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Characteristics of Clinical Manifestations in Children with Type 1 Diabetes Mellitus After Covid-19 Infection

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Abstract

The purpose of the study: To study the characteristics of clinical indicators in children with type 1 diabetes mellitus after COVID-19 infection. We conducted a study of 254 children with type 1 diabetes who had COVID-19 infection and were treated at the pediatric department of the Republican Specialized Scientific and Practical Medical Center of Endocrinology named after Academician E.H. Turakulov and 30 practically healthy children of the same age and gender. Children with type 1 diabetes mellitus who have experienced COVID-19 infection demonstrate a higher frequency of cardiovascular, autonomic, and neurological manifestations, along with an increased prevalence of chronic diabetic complications, particularly in older age groups. These alterations are likely associated with post-infectious inflammatory responses, endothelial dysfunction, and metabolic disturbances contributing to the progression of microvascular and neurocardiac impairments. These findings indicate that COVID-19 may act as an aggravating factor in the development and progression of chronic complications in pediatric patients with type 1 diabetes mellitus and highlight the importance of early diagnosis, regular cardiological evaluation, and comprehensive multidisciplinary follow-up in the post-COVID period.

Keywords: Type I diabetes mellitus, children, complaints, COVID-19, complication.

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1. Introduction

Cardiovascular complications in children with type 1 diabetes mellitus (T1DM) following COVID-19 have become a subject of intense study by international researchers. These studies cover a wide range of topics, including mechanisms of vascular and myocardial damage, long-term consequences, and characteristics of disease progression in children with T1DM. This review summarizes the most significant research by foreign authors. The study revealed that the risk of thrombosis in children with diabetes was 20-30% higher compared to children without diabetes. This is attributed to elevated D-dimer levels and platelet activation. In patients with T1DM, hypercoagulation was exacerbated by chronic hyperglycemia, which placed additional strain on the vascular system [2,7]. Rubino et al. (2020) showed that COVID-19 disrupts glycemic control in children with DM1. In 25% of patients, the development of diabetic ketoacidosis was noted, which further increased the risk of

cardiovascular complications. Pro-inflammatory cytokines such as interleukin-6 played a key role in the aggravation of metabolic and vascular complications [3,8]. Cherubini et al. (2021) conducted a multicenter study that included 100 children with DM1 who had COVID-19. 4-5% of children were diagnosed with myocarditis, which significantly exceeded the indicators among children without diabetes. Myocarditis was accompanied by ECG changes such as T wave inversion and a decrease in left ventricular ejection fraction. These data indicate that COVID-19 can exacerbate existing cardiovascular risks in children with diabetes [4,9]. Marcovecchio et al. (2019) investigated the progression of atherosclerosis in children with DM1. They noted an increase in the intima-media complex (CIMT) thickness in 30% of children after COVID-19. This was due to chronic inflammation and endothelial dysfunction caused by SARS-CoV-2 infection [5]. Daniels et al. (2021) reported that 25% of children with type 1 diabetes mellitus experience decreased vascular elasticity after COVID-19. The authors suggested that this is due to damage to endothelial cells caused by both hyperglycemia and the direct impact of the SARS-CoV-2 virus. Wang et al. (2021) studied the level of inflammatory markers in children with diabetes mellitus after COVID-19. In 20% of patients, elevated levels of interleukin-6 and ferritin persisted after 6 months, indicating continued systemic inflammation. This could lead to vascular disorders and accelerated development of atherosclerosis [6,10]. Patel et al. (2022) conducted a study of 300 children with type 1 diabetes, of which 30% reported tachycardia and chronic fatigue 12 months after COVID-19. These symptoms were associated with a disruption in the autonomic regulation of cardiac activity. The authors noted that such states can persist for a long time and require further observation [5]. Smith et al. (2021) studied post-COVID complications in children with DM1 in Australia. In 15% of patients, sinus tachycardia persisted after 9 months. D-dimer and C-reactive protein levels remained elevated, indicating continued inflammation. This confirms that COVID-19 has a prolonged impact on the cardiovascular system in children with diabetes [3].

Purpose of the study. To study the clinical and diagnostic features of cardiovascular disorders in children with type 1 diabetes mellitus after Covid-19 infection and to develop recommendations for prevention and treatment.

2. Methods

We conducted a study of 254 children with type 1 diabetes mellitus who had COVID-19 infection and received treatment in the children's department of the Republican Specialized Scientific and Practical Medical Center of Endocrinology named after Academician Yo.Kh. Turakulov and 30 practically healthy children of the same age and sex.

3. Results

The pathogenesis of specific complications of diabetes mellitus is complex: disorders of microcirculation, blood coagulation and fibrinolytic systems, antioxidant defense systems, protein component metabolism of the vascular wall and vascular permeability, manifested by signs of cardiovascular disorders in the form of tachycardia, increased blood pressure, which were significantly more frequently detected in the main study group. These diagrams show that children who have had COVID-19 often complain of weakness, headaches, rapid heartbeat, shortness of breath, and abdominal discomfort. These results emphasize the impact of infection on the condition of children with type 1 diabetes mellitus, likely due to increased inflammatory processes and dysfunction of various body systems.

At the next stage, we analyzed the frequency of chronic complications of type 1 diabetes mellitus in children.

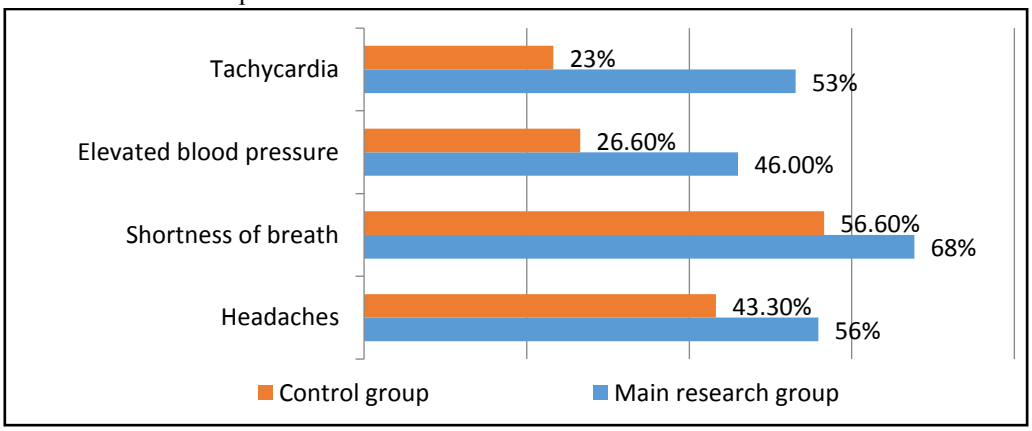

Figure 1. Complaints of children with DM1 in the study groups

Analysis of the clinical symptoms in children with type 1 diabetes mellitus after COVID-19 infection showed a significant increase in the frequency of some complaints compared to the control group. Thus, tachycardia was observed in 53% of patients in the main group versus 23% in the control group ($p<0.05$). Blood pressure elevation was noted in 46% of children who had COVID-19, while in the control group, this symptom was registered in 26.6%. Shortness of breath, as one of the possible signs of cardiopulmonary involvement, was recorded in 68% of the main group and 56.6% of the control group. Headaches were also more common - 56% versus 43.3%, respectively.

The obtained data indicate an increase in the frequency of vegetative and cardiorespiratory symptoms in children with DM1 after COVID-19, which requires more detailed cardiological and neurological examination within the framework of the post-COVID syndrome.

Table 1.

Frequency of chronic complications of DM1 depending on the age of children abs. (%)

Chronic complications	Children's age groups		Total
	7-13 years old (N=84)	13-18 years old (N=170)	(N=254)
Polyneuropathy	31 (36,9%)	152 (89,4%)	183 (72%)
Encephalopathy	22 (26,1%)	69 (40,5%)	91 (35,8%)
Retinopathy	18 (21,4%)	83 (48,8%)	101 (29%)
Nephropathy	16 (19%)	35 (20,5%)	51 (20%)
Hayropathy	6 (7,4%)	14(8,2%)	20 (7,8%)

In children aged 7-13 years, polyneuropathy occurred in 36.9%, encephalopathy in 26.1%, retinopathy in 21.4%, nephropathy in 16%, and chiropathy in 7.4% of children. With an increase in the duration of DM, the prevalence of its chronic complications increased significantly, and the incidence of prolineuropathy in the 130-18 age group increased 2.4 times and amounted to 89.4%, encephalopathy increased 1.5 times and was noted in 40.5%, retinopathy in children aged 13-18 increased 2.2 times and amounted to 48.8%, the diagnosis of nephropathy and retinopathy practically did not change compared to the 7-13 age group of children and amounted to 20.5 and 8.2%, respectively.

4. Conclusion

Children with type 1 diabetes mellitus who have experienced COVID-19 infection demonstrate a higher frequency of cardiovascular, autonomic, and neurological manifestations, along with an increased prevalence of chronic diabetic complications, particularly in older age groups. These alterations are likely associated with post-infectious inflammatory responses, endothelial dysfunction, and metabolic disturbances contributing to the progression of microvascular and neurocardiac impairments. These findings indicate that COVID-19 may act as an aggravating factor in the development and progression of chronic complications in pediatric patients with type 1 diabetes mellitus and highlight the importance of early diagnosis, regular cardiological evaluation, and comprehensive multidisciplinary follow-up in the post-COVID period.

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