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**THE FACTORS OF DEVELOPMENT AND METHODS OF EARLY  
DIAGNOSIS OF CARDIORESPIRATORY DYSAUTONOMIA**

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**Annotation** Cardio-respiratory regulation of the autonomic nervous system adapts the functional capabilities of the respiratory and cardiovascular systems to the constantly changing conditions of the external and internal environment [1, p. 254]. This article provides an overview of the factors that influence the autonomic regulation of the cardiovascular and respiratory systems, and also describes the methods of early diagnosis of cardiorespiratory dysautonomy. It has been determined that the symptom complexes of such disintegrations depend not only on the severity of the existing pathological and pre-pathological conditions, but also on the initial state of control with the autonomic nervous system over these functions.

At the stages of early diagnosis and subsequent control of pathological conditions, it is advisable to use objective methods (hardware, instrumental) research, which are used separately and in combination in cardiology, pulmonology and in the clinic of nervous diseases. In order to prevent the development of both the pathological conditions themselves and their complications, it is advisable to carry out functional tests of these systems with the subsequent analysis of the results obtained and modeling the appropriate treatment and corrective tactics [1, p. 255].

**Key words:** cardio-respiratory disautonomy, autonomic nervous system, subjective and objective research methods, diseases of the cardiovascular system,

diseases of the respiratory system.

Cardio-respiratory regulation of the autonomic nervous system, as part of the general tone of the autonomic nervous system, adapts the functional capabilities of the respiratory and cardiovascular systems with quite wide range to constantly changing conditions of the external and internal environment [1, p. 254]. Among the factors that affect the autonomic regulation of the cardiovascular and respiratory systems, and integrating these functions, of particular interest are age, sex, body weight, work and rest, habits, including harmful ones (smoking, strong tea and coffee, alcohol), as well as fitness (general physical, special and mental) training. The psychoemotional status of a person is of no small importance [1, p. 255].

Especially often, cardio-respiratory disintegration is noted in pathological conditions - diseases of the respiratory system (bronchial asthma, pneumonia, pneumosclerosis) and the cardiovascular system (angina pectoris, cardiosclerosis, myocardial infarction, cardiomyopathy). In these cases, disintegration can be expressed equally in relation to both systems or expressed by the prevalence of violations on the part of one of them.

The autonomic nervous system, realizing its influence on respiration and cardiac activity through the sympathetic and parasympathetic components, becomes vulnerable as a result of maladjustment. This is reflected in the change in the values of such indices and parameters as rhythm and heart rate, cardiac output, rhythm, depth and frequency of respiratory movements, etc [2, p. 107].

Moreover, there is a direct relationship between the severity of these conditions and the severity of such cardiorespiratory disintegration. During scientific researches, it was determined that the symptom complexes of such disintegrations depend not only on the severity of the existing pathological and pre-pathological conditions, but also on the initial state of control of the autonomic nervous system for these functions.

Functional and diagnostic research methods, including functional tests, are important for the detection and control of such disintegration: determination of lung

volumes (vital capacity of the lungs (VC) with a reserve volume of inspiration and expiration, produced using a spirometer or spiograph). Simultaneously with the VC, the due vital lungs capacity is calculated, which includes the influence of such factors as age, gender, height, weight, and the state of the respiratory muscles. A decrease in vital lungs capacity can be compensated for by increased respiration. In this regard, to assess the real autonomic control (and the degree of such disintegration) of the functional state of the respiratory apparatus, the minute volume of respiration (MVR) is determined. There are many factors that influence on the MVR (gender, age, working conditions, etc.). Therefore, to determine the values of the obtained value of the MVR, the calculation of the due minute volume of respiration (MVR) is carried out. For example, in case of pathological conditions of the lungs and disturbances of the cardiac activity, the MVR may increase as a result of increased frequency and deepening of respiratory movements. In some patients, the MVR can reach 200-300% of the MDR. This is due to the activation of the respiratory center as a result of the accumulation of carbon dioxide in the blood. Maximal ventilation of the lungs (MVL) or maximal minute volume is the volume of air passing through the lungs during maximal expressed breathing in 1 minute. This test also depends on many factors and determines the performance of the respiratory muscles, the range of extension of the chest and lungs, and bronchial passing. The decrease of the MVL indicates a complex violation of the function of the respiratory muscles, the decrease of the degree of chest extensibility and the disturbances of bronchial conduction.

With spirometry, the quantitative and qualitative characteristics of all lung volumes are determined, as well as the coefficient of oxygen utilization (COU). The coefficient of oxygen utilization rate evaluates the processes of oxygen diffusion in the lungs and the degree of ventilation efficiency. Normally, the COU is 35-45 ml per minute. The decrease of the oxygen utilization coefficient can characterize the deterioration of the processes of pulmonary ventilation (including disturbances in respiratory movements and the formation of adequate lung volumes [3, p. 683].

Pneumotachometry, as a method for determining the functional state of the breathing apparatus, determines the volume of air passing through the wind tunnel



per second. There are maximal volume rates for inspiration and expiration. For men, the rate is 5-8 liters per second. And for women 4-6 liters per second. The pneumotachometric index can reflect bronchospasm, and such a change in the diameter of the bronchi leads to a sharp slowdown in air movement. With a spasm of the bronchi, the expiration rate decreases, as a result of a violation of the passive part of breathing - expiration. For the same purposes, in the study of such a plan, the Tifno-Votchal test is also included, which is based on comparing two indicators - VLC and forced vital lungs capacity (FVLC). The test is performed with using a spirometer.

The respiratory test, which reflects the functional state of the lungs and heart, is the Stange test. Its content is the maximally possible deepest inhalation and holding the breath (holding the breath while inhaling). Healthy people are able to hold their breath for 60 seconds or even more (especially trained people, for example, athletes). In the presence of abnormalities in the respiratory apparatus (and cardiac activity), both acute and chronic, the time of such a delay can changes in the direction of decreasing this index.

The determination of the blood flow velocity in the pulmonary circulation to a certain extent can reflect the state of the small branches of the pulmonary artery encircling the alveoli, and thus helps to determine the functional state of the respiratory apparatus, which is under the control of the autonomic nervous system. In pathological conditions (especially chronic), both of the lungs and the heart, the velocity of blood flow in the pulmonary circulation slows down, that also adversely affects cardiac activity.

The main diseases of the cardiovascular system, leading to cardiorespiratory autonomous disintegration, include angina pectoris, myocardial infarction, myocarditis, pericarditis, endocarditis, cardiac arrhythmias, heart valves defects (congenital and acquired), heart neuroses and hypertension [3, p. 685]. Shortness of breath can often be a sign of cardiac insufficiency and occur acutely, in the form of attacks of suffocation, often at night. This is predominantly characteristic of left ventricular failure. Sometimes this shortness of breath can be accompanied by

tachycardia. In this case, it is called cardiac asthma. Such a phenomenon as shortness of breath can occur at rest (with chronic cardiopulmonary pathology), as well as during physical exertion. In the case of left ventricular failure, blood stagnation occurs in the lung, extravasation into the alveoli, a decrease in the respiratory surface of the lungs, insufficient blood arterialization (hypoxemia) and a progressive accumulation of carbon dioxide in the blood (hypercapnia). As a result of all this, overexcitation of the respiratory center occurs and shortness of breath develops, the manifestations of which can be of varying degrees, and in some cases even threaten a person's life. Thus, shortness of breath is a sign (index) of some disturbances of the functional state and balance of both the heart and the pulmonary apparatus. It can be an indicator of compensation or decompensation of these organs [4, p. 3806]. Rapid heartbeat or tachycardia can be observed as a symptom in many heart diseases, but especially often in arrhythmias - paroxysmal tachycardia and cardiac fibrillation. The mechanism of occurrence and development (progression) of heartbeats is quite complex and in itself is a compensatory response to hypoxemia and hypoxia, developing as a result of detrimental effects on the neuro-reflex apparatus of the heart and various manifestations of cardiorespiratory disintegration [5, p. 355].

For the purpose of functional research and, possibly, early diagnosis of cardiorespiratory disintegration, both complex and apparatus and instrumental, and rather simple and low-cost methods are widely used, such as determining the pulse and its properties (pulse quality) and measuring blood pressure. In many cases, these methods can provide very valuable early diagnostic and then differential diagnostic information. The pulse rate can change, both in the direction of increasing and decreasing, which reflects the corresponding contractions of the heart. In pathological conditions, the regularity of the pulse is disturbed, and it becomes arrhythmic (irregular) [6, p.1-5].

With ordinary palpation of the pulse, a number of its properties can be assessed with a certain degree of subjectivity. More objective is the graphical registration of the pulse using sphygmography. Sphygmography makes it possible to objectively and comprehensively assess the pulse rate, pulse filling, all types of arrhythmias, the state

of the blood vessels. The determination of the velocity of spreading of the pulse wave is also informative. For this, a sphygmogram is simultaneously recorded from the carotid artery, at the level of the upper thyroid cartilage (central pulse) and from the femoral artery, at the level of its exit from under the pupar ligament (peripheral pulse). The delay time of the peripheral pulse in relation to the central one is determined, and the velocity of spreading of the pulse waves is found using a special formula. Normally, in the descending aorta, the speed ranges from 4.5 to 8 m per second.

Determination of blood pressure is of great importance in such studies. Blood pressure is formed mainly due to the hydrodynamic effect exerted by blood on the inner walls of the circulatory system and supported by the contractions of the heart, in combination with complex neurohumoral mechanisms, with the active participation of the autonomic nervous system. Oscillography is also used as a method of graphic registration of blood pressure, since blood pressure measurement with sphygmomanometers or various binds and modifications of tonometry cannot always satisfy almost all the needs of a researcher. There is a need for graphic registration of blood pressure. The resulting record allows you to determine the minimal and maximal pressure, pulse. In addition, the so-called oscillatory index is calculated - the height of the largest oscillation, expressed in millimeters. Normally, in the area of the shoulder of a healthy person, this index is 20-22 mm, the lower leg - 25 mm. As an addition to the ongoing comprehensive research, phlebography is added in some cases. Phlebography is a recording of the venous pulse. Usually a phlebogram is recorded from the jugular vein. The phlebogram looks like a complex curve that reflects the work of the right atrium and ventricle.

The obligatory research method that helps to diagnose the various types and to determine the degree of cardiorespiratory disintegration is electrocardiography. It is a graphic registration of bioelectric phenomena that occur in a beating heart. The autonomic nervous system regulates and controls the circulatory system and, to a greater extent, ensures optimal blood flow and hemoperfusion in all organs, primarily in accordance with their metabolic needs. This control concerns primarily the

respiratory system, the multicomponent functions of which are included in the program of such provision for all organs. Coordination and synchronization of the entire cardio-respiratory complex is impossible without the integrative interaction of the respiratory and cardiovascular systems based on their control by the autonomic nervous system.

Diagnostics of such dysregulation, especially in the early stages of the development of pathological conditions, should include in the research model, first of all, methods for diagnosing the diseases of the cardiovascular and respiratory systems.

The system of diagnostic measures should also include consultations of such specialists as a pulmonologist, cardiologist, a doctor of functional diagnostics, a neuropathologist, a psychiatrist, a neuropsychiatrist, a psychologist, a sports doctor (for carrying out functional tests related to the autonomic nervous system (for example - orthostatic and clinostatic tests) [ 6, pp. 1-5].

### **Conclusions**

1. Cardio-respiratory disintegration is always a logical reflection of the dysfunction of the autonomic nervous system associated with the regulation of the heart and lungs.

2. The etiopathogenesis of pulmonary and cardiovascular diseases is quite diverse, but the initial pathological conditions are considered as mutually aggravating.

3. At the stages of early diagnosis and subsequent control of pathological conditions associated with cardiorespiratory disintegration, it is advisable to use objective methods (hardware, instrumental) research, used separately and in combination in cardiology, pulmonology and in the clinic of nervous diseases.

4. Taking into consideration the wide and varied range of predisposing factors for the appearance of this pathology, in order to prevent the development of both the pathological conditions themselves and their complications, it is advisable to carry out functional tests of these systems with the subsequent analysis of the obtained results and modeling the appropriate treatment and corrective tactics.

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