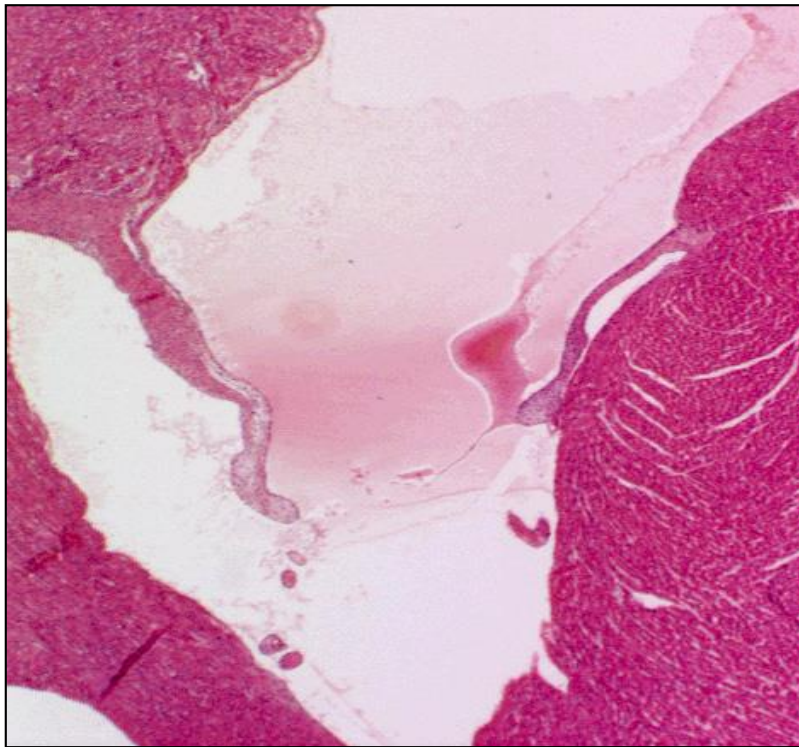
Illustrations



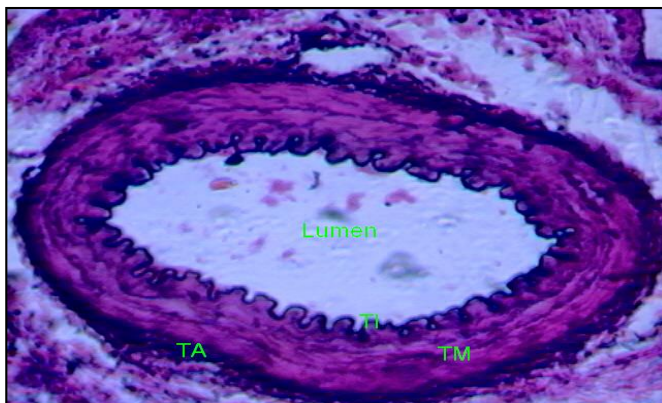
Heart



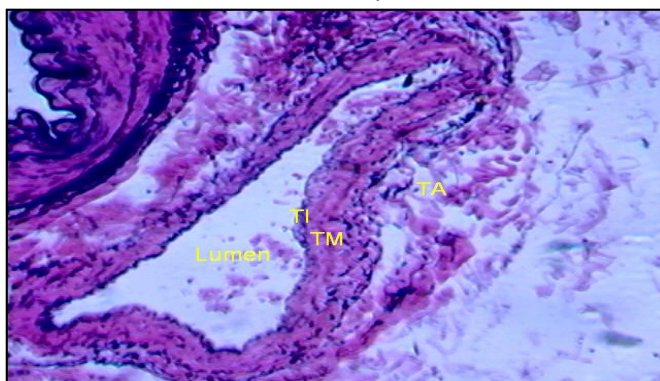
Ventricle



Heart valves



Artery



Vein

Guide Questions:

1. What are the main histological differences between atria and ventricles?

2. How do the Purkinje Fibers differ from the usual cardiac muscles of the heart?

3. What is the origin of the cardiac valves? Would the valves work better if they are composed of muscle tissue? Explain your answer.
