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FEATURES OF DYSLIPIDEMIA IN THE DEVELOPMENT OF CARDIOVASCULAR COMPLICATIONS IN CHILDREN WITH TYPE 1 DIABETES MELLITUS AFTER COVID-19 INFECTION

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Abstract. Cardiovascular complications in children with type 1 diabetes mellitus (DM1) after COVID-19 cover a wide range of topics, including the mechanisms of vascular damage, myocardial damage, long-term consequences and features of the course of the disease in children with DM1. The aim of the study was to study the features of dyslipidemia in the development of cardiovascular complications in children with type 1 diabetes mellitus after COVID-19 infection. Thus, the study revealed that in type 1 diabetes, the identified risk factors for atherosclerosis: insulin resistance, dyslipidemia, increased content of the inflammatory marker C-reactive protein, lead to macro- and microvascular changes that further progress the development of cardiovascular complications.

Keywords: diabetes mellitus, complications, lipids, COVID-19, heart.

Аннотация. Кардиоваскулярные осложнения у детей с сахарным диабетом 1 типа (СД1) после COVID-19 охватывают широкий спектр тем, включая механизмы поражения сосудов, миокарда, долгосрочные последствия и особенности течения заболевания у детей с СД1. Целью исследования явилось изучить особенности дислипидемии в развитии сердечно-сосудистых осложнений у детей с сахарным диабетом 1 типа после COVID-19 инфекции. Таким образом, в результате исследования авторами было выявлено, что при СД1 типа выявленные факторы риска атеросклероза: инсулинорезистентность, дислипидемия, повышенное содержание маркера воспаления - С-реактивного белка, приводят к макро- и микрососудистым изменениям, которые в дальнейшем прогрессирует развитие сердечно-сосудистых осложнений.

Ключевые слова: сахарный диабет, осложнения, липиды, COVID-19, сердце.

Annotatsiya. 1 tur qandli diabet bilan kasallangan COVID-19 infeksiyasi o'tkazgan bolalarda yurak qon tomir tizimi asoratlari miokardit rivojlanishi mexanizmi bilan va qandli diabet kechishiga o'z ta'sirini o'tkazishi bilan katta ahamiyatga ega. Tadqiqod maqsadi 1 tur qandli diabet bilan kasallangan COVID-19 infeksiyasi o'tkazgan lalarda dislipidemiyaning yurak qon tomir tizimi asoratiga ta'sirini o'rganish. Shunday qilib, maqola mualliflari tomonidan 1 tur qandli diabet bilan kasallangan COVID-19 infeksiyasi o'tkazgan bolalarda ateroskleroz rivojlanishi omillari aniqlandi: insulin rezistentlik, dislipidemiya, S reaktiv oqsilni ortishi, keyinchalik mikrova makro tomirlar o'zgarishiga olib kelishi va yurak qon tomir tizimida asoratlarni rivojlantiradi.

Kalit so'zlar: qandli diabet, asoratlari, lipidlar, COVID-19, yurak.

Cardiovascular complications in children with type 1 diabetes mellitus (T1DM) after COVID-19 have become the subject of close study by foreign scientists. These studies cover

a wide range of topics, including mechanisms of vascular and myocardial damage, long-term consequences, and features of the course of the disease in children with DM1. This review summarizes the most significant studies of foreign authors. Multisystem inflammatory syndrome in children (MIS-C) American researchers pay great attention to multisystem inflammatory syndrome (MIS-C), which is observed in children after COVID-19 [1,3,4]. Whittaker et al. (2020) conducted a study of 58 children with MIS-C and found that about 70% of patients had cardiovascular disorders. This included myocarditis, dilated coronary arteries, and decreased left ventricular ejection fraction. Myocarditis was accompanied by an increase in troponin and BNP (natriuretic peptide) levels, which indicated significant myocardial damage [2,11]. Clerkin et al. (2020) studied the effect of COVID-19 on the coagulation system in children with chronic diseases, including T1DM. The study showed that the risk of thrombosis in children with diabetes was 20-30% higher than in children without diabetes. This is due to increased D-dimer levels and platelet activation. In patients with DM1, hypercoagulability increased due to chronic hyperglycemia, which created an additional burden on the vascular system [5,6,7].

Rubino et al. (2020) showed that COVID-19 disrupts glycemic control in children with SD1. 25% of patients developed diabetic ketoacidosis, which further increased the risk of cardiovascular complications. Proinflammatory cytokines, such as interleukin-6, played a key role in aggravating metabolic and vascular complications [8,9,10].

Table 1

Blood lipid spectrum

Indicators	Main group # 1 (n=28)	Main group #2 (n=74)	Comparison group (n=152)	Control group (n=30)
Total cholesterol (mmol/ l)	4.2± 0.21	4.3± 0.21	4.2± 0.18*	3.9± 0.16*
Trihecyrides (mmol/ l)	1.4± 0.15	1.1± 0.3*	1.4± 0.2*	1.3±0.14*
HDL cholesterol (mmol/ l)	1.2± 0.05	1.1 ± 0.05*	1.2±0.04*	1.3 ± 0.1*
LDL cholesterol (mmol/ l)	7.4±0.15	2.4± 0.15*	2.4±0.15*	2.2± 0.12*
VLDL cholesterol (mmol/ l)	0.7±0.08	0.4±0.04*	0.6±0.06*	0.5±0.06*
Dyslipidemia (yes/no)	70% / 30%	62.5%/37.5%	47.4%/52.6%	21%/79%

Note*-significance of differences in parameters in patients with DM. p<0.001

Purpose of the study. To study the prevalence of dyslipidemia in the development of cardiovascular complications in children with type 1 diabetes mellitus after COVID-19 infection.

Materials and methods of research. We conducted a study of 254 children with type 1 diabetes who had a COVID-19 infection who received treatment in the children's department of the Republican Specialized Scientific and Practical Medical Center of Endocrinology named after Academician E. H. Turakulov and the comparison group consisted of 30 practically healthy children of the same age and gender.

Research results and their discussion. Cardiovascular diseases (CVD) remain the leading cause of death in people with diabetes. Dyslipidemia is an important modifiable risk factor for cardiovascular disease, often present in children with diabetes.

The table presents a comparative analysis of the blood lipid profile in children with type 1 diabetes mellitus after COVID-19 infection. Total cholesterol: The main group #1 significantly differs from the control group ($p < 0.001$), which indicates an increase in the level of total cholesterol in children with cardiovascular complications. Comparison with the comparison group showed no significant differences ($p < 0.001$). At the same time, the main group No. 2 also showed significant differences with the control group ($p < 0.001$) and the comparison group ($p < 0.001$), which highlights the effect of COVID-19 on the lipid profile in children with DKAN. Triglycerides: triglyceride levels in the main group №1 and №2 were significantly higher than in the control group ($p < 0.001$). This indicates severe dyslipidemia in children with diabetes, especially in the presence of complications caused by COVID-19. High-density lipoproteins (HDL-C): Although HDL-C values are similar between the groups, significant differences were found between the main group №2 and the control group ($p < 0.001$), which may be associated with a deterioration in the anti-atherogenic function of lipoproteins after COVID-19. Low-density lipoproteins (LDL-C): The main group No. 1 showed significant differences from the control group ($p < 0.001$), which confirms a high risk of atherogenic changes. A similar situation is observed for the main group №2, where the differences are also significant ($p < 0.001$). Very low-density lipoproteins (VLDL-C): The main group No. 1 significantly differs from the control group ($p < 0.001$), indicating severe hypertriglyceridemia. For the main group №2, the differences with the control group were also significant ($p < 0.001$). The level of lipids is also significant in assessing the quality of metabolic compensation for diabetes, and is a risk factor for the development of vascular complications. Main group No. 1 (children with cardiovascular complications) and main group No. 2 (children with diabetic neuropathy) show pronounced lipid metabolism disorders compared to the control group. Significant differences between the main group No. 2 and the other groups confirm the severe effect of COVID-19 on the lipid spectrum in children with DKAN. Lipid metabolism disorders were registered in all groups of children with diabetes mellitus. 70% of the examined children from group 1 had dyslipidemia in 62.5% of the children in group 2, 47.4 % in the children of the comparison group. сравнения dyslipidemia was detected.

Negative dynamics of atherogenic blood lipids was noted with an increase in the length of the disease; dyslipidemia in the initial years of T1DM is unstable and is more often detected against the background of ketoacidosis in the onset of the disease. The most unfavorable lipidogram parameters (mainly due to an increase in atherogenic lipid fractions - cholesterol, TG, LDL) were registered in adolescents over 12 years of age (regardless of the duration of diabetes) in comparison with children of younger age groups. Higher levels of atherogenic lipids were detected in overweight DM1 patients after 5 years of disease experience.

The presented diagram shows the results of an analysis of the frequency of lipid spectrum disorders in children who have had COVID-19 infection, depending on the presence of

concomitant pathologies. Among children of the main group No. 1, dyslipidemia was detected in 70%. In the main group No. 2, the incidence of lipid profile disorders was 62.5%, which is statistically significantly lower ($p < 0.01$) than in the main group No. 1. In the comparison group, lipid metabolism disorders were recorded in 47.4% of children. Among the children of the control group, lipid spectrum disorders were detected in 21% of cases. The incidence of lipid metabolism disorders increases in the presence of type 1 diabetes mellitus and associated complications. The greatest prevalence of dyslipidemia is observed among children with a combination of diabetes and cardiovascular disorders, including autonomic neuropathy. In contrast, the risk of developing dyslipidemia was minimal in the control group, which included practically healthy children. These data highlight the importance of comorbid pathology in the formation of lipid profile disorders in children who have had COVID-19.

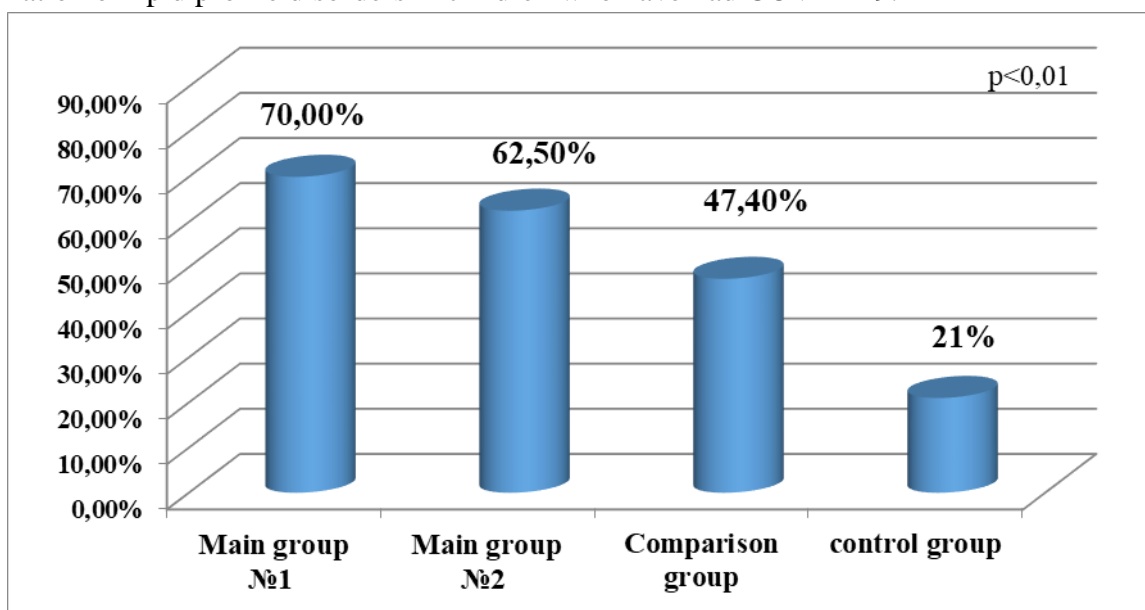


Figure 1. Frequency of dyslipidemia in the study groups with a previous COVID-19 infection

The type of dyslipidemia most commonly associated with diabetes is high triglycerides (TG) and low high-density lipoprotein cholesterol (HDL), although plasma concentrations of low-density lipoprotein cholesterol (LDL) are often elevated. In the children of the main group, an increase in LDL cholesterol was found, which was 7.4 mmol/l, as well as a decrease in LDL cholesterol of 1.2 mmol/l compared to the control group. Therefore, the atherogenic effect occurs with a slow-moving inflammation of the vascular walls with an increase in glycated hemoglobin.

Conclusion. Thus, the study revealed that in type 1 diabetes, the identified risk factors for atherosclerosis: insulin resistance, dyslipidemia, increased content of the inflammatory marker C-reactive protein, lead to macro- and microvascular changes that further progress the development of cardiovascular complications.

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