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COVID-19 and diabetes mellitus: Clinical and laboratory features in hospitalized patients

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Abstract

Introduction: In December 2019, China first encountered an unknown SARS-CoV-2 virus, after which a global lockdown began, first in European countries, and after a while the virus spread around the world. The course of COVID-19 aggravates the presence of concomitant diseases in the patient, among which diabetes mellitus occupies one of the first places. It should also be noted that the two-way interaction between COVID-19 and diabetes mellitus creates a vicious circle in which COVID-19 leads to worsening of dysglycemia, and diabetes mellitus, in turn, exacerbates the severity of COVID-19.

In this article, we evaluated the relationship between diabetes mellitus and the prognosis of COVID-19 in patients of the Shymkent Infectious Diseases Hospital.

Aim: Assessment of the relationship of type 2 diabetes mellitus (DM2) with the course and outcomes of COVID-19, depending on clinical and laboratory parameters and concomitant diseases in an infectious hospital in Shymkent.

Material and methods: Electronic medical records of groups of COVID-19 patients with diabetes mellitus (DM) (n=49) and without diabetes mellitus (n=151) were analyzed: demographic, clinical, laboratory and instrumental research methods; treatment regimens, complications and outcomes.

Results: Compared with patients without diabetes mellitus, patients with diabetes mellitus had a significantly higher incidence of bilateral pneumonia (95.92%). According to complications and clinical outcomes, the incidence of respiratory failure (42% vs. 24%, P=0.022), acute heart failure (51% vs. 18%, P<01) and death (24% vs. 8.0%, P=0.01) in the diabetes group was significantly higher than in the group without diabetes mellitus. In addition, patients with diabetes mellitus had higher levels of neutrophils (P=012), C-reactive protein (P=008), procalcitonin (P<01) and D-dimer (P=032) and lower levels of lymphocytes (P=0.032) and albumin (P=034).

Conclusion: Diabetes is a significant risk factor for an unfavorable prognosis of COVID-19. In order to avoid adverse outcomes, more attention should be paid to timely prevention and treatment of patients with diabetes, especially those who need insulin therapy.

Key words: COVID-19, diabetes mellitus, prognosis, retrospective, comorbidity

Introduction

Coronavirus infection 2019 (COVID-19) is a disease that causes an RNA-containing coronavirus, which is a recombinant between an unknown coronavirus and a bat coronavirus [1]. COVID-19 is a highly contagious disease, and the outcomes directly depend on the presence or absence of concomitant diseases [2]. According to the results of the data of most published studies, one of the most common SDS is type 2 diabetes mellitus (DM2), which aggravates the course and worsens the prognosis of COVID-19 [3]. According to epidemiological studies, diabetes increases the risk of hospitalization in hospital, hospitalization in intensive care and mortality due to COVID-19 [4]. Of all deaths in hospitals, 7.8% - 33% were patients with diabetes mellitus [5]. In one multicenter study, it was reported that in patients with diabetes, the risk of death was 1.49 times higher [6]. According to the results of other studies, it was noted that in patients with diabetes mellitus, the risk of hospitalization in the intensive care unit and the need for a ventilator doubled

[7]. Another meta-analysis reports a two- to three-fold increase in the risk of severe forms of COVID-19 [8]. Therefore, attempts should be made to assess the potential role of diabetes mellitus at the systemic level.

Material and methods

In this retrospective study, we analyzed the data of 200 patients hospitalized in the infectious diseases hospital of the city of Shymkent, in the period from January 2021 to October 2021 with a diagnosis of COVID-19, including 49 cases with diabetes mellitus, and 151 without diabetes mellitus.

Data collection

Patient data, including demographic, clinical, laboratory, instrumental methods, treatment methods, complications and outcomes were taken from electronic medical records of patients.

Criteria for inclusion in the study: the SARS-CoV-2 virus has been verified, diabetes and age over 18 years.

Exclusion criteria: absence of coronavirus infection in the patient, age under 18, pregnancy.

Statistical analyses

All statistical analyses were carried out using the SPSS program (version 21.0, SPSS, Chicago, Illinois, USA). Quantitative continuous variables with asymmetric distribution were summed as median and interquartile range, continuous variables with normal distribution were summed as mean and standard deviation, and percentages were used to express qualitative characteristics (%).

Results

In total, 200 patients with COVID-19 were included in this retrospective study. The average age was 61 years, of which 108 patients (54%) were women. The most common symptoms of the disease were fever (87%), followed by cough (66%), anorexia (37%), fatigue (38%) and shortness of breath (42.5%). Almost half of the patients had one or more comorbid pathologies, such as arterial hypertension (63%), sugar diabetes (24.5%), cardiovascular diseases (57%), chronic respiratory diseases (8.4%), chronic liver diseases (6%), and chronic kidney diseases (1,4%). 69 (34,5%) the patients were in critical condition.

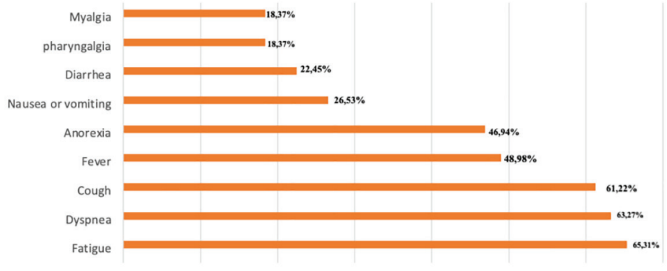

Figure 1 - Symptoms in patients with diabetes mellitus

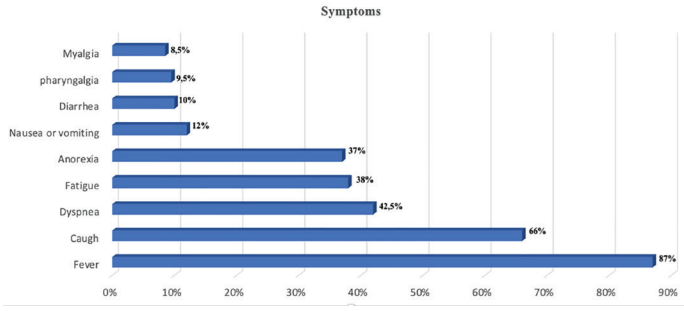

Figure 2 - Symptoms in patients without diabetes mellitus

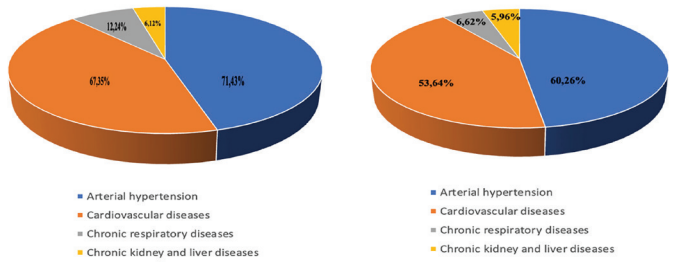

Figure 3 - Concomitant diseases in patients

Most of the available evidence suggests a significant increase in severity and mortality from COVID-19 in people with type 2 diabetes mellitus, especially when combined with poor glycemic control [9]. In recent years, both in Kazakhstan and abroad, there has been a sharp increase in the incidence of diabetes mellitus, especially in industrialized countries, where its prevalence is 5-6% and tends to increase further, primarily in age groups older than 40 years [10]. Many studies have shown that aging is one of the important risk factors affecting the prognosis of COVID-19 [11]. Thus, a large number of elderly patients in the group of diabetes mellitus may indicate a poor clinical outcome. In this study, arterial hypertension was more often detected in patients with diabetes mellitus (71%) (Figure 3). And also, according to the severity of the condition, patients with diabetes mellitus had a severe infection (73%).

Recent data have shown that COVID-19 patients with diabetes had lower lymphocyte counts and higher neutrophil counts compared with COVID-19 patients without diabetes [12]. Upon admission, many patients had a tendency to lymphopenia (1.04) (Table 1), elevated levels of infection-related biomarkers (C-reactive protein (34.5) and procalcitonin (0.8)) and relatively high levels of neutrophils (7.92), alanine aminotransferase (46), total bilirubin (9.7), albumin (36.0), blood urea nitrogen (6), serum creatinine (70), cardiac troponin (0.012) and D-dimer (0.41) (Table 2). Patients with COVID-19 are more likely to have lymphopenia, but thrombocytopenia and leukopenia are relatively rare. In patients with diabetes mellitus, especially with severe conditions, the levels of serum biomarkers of inflammation, such as interleukin-6, C-reactive protein and procalcitonin, are significantly increased, and these indicators are predictors of an unfavorable prognosis of COVID-19 (Table 1) The D-dimer is a product of fibrin degradation and is one of the main markers coagulation activity [13]. High concentration of serum D-dimer is closely associated with various thrombotic diseases, including myocardial infarction, cerebral infarction, pulmonary embolism and venous thrombosis [13]. In our study, we found that the concentration of serum D-dimer in patients with diabetes was significantly higher than in patients without diabetes mellitus, indicating that patients with COVID-19 with diabetes are more likely to develop a hypercoagulated prothrombotic condition.

It is safe to say that there is still no evidence that antiviral treatment can significantly improve the condition of patients with COVID-19 [14]. Most patients received only such types of treatment as oxygen therapy, infusion therapy and respiratory support. Some patients received antibiotics, corticosteroids. Critically the patients needed observation and artificial lung ventilation in the intensive care unit. In our study, diabetic patients were more likely to receive hormone therapy and artificial lung ventilation than patients without diabetes, which indicates that diabetic patients have more severe complications and require more complex therapy.

Table 1 The main demographic indicators of patients

Gender / Age	Overall (n=200)	Patients with diabetes mellitus (n=49)	Patients without diabetes mellitus (n=151)
Female	108/200 (54%)	29/49 (59,18%)	79/108 (73,15%)
Male	92/200 (46%)	20/49 (40,82%)	72/92 (78,26%)

Table 2 Blood test

Blood cells	Normal range	Overall(n=200)	Patients with diabetes mellitus (n=49)	Patients without diabetes mellitus (n=151)
Leukocytes, x 109/l	3,5-9,5	5	6,85	5,35
Neutrophils, x 109/l	1,8-6,3	3	7.92	2
Lymphocytes x 109/l	1,1-3,2	1,5	1,04	4,8
Platelets x 109/l	125-350	196	190	193
Hemoglobin x 109/l	130-175	127	126	127 (116, 137)
Alanine aminotransferase, IU/l	9-50	26 (13, 35)	46 (16, 50.5)	22 (13, 35)
Aspartate Aminotransferase, IU/l	15-40	27 (18, 38)	26 (21, 38,5)	25 (18, 38)
Total bilirubin, mmol/l	2-23	8 (5.7, 11)	9.7 (7.4, 13.05)	7.5(5.5, 10.7)
Albumin, g/l	40-55	37 (33.3, 41.5)	36,0 (30.9, 41.5)	37.)(33.7, 41.5)
Blood urea nitrogen, mmol/l	3,6-9,5	4.38 (3.43, 5.79)	6 (3.68, 6.59)	4.3 (3.41, 5.61)
Serum creatinine, mmol/l	57-111	64(53. 74)	70 (55, 79.5)	63 (52.7, 73)
Cardiac troponin, ng/ml	0-0,014	0,008 (0.006, 0.014)	0.012 (0.008, 0.028)	0.008 (0.005. 0.013)

Biomarkers associated with infection. Blood clotting function	Normal range	Overall(n=200).	Patients with diabetes mellitus (n=49)	Patients without diabetes mellitus (n=49)
C-reactive protein, mg/l	0-3	18 (2.3, 57.4)	34,5 (6.1, 84.3)	16 (2.0, 51.7)
Procalcitonin, ng/ml	0-0,1	0.05 (0.03, 0.013)	0.8 (0.04, 00.23)	0.05 (0.03, 0.11)
prothrombin time, s	9,3-12,9	12.3 (85, 13.62)	12,98 (11.6, 13.62)	12.3(11.5, 13.2)
D-dimer, µg/l	0,-0,243	0.21 (0.10, 0.61)	0.41 (0.13, 1,06)	0.19 (0.09, 0.52)

According to the results of this study, the main cause of death of patients with COVID-19 was the development of complications — the simultaneous development of ARDS (48.98%) and the development of sepsis (4.08%), acute renal failure with a combination (6.12%) with thrombotic complications (38.78%). The results obtained by us are generally consistent with the results of data from foreign studies, which the main causes of death of patients with COVID-19 were sepsis, ARDS, acute renal failure and cardiovascular complications [15].

Conclusion

The retrospective analysis made it possible to evaluate the factors associated with deaths in patients with COVID-19 both without DM2 and with concomitant DM2. These factors include age >60 years, hyperglycemia and hypoglycemia, the presence of concomitant disease, the development of complications. The results of this retrospective analysis are consistent with previously published data, but further studies are needed to assess outcomes depending on clinical and laboratory parameters, the presence of a comorbid background and complications of COVID-19. It should also be noted that the two-way interaction between COVID-19 and diabetes mellitus creates a vicious circle in which COVID-19 leads to worsening of dysglycemia, and diabetes mellitus, in turn, exacerbates the severity of COVID-19. Thus, it is very important that patients with diabetes mellitus take all necessary preventive measures and ensure good glycemic control in a pandemic.

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