Pro Index | Journal of Science in Medicine and Life

Volume: 2 Issue: 5 Year: 2024

http://journals.proindex.uz

Course of Type 2 Diabetes Mellitus with Covid-19

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Abstarct: Diabetes mellitus is one of the major health problems of the 21st century. Around the world, about 382 million people suffer from diabetes, and this figure is only growing every year, which leads to early disability of the population. Purpose of the study: To identify the features of the course of diabetes mellitus against the background of coronavirus infection based on literature data. Materials and methods: A comparative analysis and synthesis of information on the course of type 2 diabetes mellitus in COVID-19 was carried out on the basis of literature data: a review of articles, highlighting key scientific studies and reviews. The selection of literature was carried out in the databases: eLIBRARY, CyberLeninka, PubMed. Results and discussion: The severe course and high incidence of deaths in patients with diabetes is explained by the peculiarities of the interaction of the virus and its receptor under conditions of hyperglycemia. The cytotoxic effect of the virus on pancreatic islet cells leads to the development of insulin deficiency. Conclusion: Mortality from COVID-19 in patients with type 2 diabetes mellitus is more than twice as high. There is a decrease in O2 saturation with an increase in blood glucose levels. A number of studies have shown that glycemic levels ranging from 3.9 to 10.0 mmol/l are associated with significantly lower mortality than those with glycemic levels exceeding 10 mmol/l. During the X-ray examination of patients with diabetes, bilateral pneumonia predominated.

Key points: diabetes mellitus, COVID-19, hyperglycemia, insulin resistance.

Introduction

Diabetes mellitus is one of the major health problems of the 21st century. The prevalence of diabetes mellitus is increasing in all countries and has now reached epidemic proportions, affecting approximately 382 million people worldwide. This is due to an increase in the number of people who are overweight and obese, including pregnant women. A large proportion of people suffering from type 2 diabetes occur in the elderly population. According to the World Health Organization, diabetes will become the seventh leading cause of death by 2030 [1].

Diabetes mellitus is an endocrine disease characterized by chronic hyperglycemia, which develops as a result of absolute or relative insulin deficiency [2]. Diabetes mellitus develops as a result of insulin resistance (decreased sensitivity of muscle cells, liver, and adipose tissue to insulin), impaired function of pancreatic β-cells, and increased glucose production by the liver.

Hyperglycemia in diabetes leads to disruption of all metabolic processes, leading to dysfunction of various organ systems. Hyperglycemia triggers processes of biochemical transformations leading to damage to the vascular wall. First of all, this is due to the high risk of developing cardiovascular complications, as well as early disability of patients and high mortality. Every year, about 6.7 million people aged 40-70 years die due to the development of chronic complications of diabetes [3].

Socially significant diseases, including diabetes mellitus, have been identified by WHO as leading diseases that increase the likelihood of infection with COVID-19 [4]. Diabetes mellitus has been found to increase the severity of COVID-19 [5].

Target: To identify the features of the course of type 2 diabetes mellitus against the background of coronavirus infection based on literature data.

Materials and methods

A selection of scientific publications was carried out for the period from 2020 to 2023. A search was carried out in scientific electronic libraries: CyberLeninka, PubMed, and eLIBRARY. Comparative analysis and synthesis of information obtained from selected sources were used as research methods. Synthesis was used to summarize the data obtained. Through analysis of the data obtained, the main changes that were observed in patients suffering from type 2 diabetes during Covid-19 were formulated.

After collecting the main material, scientific studies were studied on the characteristics of the course of coronavirus infection against the background of type 2 diabetes mellitus. Various studies have been conducted on this problem, which has made it possible to obtain a more complete understanding of the course of type 2 diabetes mellitus against the background of Covid-19. The information received was structured in the form of linked text.

Results and discussions

At the end of 2019, humanity was faced with an outbreak of a new coronavirus infection in the People's Republic of China. The causative agent of the infection was given the official name SARS-CoV-2, and already in March 2020, WHO declared a pandemic of COVID-19 in the world [4]. Patients with diabetes mellitus (DM) turned out to be the most vulnerable during the pandemic due to the characteristics of their immune status and immune response to a viral attack, due to excessively high activity of the virus in conditions of hyperglycemia, as well as comorbidity and obesity, which often accompany the course of DM [6]. Statistics collected over several years of the pandemic show that diabetes mellitus complicates the course of coronavirus infection. Mortality from COVID-19 in type 2 diabetes is more than twice as high as in its absence [5]. A number of studies have shown that daily fluctuations in this indicator ranging from 3.9 to 10.0 mmol/l are associated with significantly lower mortality than with a glycemic level exceeding 10 mmol/l. Studies also recorded a 2-fold higher mortality rate for patients with an HbA1c level >9% [8].

The severe course and high incidence of deaths in patients with diabetes is explained by the peculiarities of the interaction of the virus and its receptor under conditions of hyperglycemia. The SARS COV-2 virus is tropic for the angiotensin-converting enzyme type 2 (ACE2) receptor. By interacting with it, the virus invades human target cells (primarily the alveolar cells of the lungs). The expression of this enzyme is quite high in the oral mucosa, nasopharynx and lung tissue. Accordingly, the “entry gate” for the virus is the upper respiratory tract, after which the virus penetrates the alveoli, which leads to respiratory failure and severe pneumonia. Also, a high content of ACE2 is found in enterocyte cells of the colon, myocardial cells, proximal renal tubules, liver, pancreas, which leads to extrapulmonary manifestations, such as diarrhea, loss of smell, and first-time transient hyperglycemia. In patients with diabetes, the release of cytokines in response to viral infection occurs much more intensely than during normal carbohydrate metabolism [4, 6, 10].

Insulin resistance reduces T cell activity, weakening the immune response. Weakening of the immune defense in diabetes leads to a decrease in the recruitment of neutrophils to the site of inflammation, impaired production of interferon gamma, impaired antigen presentation, and dysregulation of humoral immunity [9].

Also, patients with hyperglycemia have an increased susceptibility to a cytokine storm during COVID-19, which was manifested by high levels of IL-6, IL-1β, and tumor necrosis factor-α [5]. Consequently, with unsatisfactory glycemic control, patients with diabetes are susceptible to higher activity of the “cytokine storm” and the risk of unfavorable outcome of viral infection [6].

High levels of hyperglycemia in patients with SARS-CoV-2 infection lead to a decrease in O2 saturation, which leads to respiratory failure and contributes to severe pneumonia. Studies have revealed an inverse relationship between the level of blood oxygen saturation and hyperglycemia. The higher the hyperglycemia, the lower the level of O2 saturation [5].

In addition to hyperglycemia in people with diabetes, namely 80% of patients, obesity is observed, this has a negative effect on the functioning of the lungs, which accordingly leads to a decrease in forced expiratory volume and forced vital capacity in general [14].

Also, more often in patients with diabetes mellitus, a larger volume fraction of the lungs is involved in the pathological process. When analyzing the localization of the pathological process in the lungs, during an X-ray examination of patients, it was found that among patients with diabetes, bilateral pneumonia (87.3%) prevailed over unilateral pneumonia (12.7%) [9].

The cytotoxic effect of the virus on pancreatic islet cells leads to the development of insulin deficiency [10]. This has been explained based on SARS-CoV-2-mediated damage to pancreatic β-cells, since ACE 2, which plays a potent anti-inflammatory and antioxidant role, is also expressed on pancreatic islets [5]. It follows from this that a decrease in ACE2 on the surface of β cells leads to a decrease in their functional activity and insufficient insulin production [10]. Impaired insulin secretion as well as increased insulin resistance also contributed to the high mortality rate.

Prolonged increases in blood glucose levels in diabetes mellitus lead to excessive glycosylation of proteins, which contributes to the loss of BBB integrity [7]. It is also known that the SARS-CoV-2 virus uses ACE-2 receptors to enter cells, which is also found in brain tissue, leading to cerebrovascular diseases [11].

It is known that in T2DM an imbalance is formed in the hemostatic system [15].

Some researchers studied the effect of diabetes on the progression and prognosis of COVID patients-19. In a limited sample, serum levels of inflammation-related biomarkers such as IL-6, C-reactive protein, serum ferritin and coagulation index, and D-dimers were significantly higher in patients with diabetes compared to those without diabetes [12]. Elevated levels of D-dimer and fibrinogen indicate that patients with diabetes are more vulnerable to increased hypercoagulability and intravascular coagulation [13]. Which contributes to an increased risk of life-threatening complications with COVID-19.

Conclusion

Based on the literature data, we can draw a conclusion about the unfavorable course of type 2 diabetes against the background of coronavirus infection. A number of studies have shown that daily fluctuations in glucose up to 10.0 mmol/l are associated with significantly less mortality than with glycemic levels exceeding 10 mmol/l. There is a decrease in O2 saturation with an increase in blood glucose levels. Patients with type 2 diabetes had higher rates of: IL-6, CRP, serum ferritin, and D-dimer compared to patients without diabetes. Thus, patients suffering from type 2 diabetes during COVID-19 experienced biochemical changes in the blood, which require increased glycemic control.

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