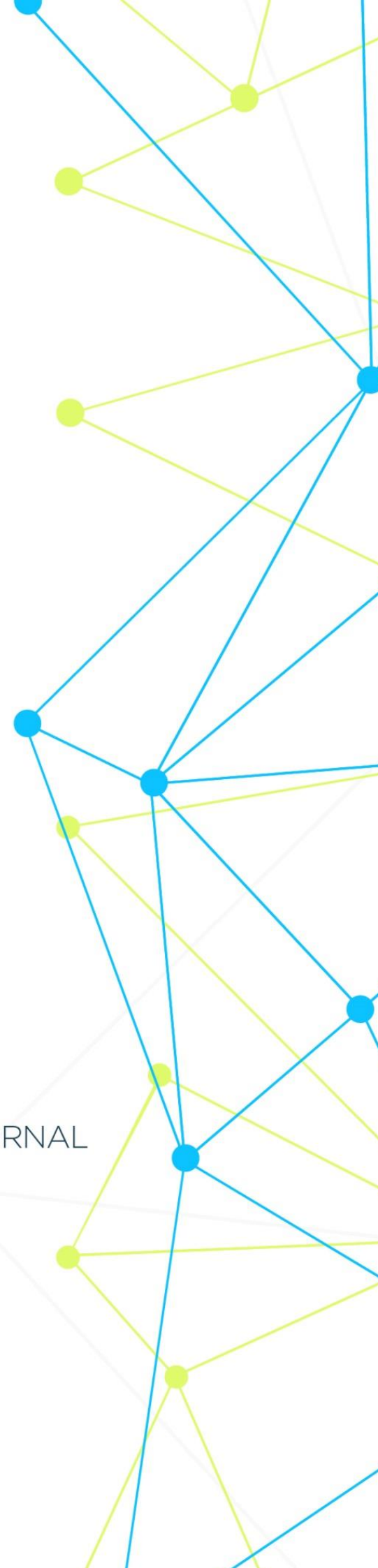


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## **CORRELATION RELATIONSHIP OF IMMUNE-METABOLIC PARAMETERS IN ARTERIAL HYPERTENSION**

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**Abstract.** The authors conducted a study on the study of immuno-metabolic parameters in the regulation of blood pressure and the assessment of their diagnostic significance for optimizing the methods of diagnosis and prevention of complications of arterial hypertension. A correlation analysis of the parameters of carbohydrate, lipid metabolism and the immune system, an assessment of the significance of each parameter in the regulation of blood pressure was carried out. It was found that an increase in the level of IgG in the blood confirms the risk of developing atherosclerosis in hypertension of the 1st degree, and a decrease in the level of IgG in the blood shows the development of secondary immunodeficiency. Each result obtained determines the further tactics of management of patients with hypertension of the 1st degree.

**Keywords:** arterial hypertension, metabolic syndrome, immune system, carbohydrate metabolism.

### **Introduction**

Arterial hypertension (AH) is the leading risk factor for premature death. According to WHO experts, hypertension is the cause of 54% of cardiovascular deaths. The incidence of hypertension as the most important indicator of the state of

public health is of an epidemiological nature. The prevalence of hypertension in the Russian Federation is 39.2 % among men, and 41.1% in women. While in the United States, depending on age and gender, if a person lives to 70 years, then 50% of all people are hypertensive [1].

In recent years, data have been accumulating indicating the role of the immune system in the regulation of blood pressure (BP) and cardiovascular risk associated with hypertension. The first line of defense of the immune system involves an innate reaction and occurs very quickly. The second line of defense, namely adaptive immunity, is characterized by a belated, but very purposeful reaction. From the point of view of the development of hypertension, the interaction between these two components of the immune system seems to be significant [2,3].

T-cell cytokines play a central role in the pathophysiology of cardiovascular diseases and hypertension and contribute to damage to end organs [4,5].

Cytokines often have overlapping functions, which is a problem in studies targeting individual cytokines to assess their role in hypertension and tissue damage. All these circumstances are responsible for the variability in the improvement of hypertension due to the suppression of specific cytokines [6]. While pro-inflammatory cytokines such as IL-2, IL-17, IFN- $\gamma$  and TNF- $\alpha$  have a detrimental effect in the pathogenesis of hypertension, the role of anti-inflammatory IL-10 is protective. Adaptive immune responses mediated by both T-cells and B-cells play a key role in the development of hypertension and mediating damage to target organs.

Correlations are probabilistic changes that can be studied only on representative samples by methods of mathematical statistics. Correlations indicate that changes in one trait, as a rule, are accompanied by certain changes in another.

**The aim of the study** is to study the correlation between the immune status and the parameters of carbohydrate metabolism to optimize the methods of diagnosing hypertension.

**Materials and methods of research.** The study included 64 patients with I-degree hypertension aged from 30 to 70 years (average age  $54.0 \pm 1.0$ ), hospitalized in

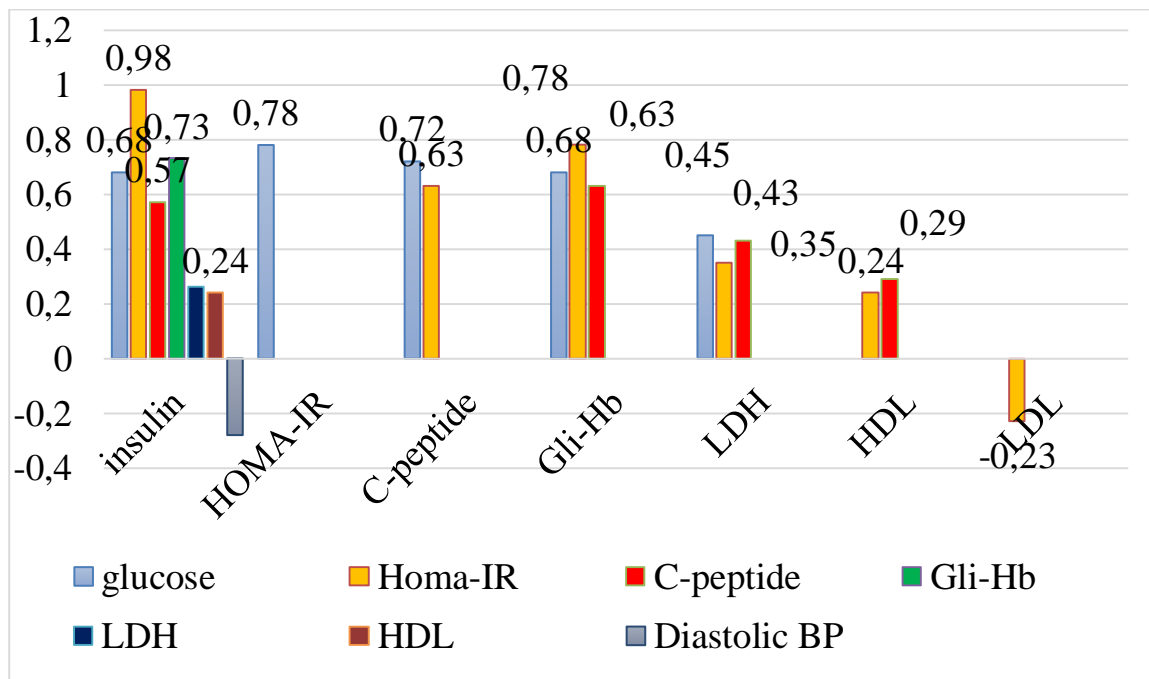
the Bukhara Regional Cardiology Dispensary. AH was verified according to the requirements of the World Health Organization( WHO), classified according to the international classification of Diseases (ICD-10). The exclusion criteria from the study were grade 2 hypertension, isolated systolic arterial hypertension, myocardial infarction, type 1 diabetes mellitus, unstable angina, pheochromocytoma, atrial fibrillation, chronic heart failure, acute cerebral circulatory disorder, dyscirculatory encephalopathy, urolithiasis, cholelithiasis, bronchial asthma. At the same time, adhered to the ACC/AHA Hypertension Guidelines classification (2017).

All patients underwent clinical and immunological, biochemical, laboratory, functional (DOECHOEG, ECG) and anthropometric (measurement of weight and height) researches.

**Results and their discussion.** The connection of the complement system with the components of blood pressure is established. The complement components involved in the regulation of the inflammatory response, in particular C3, have a noticeable positive relationship with systolic blood pressure (Systolic BP)  $-r=0.42$  and diastolic blood pressure (Diastolic BP)-  $r=0,55$ . Consequently, the established correlation noticeable positive relationships in the study confirm the participation of serum proteins in the regulation of blood BP.

The study of carbohydrate metabolism in patients with hypertension showed a high positive relationship of blood glucose with insulin- $r=0.68$ , with the Homa-IR index (Homeostasis Model Assessment Insulin Resistance) -  $r=0.78$ , with C-peptide -  $r=0.72$ , HbA1c (glycated hemoglobin) -  $r=0.68$  and a noticeable positive relationship with lactate dehydrogenase (LDH)  $r=0.45$ . At the same time, insulin in the blood has a high positive relationship with the Homa-IR -  $r=0.98$  and HbA1c -  $r=0.73$  index, the relationship between insulin and C-peptide was average positive- $r=0.57$ . The relationship between insulin and LDH was weakly positive- $r=0.26$ , as well as between insulin and high-density lipoproteins (HDL)-  $r=0.24$ .At the same time, insulin had a negative weak association with Diastolic BP -  $r= -0.28$ . The Homa-IR index also has a high positive relationship with HbA1c -  $r=0.78$  and an average

positive relationship with C-peptide -  $r=0.63$ , and with LDH it has a noticeable positive relationship- $r=0.35$ . The correlation relationship between the Homa-IR index and HDL was weak and positive- $r=0.24$ , while the relationship with LDL was negative and weak -  $r= -0.23$  (Fig. 1).

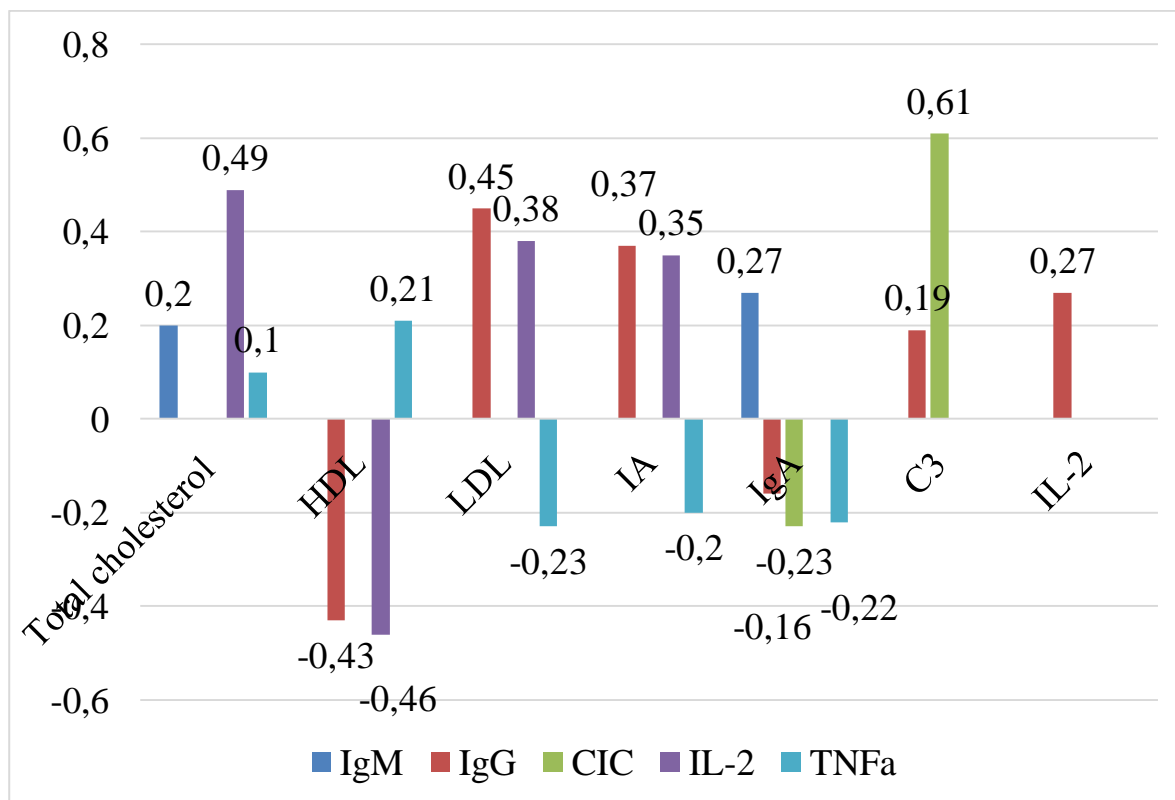


**Fig1. Correlation dependence of indicators of carbohydrate metabolism in hypertension of the 1st degree**

C-peptide, in turn, has an average positive relationship with HbA1c -  $r=0.63$ , LDH -  $r=0.43$  and a weak positive relationship with HDL -  $r=0.29$ . There is no relationship between the indicators of carbohydrate metabolism and the studied immunological parameters of blood (CIC, C3, CRP, IL-2, TNF-a) in grade 1 hypertension. The established positive correlations of blood glucose with the studied indicators of carbohydrate metabolism in hypertension of the 1st degree allows predicting the development of prediabetes, or rather the formation of type 2 diabetes mellitus in hypertension. The obtained data dictate the need for preventive measures to prevent the formation of hypertension by regularly studying the indicators of carbohydrate metabolism in people starting from the age of 30.

By studying the relationship between the parameters of the lipid spectrum, a high negative relationship between HDL and low-density lipoproteins (LDL) was

established-  $r = -0.92$  and between HDL and the atherogenicity index (IA) -  $r = -0.83$ . At the same time, IA has a high positive association with LDL -  $r = 0.81$ . At the same time, a noticeable negative relationship was also established between HDL and IL-2 ( $r = -0.46$ ), between HDL and IgG ( $r = -0.43$ ). Total cholesterol in grade 1 hypertension has an average positive relationship with IL-2- $r = 0.49$  (Fig.2).



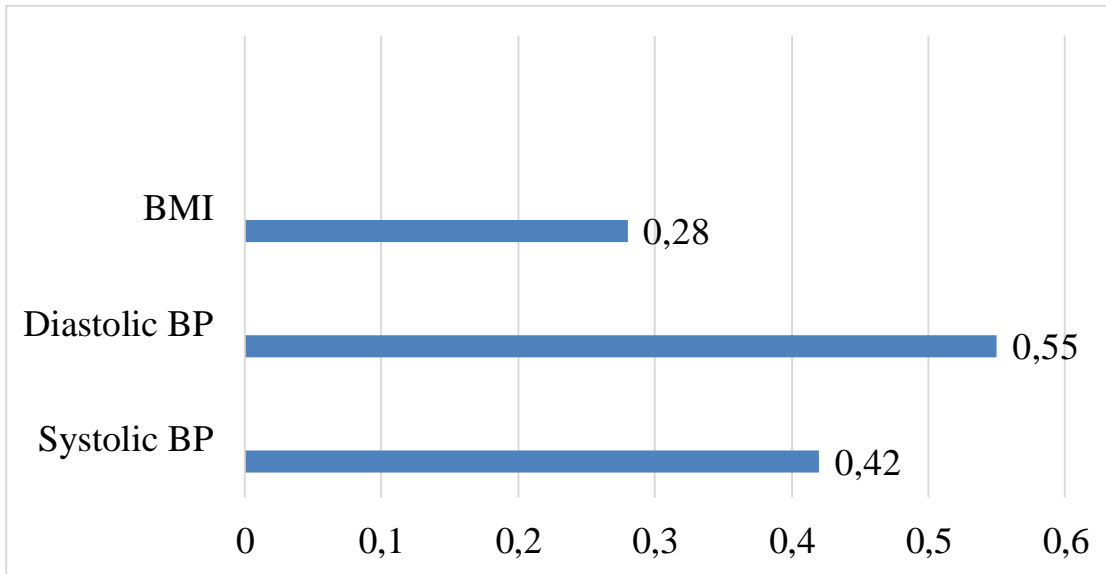
**Fig. 2. Correlation relationship between the parameters of the lipid spectrum and the immunological parameters of blood in hypertension of the 1st degree**

Thus, the established relationships between the parameters of the lipid spectrum and cytokines serve as indicators of the prevention of atherosclerosis in patients with hypertension. At the same time, an increase in the level of HDL in the blood confirms a decrease in IA and, in order to avoid financial costs, it is possible to limit ourselves only to determining the level of HDL or LDL in the blood in patients with established risk factors for the formation of hypertension. It is necessary to indicate the fact that in the study of grade 1 hypertension, significant correlations were established between the indicators of lipid and carbohydrate metabolism and the studied indicators of immunity. Thus, the study revealed a high positive relationship of LDL

with IA -  $r=0.81$ , an average positive relationship with IL-2- $r=0.38$ , with IgG- $r=0.45$ . At the same time, LDL has a negative weak relationship with TNF- $\alpha$  -  $r=-0.23$ , and IA has a noticeable positive relationship with IgG -  $r=0.37$ .

This leads to the conclusion that, taking into account the established relationships between the studied blood parameters, it is necessary to study the level of blood IgG, which allows early diagnosis of both secondary immunodeficiency in hypertension and early diagnosis of atherosclerosis due to its established connection with IA -  $r=0.37$ . This means that an increase in the level of IgG in the blood confirms the risk of developing atherosclerosis in hypertension, and a decrease-the development of secondary immunodeficiency. Each result obtained determines the further tactics of management of patients with hypertension of the 1st degree. Therefore, everything established confirms the dependence of immunological parameters on the degree of hypertension and the severity of the metabolic syndrome (MS).

By studying the relationship between the indicators of circulating immune complexes (CIC) and complement C3 in the study in patients with grade 1 hypertension, a high positive relationship was established -  $r=0.61$ . The obtained result allows predicting the CIC level by the C3 complement level and vice versa and indicates the participation of the CIC in the regulation of blood pressure components. This conclusion confirms the still established high positive associations of complement C3 with Systolic BP and Diastolic BP (Fig. 3.).



**Fig. 3. Correlation relationship of complement C3 with the components of blood pressure and BMI in 1st degree hypertension**

Cytokines in hypertension showed an average positive relationship- $r = 0.39$  between IL-2 and TNF $\alpha$  in the blood. Therefore, the IL-2 level can predict the process of cell apoptosis and the formation of coronary heart disease (CHD) in patients with grade 1 hypertension.

**Conclusion:** The established correlations between carbohydrate, lipid and immunological parameters of blood allow predicting the development of coronary heart disease and other organ changes in patients with grade 1 hypertension and dictate the need to organize and conduct early preventive measures to prevent the development of complications of hypertension, starting from the age of 30.

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