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CLINICAL METHODS OF STUDYING CARDIOVASCULAR ACTIVITY

Achievements of modern medicine, scientific and technical progress have significantly expanded the possibilities of diagnosis and treatment of diseases of the cardiovascular system. Accurate and objective diagnostics make it possible to clearly diagnose functional and structural disorders of various organs and systems.

Cardiovascular system research methods are divided into invasive and non-invasive. Functional methods include studies of central and peripheral blood circulation, which include sphygmography, central and peripheral pulse curves, arterial oscillography and tachooscillography, rheography, methods of functional research of the arterial and venous system. The methods of registration and calculation of hemodynamic parameters include phonocardiography, phase analysis of cardiac activity, graphical methods of studying the mechanical activity of the heart, and ultrasound examinations of the heart.

Registration and evaluation of electrical properties of the heart are carried out using the methods of electrocardiography and vectorcardiography. Methods of X-ray research are radiography and radioscopy, tomography, angiocardiography. Radionuclide research methods for diseases of the cardiovascular system are radionuclide angiocardiography, radionuclide aortography, radionuclide phlebography [2, p.86].

Electrocardiography is a method of graphic registration of electrical phenomena that occur in the heart muscle during its activity. The curve that shows the electrical activity of the heart is called an electrocardiogram. Therefore, an electrocardiogram is a record of the changes in potential differences that the heart undergoes during its excitation. Electrocardiography is one of the main methods of studying the heart and diagnosing cardiovascular diseases. It is indispensable for diagnosing rhythm and conduction disorders, hypertrophies, and ischemic heart disease. This method makes it possible to diagnose with great accuracy the localization of focal changes in the myocardium, their distribution, depth and time of appearance; makes it possible to detect dystrophic and sclerotic processes in the myocardium, disorders of electrolyte metabolism that occur under the influence of various toxic substances. Electrocardiography is widely used for functional examination of the cardiovascular system, and the combination of electrocardiographic examination with functional tests helps to detect hidden coronary *artery disease*, variable rhythm disturbances, and to carry out a differential diagnosis between functional and organic disorders of the heart. A standard electrocardiogram captures the heart's activity in a short period of time, that is, captures only a few contractions of the myocardium, depending on the cardiograph used. Holter electrocardiogram monitoring is used for a more detailed analysis of information about the state of the patient's heart over a much longer period of time [1; 2; 6].

Holter monitoring of the electrocardiogram is a registration of heart activity by long-term recording of the electrocardiogram in the conditions of the patient's activity,

with further analysis of the obtained data. Holter monitoring is widely used to diagnose coronary artery disease, heart rhythm and conduction disorders, and evaluate the effectiveness of treatment of cardiovascular diseases. This examination makes it possible to simultaneously register several leads, which increases the informativeness of the method in the diagnosis of coronary artery disease and heart rhythm disorders. Increasing the duration of the study makes it possible to assess the conditions for the occurrence of heart rhythm disorders, their features. A device for Holter monitoring of an electrocardiogram provides continuous recording of an electrocardiogram under conditions of daily heart activity, playback of recorded signals, processing, and interpretation of the obtained data. Recording information is possible in analog or digital mode of information registration. Indications for Holter monitoring of the electrocardiogram are assessment of symptoms associated with heart rhythm and conduction disturbances; risk stratification in patients with structural heart diseases without symptoms of arrhythmia; evaluation of the effectiveness of treatment of heart arrhythmia; assessment of functions of implanted devices; diagnosis and evaluation of the effectiveness of treatment of myocardial ischemia [3, p.122].

Echocardiography is a non-invasive method of examining the heart and major blood vessels using ultrasound, which allows to visualize anatomical features and assess the function of the heart and major blood vessels. Ultrasound with a frequency of 1-1.5 MHz is used in medicine. The possibilities of ultrasound examination of the heart make it possible to quickly diagnose most heart diseases at the initial stage of development. This method of examination is not only the most informative, but also the safest, does not cause any complications or side effects. Echocardiography is one of the most powerful diagnostic and monitoring tools and can be used to determine and monitor changes in cardiac output, to determine disturbances in intracardiac hemodynamics and coronary perfusion, to ensure standardization of analytical information relevant to the diagnosis. The practical use of echocardiography is provided in patients with acute cardiovascular conditions, acute heart failure, suspected cardiac tamponade, acute valvular function disorders, including endocarditis, acute pathology of the ascending aorta, and complications after invasive interventions. Types of echocardiographic imaging are transthoracic echocardiography (a common initial imaging technique in the assessment of acute cardiovascular conditions); transesophageal echocardiography (especially necessary in cases of acute aortic syndromes, acute valvular regurgitation, acute dysfunction of valve prostheses, aortic dissection and atrial fibrillation to rule out thrombosis); contrast-enhanced echocardiography (it is useful for evaluating the systolic function of the left ventricle in patients with poor visualization of the endocardial borders of the left ventricle, especially in cases of pseudoaneurysms and intracardiac volume formations).

Angiocardiography is an X-ray method of examining the condition of the heart and major blood vessels. The technique is used to diagnose congenital defects of the heart and great vessels (to detect defects of the interatrial or interventricular septum, aorta coarctation, overriding aorta, non-occlusion of the aortic duct, etc.). During the examination, a radiopaque substance, usually containing iodine (cardiotrast, yoduron, pielozil, diodon, diodrast) is injected transvascularly into the heart chamber through a catheter. The points of contrast agent administration are the artery for the left chambers and the vein for the right chambers of the heart. From there, it spreads through the major blood vessels with the flow of blood. This is captured through a series of images

that allow determining the path of contrast spread through the blood vessels. Modern angiocardiography is performed using digital technologies (computer angiocardiography). Angiocardiography can also be used to diagnose congenital heart defects in atrial septal defects, to determine myocardial function in ischemic heart disease, in case of valve dysfunction, and other acquired or congenital heart pathologies [4, p.87].

The study of central and peripheral blood circulation (sphygmography) is a non-invasive method of studying cardiovascular activity, which is based on the graphic registration of the oscillations of the arterial walls during the passage of a pulse wave. Due to the fact that blood does not flow from the heart in a continuous stream, but is ejected in portions, the flow of blood through the blood vessels has a pulsating character. The elasticity of the walls of the aorta and arteries leads to the fact that at the moment of systole, the blood that is pushed out of the left ventricle stretches the walls of the aorta, creating systolic pressure. At this moment, such areas of the circulatory system receive more blood than flows out of them to the peripheral vessels. During diastole, deformed vessels push blood to peripheral areas and the pressure in the aorta drops to a minimum. The potential energy of the deformation of the vessel walls is transformed into the kinetic energy of the blood flow. At the moment of systole, a wave of increased pressure is formed and propagates in the aorta, which is called a pulse wave. The speed of its spread does not coincide with the actual speed of blood, but much exceeds it. Formation of blood pressure, changes in the rate of heart contractions, stroke volume of blood, elasticity and tone of the arterial walls are reflected in the pulse curves – sphygmograms. Sphygmograms can differ depending on the anatomical localization of the source, physical properties of the sensors, and physical and mathematical characteristics. The pulse curves recorded on the arteries closer to the heart are called sphygmograms of the central pulse (for the arch of the aorta, subclavian and carotid arteries). The sphygmogram of the peripheral pulse determines the features of the propagation of the pulse wave in the peripheral arteries. Also, with the help of sphygmography, the contractile properties of the myocardium, the dynamics of force and the speed of heart contractions are studied, arterial tone and the state of local blood flow are assessed.

Magnetic resonance imaging of the heart is currently the most accurate diagnostic method, which most accurately reproduces the structure of the heart and its anatomical structure, allows to assess its function, as well as pathological changes.

Magnetic resonance imaging is a non-invasive test that uses a magnetic field and radio frequency waves to create detailed pictures of the heart without using ionizing (X-ray) radiation. The indication for magnetic resonance imaging of the heart is the detection and visualization of congenital disorders of the heart and major blood vessels; differentiation of idiopathic and ischemic cardiomyopathy; detection of fibrous changes in hypertrophic cardiomyopathy; to visualize specific signs of inflammatory changes in the myocardium; differentiation of acute and transferred myocardial infarction; the best method for diagnosing arrhythmogenic cardiomyopathy of the right ventricle with assessment of fibrosis; for the differentiation of hibernation and stunning of the myocardium in order to determine the tactics of treatment; detection of primary and secondary formations of the heart; assessment of localization and extracardiac spread, analysis of vascularization of tumors; to detect diseases of heart valves and aorta. In most cases, magnetic resonance imaging of the heart is performed with

contrast, so the contraindications refer to general contraindications to contrast administration [5].

Rheography is a diagnostic method that examines blood flow in organs and biotissues. The essence of rheography is the graphic registration of changes in the electrical conductivity of the organ caused by pulse fluctuations of the blood current. Among all the structures of our body, blood has the highest electrical conductivity. The main indicators during the analysis of the rheographic curve are rheographic index (reflects the amount of total blood filling of the area under investigation); the amplitude of the initial section of the rheogram (characterizes the magnitude and speed of blood filling of the arterial bed); systolic-diastolic index (used to assess the state of venous outflow) [3, p.88].

The analyzed diagnostic methods are effectively used in clinical practice for the diagnosis of cardiovascular diseases, and the formation of an individual approach to their treatment will make it possible to reduce the activity of the disease and increase the effectiveness of therapy. The latest examination methods, innovative technologies, and the competence of specialists ensure the highest quality of diagnosis and help to avoid possible errors in maintaining health and a full-fledged lifestyle.

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