

Study of the State of the Cardiovascular System and the Risk of Heart Failure in Chronic Obstructive Pulmonary Disease

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Abstract Chronic obstructive pulmonary disease (COPD) is an independent nosologically form representing a disease characterized by a limitation of the air flow velocity associated with a pathological inflammatory process in the lungs. With chronic obstructive pulmonary disease, this process is irreversible, constantly progressing and leading to severe complications from the cardiovascular system. The study of the clinical features of the functional state of the cardiovascular system in patients with chronic obstructive pulmonary disease, depending on the stage of the disease, hence the severity of right ventricular failure, and later left ventricular failure, the frequency of arrhythmias, the formation of a chronic pulmonary heart, changes in the imbalance of the blood coagulation system, microcirculation are of great importance in the further study of this important problem.

Keywords Chronic obstructive pulmonary disease, Coronary heart disease, Chronic pulmonary heart disease, Arrhythmia, Metabolic syndrome, Pulmonary arterial hypertension

1. Relevance

Chronic obstructive pulmonary disease ranks 4th among the causes of death [2,24]. According to the World Health Organization, by 2030, chronic obstructive pulmonary disease will become the third leading cause of death in the world. Currently, about 3 million deaths are associated annually with chronic obstructive pulmonary disease [15]. Smoking and metabolic syndrome are the main cause of chronic obstructive pulmonary disease (COPD) and one of the main risk factors for the development of various cardiac diseases, in particular coronary heart disease, and hypertension. Already at the stage of the formation of these diseases, there are common pathogenetic mechanisms. If we have a pathology on the part of the lungs, then there is a pathology of the heart [5]. If there is pathology on the part of the cardiovascular system, then a chronic pulmonary heart, various rhythm disturbances and pulmonary embolism may occur [18-23].

An international study, which analyzed about 6 thousand patients with COPD of moderate severity, showed that within 5 years the prevalence of cardiovascular events in patients of this group in the total mortality of 25%. [14-21].

Among the reasons for the patient's first hospitalization, COPD consists 42%-cardiac causes, repeated - 48%. With a decrease in the volume of forced exhalation 1 by 10%, the risk of cardiovascular mortality increased by almost 28%. This means that a decrease in the volume of forced exhalation 1 (VFE1) is one of the criteria for predicting the further state of cardiovascular complications. The level of C-reactive protein, total cholesterol, lipoproteins and their fractions, as well as indicators of respiratory function are independent predictors of myocardial damage [11-14].

All this shows the relationship between COPD and cardiovascular pathology. The main complications from the cardiovascular system in COPD are arterial hypertension, cardiac arrhythmias, ischemic heart disease, the formation of pain-free myocardial ischemia and chronic pulmonary heart disease. When there are two pathological conditions, they weigh down the course of each other. There are also certain diagnostic difficulties – the so-called cardiological masks for COPD, and a patient with cardiac pathology may have bronchial and broncho-obstructive masks [7-10].

Currently, special attention is paid to the study of COPD risk factors, among which a special place is occupied by dustiness of cities, industrial dust, age, tobacco smoking, respiratory infections, their frequent exacerbations, aggravating the course of obstructive pulmonary disease. Thus, tobacco smoking is associated not only with the appearance of pathological processes in the lungs, but also with the development of systemic inflammatory reactions,

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oxidative stress, vascular endothelial dysfunction, increased activity of procoagulant factors, oncogenes application and other systemic effects [1-7].

Relatively little studied is the relationship between respiratory insufficiencies developing in patients with COPD, on the one hand, and, on the other hand, left ventricular dysfunction and the occurrence of ventricular arrhythmias. In studies by R.A. Incalzi, R. Pistelli et al. [23] in patients with COPD, a connection was made between the function of the left ventricle and cardiac arrhythmias. Ventricular arrhythmia was monitored for 24 hours, the study was repeated as the clinical manifestations of respiratory failure improved. Diastolic dysfunction of the left ventricle is one of the factors contributing to the development of ventricular arrhythmias. The authors found a direct relationship between the severity of manifestations of respiratory insufficiency and diastolic dysfunction of the left ventricle, while the indicators of blood gases and the clinical presentation do not correlate with arrhythmic episodes. In clinical practice, it is recommended to conduct a more detailed diagnostic assessment of the episodes of ventricular arrhythmias that have arisen against the background of diastolic dysfunction of the left ventricle, since these manifestations may be hidden myocardial ischemia, pain-free forms of angina pectoris and overload of the right ventricle during the formation of the pulmonary heart [1-12].

It should be noted that with the development of arrhythmia, there is also always a deterioration in the clinical manifestations of respiratory insufficiency, i.e. a syndrome of mutual aggravation is formed. Thus, atrial tachycardia, the main morphological feature of which is the discreteness of the "P" wave in leads I, II, III with different intervals P_P, P-R, R-R, is associated, to a large extent, with the development of respiratory failure, and functional changes in the work of the heart muscle are associated with its occurrence. The prognosis of the course of COPD with the appearance of this type of cardiac arrhythmia is considered unfavorable [10-12]. Epidemiological studies on the issue of arrhythmias in patients with chronic obstructive pulmonary disease are clearly insufficient – there are many unresolved issues, in particular, the role of secondary pulmonary hypertension has not been practically studied [14,17,24]. The role of medications prescribed to cardiological patients in order to control blood pressure, heart rate, and beta-blockers also belong to the same little-studied issues. No less significant among other extrapulmonary systemic effects of COPD are weight loss, eating disorders, dysfunction, hypotrophy and atrophy of skeletal muscles, mental state, i.e. clinical syndrome of secondary trophological insufficiency. The researchers' interest in this problem in therapeutic patients, including those with COPD, is due to the fact that the trophological status is a cumulative indicator reflecting the processes of various metabolic links within the entire trophic chain, providing stable homeostasis [15,16].

The presence of secondary immunological insufficiency in patients suffering from COPD is well known. Uncontrolled differentiation of highly organized tissues,

including the immune system, due to tissue hypoxia in patients with Broncho obstructive syndrome can lead to both a lack of anti-infectious immunity and a breakthrough in immunological tolerance. There is evidence of a clear relationship between a decrease in myocardial contractility and the severity of autosensitization. With an exacerbation of the inflammatory process in the lungs in patients, sensitization to cardiac antigen is determined. In patients with reduced myocardial contractility, sensitization to cardiac antigen persists during remission of COPD, which indicates the inclusion of autoimmune mechanisms in the development of myocardial lesions in them. Autoimmune damage to the myocardium inevitably changes its bioelectric properties, contributing to the formation of rhythm disturbances in the work of the heart [18,19].

We know that in the treatment of heart failure, angiotensin-converting enzyme inhibitors, sartans, beta-blockers, mineralocorticoid receptor antagonists, antiplatelet agents, anticoagulants, cardiac glycosides, diuretics, statins are used in complex treatment. According to some authors, angiotensin-converting enzyme inhibitors, the use of perindopril or lisinopril as components of the complex treatment of chronic heart failure with highly selective β_2 -adrenomimetic combinations of salmeterol (2 times a day) in patients with chronic heart failure, compensated and decompensated COPD give good results [15,18]. When combined with chronic heart failure and COPD, the angiotensin-converting enzyme (ACE) inhibitors used reduce endothelial dysfunction, slow down the remodeling of the left and right ventricles, and improve the quality of life. In addition, the drugs also reduce the inflammatory processes in the lungs and vasoconstriction, thereby improving the capillary gas exchange of the alveoli. Some studies have shown that mineralocorticoid receptor antagonists and diuretics are prescribed for the treatment of chronic heart failure of etiology. Mineralocorticoid receptor antagonists prevent damage to the alveolar capillary membrane, thereby improving gas distribution [12,22]. The presence of secondary immunological deficiency in patients with chronic obstructive pulmonary disease has been well studied. In patients with obstructive bronchial syndrome, tissue damage due to tissue hypoxia, including a compromised immune system, can lead to a decrease in immunity to infection and a violation of immunological tolerance. There is a clear link between a decrease in myocardial contraction and the severity of autosensitization. Patients are more susceptible to cardiac antigens with increased inflammation in the lungs. In patients with impaired myocardial contraction, COPD retains sensitivity to cardiac antigen during remission, which indicates the presence of autoimmune mechanisms in the development of myocardial damage. Autoimmune damage to the myocardium inevitably changes its contractile properties, contributing to the formation of heart failure [11,21].

Thus, the study of the clinical features of the functional state of the cardiovascular system in patients with chronic obstructive pulmonary disease, depending on the stage of the

disease, hence the severity of right ventricular failure, and later left ventricular failure, the frequency of arrhythmias, the formation of a chronic pulmonary heart, changes in the imbalance of the blood coagulation system, microcirculation are of great importance in the further study of this important problem.

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