PREDICTION OF POST-COVID COMPLICATIONS IN HUMANS WITH METABOLIC SYNDROME AND ITS COMPONENTS

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Abstract*. This article is devoted to the study of modern diagnostic methods in patients with metabolic syndrome who have had COVID-19. Post-Covid syndrome (PCS), also known as "long COVID," is a relatively new problem for healthcare professionals in terms of its expected prognosis. To date, its pathogenetic mechanisms have not been fully studied. It is a symptom complex that can affect various human organs and systems, regardless of the severity of the SARS-CoV-2 infection and in all age groups.*

Purpose of the study: To study modern diagnostic methods in patients with metabolic syndrome who have had COVID-19

Materials and methods. The subjects of the study were 53 patients in the acute period of coronavirus infection caused by COVID-19, who met the criteria for inclusion in the study. Group 1 consisted of 35 people with metabolic syndrome and 18 patients without metabolic syndrome in the acute period of COVID-19.

Results of the study:

In the 1st group of patients, in relation to the 2nd group, the data on HbA1c was 5.26±0.74, while in the 2nd group it was 8.18±5.02, which is almost 3% higher. Significantly high TG levels were observed in the group with MS (p=0.04) and low HDL (p=0.03). Also, the imbalance in lipid status in patients with MS who had a coronavirus infection was characterized by an increased content of total cholesterol and LPN.

Summary: The HOMA index showed the most predictive value in assessing the risk of complications in patients with MS who have had COVID-19.

Keywords*: COVID-19; post-Covid syndrome; metabolic disorders; hyperglycemia.*

Relevance. According to WHO, about 30% of the world's inhabitants are overweight, of which 16% are women and 14% are men, and the number of people suffering from obesity increases by 10% every 10 years [1,3]. By 2040, the number of people with diabetes aged 20–79 years is projected to increase to 642 million (uncertainty range: 521–829 million) [1,15,17]. Metabolic syndrome (MS) is a cluster of cardiovascular disorders, including abdominal obesity, high blood pressure, impaired glycemia, dyslipidemia based on insulin resistance (IR) and compensatory hyperinsulinemia [2,4]. According to WHO, the prevalence of obesity in Uzbekistan (2016-2020) increased from 16.6% to 28.0%. According to various data, on average, from 20 to 30% of the adult population in most countries suffer from MS [5,7]. However, the prevalence range of MS varies significantly depending on the geographical region, level of development of the country and diagnostic criteria. Thus, the high prevalence of MS in various regions indicates the significance of this socio-economic problem; the relevance of early diagnosis and timely treatment of the main components of MS [7,8,10,11].

The causes of the development of MS are a variety of genetic and acquired factors that play a role in the final inflammatory pathway leading to cardiovascular disease and diabetes [5,18]. Today, complications that developed after coronavirus disease 2019 (COVID-19) are a global problem [6,19,20]. Although the pathophysiological mechanisms are still not understood, it has been noted that most infected individuals have a favorable prognosis, chronic diseases commonly seen in the elderly (hypertension, diabetes mellitus, cerebral vascular diseases and their predisposition conditions) can lead to serious clinical outcomes during pre-pandemic [9,10]. Individuals with metabolic syndrome are at increased risk of adverse disease outcomes and mortality from COVID-19. The pathophysiological mechanisms of these observations are not fully understood.

The epidemiology of COVID-19 is influenced by four key demographic factors: older age (median age of death is 75 years); gender (male), immunocompromised and underlying comorbidities such as cardiovascular disease, diabetes mellitus, chronic respiratory disease and hypertension [10,19]. Large cohort studies have shown that obesity, diabetes and hypertension [11] are individually associated with increased severity of COVID-19, but the mechanisms remain poorly understood. According to Xie J. et al. [4,20] The most common comorbidities were hypertension (80%), obesity (65%), diabetes (54%), and low HDL (39%) compared with heart failure (14%), chronic obstructive pulmonary disease (10%) and asthma (10%). Thus, MS is a risk factor influencing the progression and prognosis of COVID-19, during a viral infection, MS and its individual components, as well as a weakened immune system, enhanced by diabetes, obesity and hypertension, contribute to worsening COVID-19 severity and mortality. Today, special attention is paid to understanding the connection between COVID-19 and the triumvirate (hypertension, obesity and diabetes) and the development of cardiovascular and renal complications. Understanding the mechanisms underlying the associations between COVID-19 infection and the triumvirate is important to develop effective targeted treatments and better prepare for future epidemics and pandemics [8]. The pathophysiological mechanisms underlying the effect of T2DM on the progression of COVID-19 are not fully understood. Abnormalities in pulmonary function have been reported in relation to lung volumes, lung diffusing capacity, ventilation control, bronchomotor tone, and bronchial neuroadrenergic innervation, which may explain the propensity for adverse outcomes in patients with COVID-19 and T2DM. Perhaps the lungs are the target organ for diabetes [9,10,12,13]. At the same time, dysregulation of the immune response caused by T2DM is also likely to account for the increased severity of COVID19 disease in patients with T2DM, as a higher rate of lymphopenia and elevated levels of neutrophils, serum CRP, and IL-6 were observed. in patients with COVID-19 and pre-existing T2DM in our study [10,11,16]. Currently, complications of COVID-19 in obese people are a major concern. Although anthropometric data are helpful in understanding the role of obesity in patients with COVID-19, recent studies suggest that increased BMI is associated with poor prognosis [14,15]. Although the magnitude of the risk varies across studies, hypertension is more likely to contribute to the severity and death associated with COVID-19.

Purpose of the study: To study modern diagnostic methods in patients with metabolic syndrome who have had COVID-19.

Materials and methods. The subjects of the study were 53 patients in the acute period of coronavirus infection caused by COVID-19, who met the criteria for inclusion in the study. Group 1 consisted of 35 people with metabolic syndrome and 18 patients without metabolic syndrome in

the acute period of COVID-19. The age of the patients ranged from 32 to 80 years. Of these, 22 (41.5%) were men and 31 (58.5%) were women. More than half of the patients (67.9%) were aged between 50 and 70 years.

Results of the study: The studies showed that 58.5% of patients had concomitant concomitant pathology. Structure of comorbidities: arterial hypertension (54.7%), overweight and obesity (71.7%), lung diseases (20.8%), history of diabetes mellitus (22.6%), chronic kidney diseases (15 .1%), diseases of the digestive system (13.2%). The main complaints were weakness (52.8%), cough (43.4%), increased blood pressure (35.8%), excessive sweating (35.8%), shortness of breath and feeling of lack of air (30.2%), pain in joints (26.4%).The studies showed that the initial indicators characterizing glycemia (fasting glycemia, postprandial glycemia and HbA1c, %) were comparable in the studied groups. In the 1st group of patients, in relation to the 2nd group, the data on HbA1c was 5.26±0.74, while in the 2nd group it was 8.18±5.02, which is almost 3% higher. Initial fasting blood glucose levels in the group with MS were significantly higher than those in the group without MS (8.7±0.84 mmol/l and 5.0±1.4 mmol/l, respectively). We studied the HOMA IR indicators; in the group with MS it was significantly higher compared to those without MS (p=0.03), which indicates that patients in the acute period of COVID-19 with MS have a tendency to have impaired carbohydrate metabolism; further treatment is required correction of glycemic status.

Accumulation of LDL can induce inflammasome activation and the release of proinflammatory cytokines such as IL-1b and IL-18, and low HDL levels are negatively correlated with CRP levels. Studies aimed at studying indicators of lipid status showed that significantly high TG levels were observed in the group with MS (p=0.04) and low HDL (p=0.03). Also, the imbalance in lipid status in patients with MS who had a coronavirus infection was characterized by an increased content of total cholesterol and LDL, but no significant differences were found. This indicates a violation of fat metabolism in this category of patients (Table 1).

Table No. 1

Indicators of lipid metabolism in patients with coronavirus infection in the acute period

Indicators	without MS, n=18	with MS, n=35	r
TC, mmol/l	4,09±1,14	4,43±1,41	0,56
TG, mmol/l	1,25±0,15	2,23±1,2	0,04
HDL, mmol/l	1,31±0,12	1,01±0,34	0,03
LDL, mmol/l	2,3±0,71	2,64±0,87	0,34

We found that patients with MS had significantly increased markers for determining the severity of COVID-19 (CRP, D-dimer and IL-6).

When studying laboratory parameters, information is more often found in the literature about changes in the concentration of CRP and D-dimer, the levels of which increase significantly in patients with severe disease.

When comparing the results and the data obtained in our study, elevated levels of CRP and D-dimer in patients with COVID-19 were definitely a marker of the presence of disseminated intravascular coagulopathy (Table 2).

Despite the increased levels of these markers, cytokine storm was not observed in patients of the studied group. According to 3 indicators of CRP, D-Dimer, IL-6, there were significant differences between the groups without MS and with MS [5,19].

Table No. 2.

Markers of severity of coronavirus infection

Indicators	without MS, n=18	with MS, n=35	r
SRP, mg/l	45,5±18,3	64,4±21,7	0,002
D-dimer, mg/ml	1,03±1,31	3,03±3,77	0,04
IL-6, pg/l	7,63±4,52	16±7,7	0,003
Procalcitonin, mg/ml	0,11±0,04	0,15±0,12	0,31
Ferritin, ng/ml	238±157,6	277,1±249,5	0,65

Based on the analysis, we developed a scale that is prognostically significant in assessing the risk of complications in patients with MS who have had COVID-19. An analysis of the frequency of metabolic disorders during the acute period of coronavirus infection showed that among patients with MS, overweight and obesity are 4 and 15 times more common, arterial hypertension is 8 times more common, dyslipidemia is 10 to 20 times more common, fasting glucose levels are ≥5.6 mmol/l almost 6 times more often than in the group without MS. The most very good diagnostic value was the HOMA index (AUC - 0.878), BMI (AUC - 0.852); insulin level (AUC - 0.821); fasting glucose level (AUC - 0.818) (Table 3).

Table No. 3

Frequency of metabolic disorders in patients with COVID-19 in the acute period

Indicators	Groups				Total, n=53		OR	95%CI	r
	without MS, n=18		with MS, n=35						
	n	%	N	%	n	%			
BMI 25,5-29,9 кг/м²	2	11,1	11	31,4	13	24,5	3,67	0,72-18,8	0,10
BMI>30 кг/м²	-	-	24	68,6	24	45,3	15,3	3,19-73,1	<0,001
BP≥ 135/85 мм рт. ст.	1	5,6	7	20,0	8	15,1	8,31	2,16-32,0	<0,001
TG ≥1,7 ммоль/л	-	-	8	22,9	8	15,1	20,6	1,08-39,1	<0,001
HDL <1,0 ммоль/л	1	5,6	9	25,7	10	18,9	9,5	1,01-89,0	0,03
LDL >2,5 ммоль/л	2	11,1	7	20,0	9	17	1,73	0,45-6,74	0,42
Fasting glucose ≥5.6 mmol/l	2	11,1	14	40,0	16	30,2	5,33	1,06-26,9	0,03
I/V DM -	-	-	4	11,4	4	7,5			0,14
SD in medical	-	-	6	17,1	6	11,3			0,06

Newly diagnosed diabetes was noted in 11.4% of cases in the group with MS; a history of type 2 diabetes occurred in 17.1% of cases. The category of good diagnostic significance included HDL level (AUC - 0.798); SBP (AUC - 0.781); DBP (AUC - 0.769. This) and TG level (AUC - 0.756). The purpose of this study was to examine the relationship between metabolic syndrome and the pathophysiology, incidence, prevalence and severity of COVID-19. Obesity has generally been considered the second most common comorbidity in patients with severe COVID-19[20].

Summary: Thus, an analysis of the frequency of metabolic disorders during the acute period of coronavirus infection showed that among patients with MS, overweight and obesity are 4 and 15 times more common. The HOMA index showed the most predictive value in assessing the risk of complications in patients with MS who have had COVID-19.

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