The State of the Cardiovascular System in Type 2 Diabetes Patients Who Have Undergone COVID-19

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ABSTRACT

The COVID-19 pandemic caused by the novel coronavirus SARS-CoV-2 has had a significant impact on global health, affecting millions of individuals worldwide. Emerging evidence suggests a potential link between COVID-19 and various cardiovascular complications, as well as an exacerbation of existing comorbidities such as type 2 diabetes mellitus (T2DM). Type 2 diabetes (T2D) patients are known to be at an increased risk of developing severe complications from COVID-19. Among these complications, cardiovascular involvement has been widely reported. This research article aims to explore the state of the cardiovascular system and clinical features of T2DM following COVID-19, highlighting the potential mechanisms, implications, and management strategies.

Introduction

The SARS-CoV-2 virus is a single-stranded RNA virus that belongs to the family of coronaviruses. The virus has a spherical shape and is covered with spike proteins on its surface. These spike proteins are responsible for binding to the ACE2 receptors on human cells, which allows the virus to enter and infect the cells. ACE2 receptors are found in various organs in the body, including the lungs, heart, kidneys, and intestines. The virus uses its spike proteins to bind to the ACE2 receptors and gain entry into the cells. Once inside the human cells, the virus uses its RNA to hijack the cell's machinery and replicate itself. This leads to the destruction of the infected cells and triggers an immune response in the body. The binding of the virus to the ACE2 receptors can also lead to a decrease in the number of available ACE2 receptors in the body. ACE2 receptors play a crucial role in regulating blood pressure and maintaining cardiovascular health. A decrease in the number of available ACE2 receptors can lead to an increase in blood pressure and cardiovascular complications. The pathophysiological characteristics of COVID-19 include respiratory distress, acute respiratory distress syndrome (ARDS), and cytokine storm. ARDS occurs when the lungs become inflamed and filled with fluid, making it difficult for oxygen to reach the bloodstream. Cytokine storm is an overreaction of the immune system, where the body releases too many cytokines that can cause damage to organs and tissues.

Type 2 diabetes mellitus is a chronic metabolic disorder characterized by insulin resistance and impaired glucose regulation. The prevalence of T2DM has been increasing

globally, and it is often associated with various cardiovascular complications, including coronary artery disease, hypertension, and stroke. The emergence of COVID-19 has raised concerns about its impact on individuals with pre-existing T2DM, as well as the potential development of new-onset diabetes following infection.Type 2 diabetes and COVID-19 have emerged as two major global health challenges. Evidence suggests that T2D patients are more susceptible to severe illness and have a higher mortality rate when infected with COVID-19. This increased vulnerability is primarily attributed to the pre-existing cardiovascular comorbidities commonly seen in T2D patients. The interplay between T2D and COVID-19 can lead to a synergistic effect on the cardiovascular system. Chronic systemic inflammation, immune dysregulation, endothelial dysfunction, hypercoagulability, and dysregulated renin-angiotensin-aldosterone system (RAAS) are some of the mechanisms contributing to this increased cardiovascular risk. Additionally, direct viral invasion of myocardial cells and systemic cytokine storm can further exacerbate cardiac dysfunction. Studies have reported that COVID-19 can induce new-onset diabetes or worsen glycemic control in individuals with pre-existing T2DM. The underlying mechanisms may include the direct effects of viral infection on pancreatic beta cells, increased insulin resistance due to systemic inflammation, and the use of certain medications in the treatment of COVID-19. Poor glycemic control in individuals with T2DM has been associated with worse outcomes, including increased mortality rates and a higher risk of complications

Materials and Methods.

This study includes 50 randomly selected patients with type 2 diabetes mellitus admitted to Tashkent Medical Academies 3rd Clinic. 25 patients who have undergone laboratoty confirmed Covid-19 infection an average of 1 month prior to the study were randomly selected into the study group. Another 25 patients with type 2 diabetes who did not undergo Covid-19 infection were

randomly selected for the study as a control group.The following tests were performed: fasting and postprandial glucose, glycated hemoglobin, coagulogram, lipid spectrum. The instrumental examinations included ECG, echocardiography, and blood pressure assessments. Blood glucose levels were measured using biochemical analysis (SPINREACT, S.A.U. kits). HbA1c was assessed using biochemistry methods (FILTERSAMPLER kits). Lipid levels (total cholesterol, triglycerides, LDL, HDL) were determined using biochemical analysis (SPINREACT, S.A.U. kits). The results were presented as a percentage or as the mean error (M±m). Statistical analysis was carried out using STATISTICA software for Windows (version 9.0). Correlation analysis was performed to evaluate the relationship between the parameters studied, and the Pearson correlation coefficient was calculated. $p<0.01$ and $p<0,001$ were considered statistically significant.In order to investigate influence of Coronavirus infection on the course of diabetes mellitus and the state of cardiovascular system, we collated main clinical characteristics of both group patients

Results.

Overall 50 patients (23 men;27 women, medium age 53.6±6.9) were analyzed. The glucose metabolism indicators in diabetics who have been infected with Covid-19 were found to be much worse compared to those who have not had Covid-19. Both fasting and postprandial glucose levels were higher in research group (FPG-median 13.6 vs 8.5 mmol/L and PPG-median 19,3 vs 12,8 mmol/L $p<0.001$). Research group patients had elevated glycated hemoglobin levels than control group(12,5% vs 8,5%)
To assess the impact of Covid-19 infection on the cardiovascular system, arterial hypertension, lipid spectrum, and coagulogram indicators were compared. 30% patients suffered from hypertensive crisis when they were ill with Covid-19infection, and even during the research, blood pressure indicators were found to be worse compared to those who did not have Covid-19. There was a

remarkable difference in blood pressure levels in Covid-19 undergone diabetics compared to non-infected ones(systolic arterial pressure 162.6 vs 145.7 mmHg p<0.05). Research group showed elevated prevalence of Ischemic heart disease (87.5% vs 58.7%).

80% of patients who had Covid-19 developed pneumonia and were treated with pulse therapy using glucocorticoids (60%). As a result of pulse therapy, it was noted that the patients' fasting and postprandial glucose levels increased to over 25 mmol/L. Considerably high glucose fluctuations and exposure to hyperglycaemia were experienced by research group patients during Covid-19 infection.

When the results of the lipid spectrum analysis were studied, statistically reliable results were obtained for the amount of HDL (0.65 mmol/L vs 0,9 mmol/L; p<0.01). Other components of lipid spectrum showed high levels in both group patients. .

	Research group (n=25)	Control group (n=25)
Age		
Duration of diabetes	8,6±4,5	8,2±3,2
Fasting plasma glucose	13,6 mmol/L	8,5 mmol/L
Two-hour Postprandial glucose	19,3 mmol/L	12,8 mmol/L
Glycated hemoglobin HbA1c%	12,3%	8,5%
Total cholesterol	6,7 mmol/L	6,2 mmol/L
HDL	0,65 mmol/L	0,91 mmol/L
TG	3,5 mmol/L	3,6 mmol/L
LDL	5,8 mmol/L	5,63 mmol/L
Systolic blood pressure	162,6 mmHg	145,7 mmHg
Diastolic blood pressure	105,5 mmHg	90,7 mmHg
Ischemia in ECG	87,5%	58,7%

Conclusions.

COVID-19 has a significant impact on the cardiovascular system and clinical features of individuals with T2DM. Coronavirus infection worsens both glycemic control and the state of cardiovascular system in diabetic patients. The interplay between COVID-19, T2DM, and cardiovascular complications underscores the need for comprehensive management strategies and further research to improve outcomes in this vulnerable population. By understanding the mechanisms and implications, healthcare providers can optimize care for individuals with T2DM following COVID-19, reducing the burden of cardiovascular complications and improving overall health outcomes.

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