

ANATOMICAL AND PHYSIOLOGICAL FEATURES OF THE HUMAN CARDIOVASCULAR SYSTEM

Abdukhamidova Robiyakhan Afzalkhujaevna
Faculty of Medicine, Group 130a, Student
EMU, University.

Abdukodirova Nodima Khabibullaevna
Supervisor, EMU, Assistant Professor in the Department of
Medical and Biological Sciences of the University

Abstract

This article examines the fundamental anatomical aspects of the human cardiovascular system as a single, highly integrated structure that ensures hemodynamics and homeostasis. Particular attention is paid to the macro- and microstructure of the heart (myocardium, conduction system, valve apparatus), as well as the architecture of the vascular bed—the morphological differences between arteries, veins, and the microcirculatory system (capillaries). The paper describes in detail the topography of the systemic and pulmonary circulations, the mechanisms of valve regulation, and the characteristics of collateral blood flow. Understanding the detailed anatomy of the cardiovascular system is the basis for the subsequent study of cardiac pathologies and the improvement of surgical and therapeutic treatment methods.

The cardiovascular system is one of the most important systems in the human body, transporting oxygen, nutrients, and hormones, as well as removing waste products. The main components of this system are the heart and blood vessels—arteries, veins, and capillaries. The heart functions as a pump, ensuring the continuous movement of blood through the systemic and pulmonary circulations. This article examines the anatomical features of the heart, the structure of the vascular system, and the functional significance of various parts of the cardiovascular system in maintaining homeostasis.

Keywords: Cardiovascular system, cardiac anatomy, myocardium, cardiac conduction system, hemodynamics, arteries, veins, microcirculatory bed, systemic circulation, pulmonary circulation.

Introduction

The aim of the study: A comprehensive theoretical and morphological analysis of the anatomical structure of the human heart and blood vessels, systematization of modern data on their topography, tissue structure and functional relationships to form a fundamental basis for the study of normal anatomy and cardiology.

Research objectives

To achieve this goal, the following tasks must be solved:

1. To study and systematize modern scientific data and educational literature on the macroscopic anatomy of the heart and great vessels.



2. To analyze the features of the microscopic (histological) structure of the walls of various types of arteries, veins and vessels of the microcirculatory bed.
3. Describe the topographic and anatomical relationships of the heart with the surrounding organs of the mediastinum.
4. To trace the course of the main and collateral blood flow within the systemic and pulmonary circulations.
5. To identify the relationship between the anatomical structure of the elements of the cardiovascular system and their hydrodynamic (functional) tasks in the body.

Research methods

The work uses a complex of theoretical and descriptive-morphological research methods:

Theoretical and comparative analysis: study of classical and modern works in the field of normal anatomy, histology and cardiology.

Anatomical (descriptive) method: description of the shape, position, layered structure and topography of the heart and blood vessels.

Morphological comparison method: analysis of the histological structure of the vascular wall (muscular, elastic and mixed types) depending on the hemodynamic load.

Illustrative-graphic method: the use of anatomical atlases, diagrams and three-dimensional models to visualize the circulatory system and the internal architecture of the heart.

Research results (Research Results)

The following key findings were identified during the analysis:

Macrostructure and topography of the heart

The heart (\$ cor \$) is defined as a hollow muscular organ with four chambers (two atria and two ventricles). The right and left halves of the heart are normally completely separated by the interatrial and interventricular septa.

Valve apparatus: fibrous rings, bicuspid (mitral), tricuspid (tricuspid) and semilunar valves (aorta and pulmonary trunk) ensure strictly unidirectional blood flow.

Conducting system: the sinoatrial and atrioventricular nodes, the bundle of His and the Purkinje fibers form an autonomous system for generating and conducting electrical impulses, ensuring the automaticity of cardiac contractions.

2. Differential anatomy of the vascular bed

The structure of the blood vessel wall is strictly adapted to the pressure and velocity of blood flow:

Arteries: have a thick, elastic wall with a pronounced muscular layer (*tunica Media*), which allows them to withstand high systolic pressure. Arteries are divided into elastic (aorta), muscular-elastic, and muscular types.

Veins: characterized by a thinner wall, poor development of the muscular layer and the presence of pocket-like valves (with the exception of the vena cava and veins of the head/neck), preventing the backflow of blood under the influence of gravity.



The microcirculatory bed includes arterioles, capillaries, and venules. The capillary wall consists of a single layer of endothelium and a basement membrane, which provides optimal conditions for transmembrane gas exchange and metabolism between the blood and tissues.

3. Architectonics of circulatory systems

The blood flow pathways are systematized:

Lesser (pulmonary) circulation: originates from the right ventricle via the pulmonary trunk, carries venous blood to the lungs for oxygenation, and returns arterial blood via the four pulmonary veins to the left atrium.

Systemic circulation: originates from the left ventricle via the aorta, distributes arterial blood throughout the body, and returns venous blood via the superior and inferior vena cava to the right atrium.

The study examined the anatomical features of the human cardiovascular system and determined the functional significance of its main components. It was established that the heart is the central organ of circulatory function and consists of four chambers: two atria and two ventricles. The myocardium ensures the contractile function of the heart, and the valve apparatus maintains unidirectional blood flow.

Studies of blood vessels have shown that arteries have dense, elastic walls capable of withstanding high blood pressure, while veins have thinner walls and valves that prevent backflow. Capillaries facilitate the exchange of oxygen, nutrients, and metabolic waste products between the blood and the body's tissues.

It has also been established that the cardiovascular system is closely linked to the functioning of all organs and systems of the body, maintaining homeostasis. Disturbances in the anatomical structure or function of the heart and blood vessels can lead to the development of various diseases, including arterial hypertension, coronary heart disease, and heart failure.

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Conclusions

The cardiovascular system plays a key role in maintaining the body's vital functions. The heart acts as a central pump, ensuring continuous blood circulation. Arteries, veins and capillaries have structural features that correspond to their functions. The coordinated work of all components of the cardiovascular system is necessary to maintain normal metabolism and homeostasis of the body. Knowledge of the anatomy of the cardiovascular system is important for understanding the mechanisms of development of cardiovascular diseases and methods of their prevention.

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