Original Article

The study of clinical and laboratory parameters of elderly patients with arterial hypertension and post-covid syndrome.

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ABSTRACT

Since the onset of the COVID-19 pandemic, the coronavirus infection (COVID-19) has evolved into a serious global issue, widely discussed and studied by scientists around the world. The complexity of researching and classifying this disease lies in the absence of unified criteria: symptoms vary greatly, diagnostic thresholds fluctuate within wide ranges, and the clinical picture is complex and diverse. It largely depends not only on the patient's age but also on their prior pathological history, quality of life, and geographical location.

Under these circumstances, special attention must be paid to the study of diseases that have become increasingly prevalent, are associated with a high frequency and variety of complications, and have acquired new clinical features following COVID-19.

In the course of our study, we systematized the main symptoms most characteristic of patients with cardiovascular pathology and post-COVID syndrome (PCS), comprising the main group (51 patients). The control group consisted of patients with similar cardiovascular conditions but without PCS (94 patients), assessed by clinical and laboratory parameters.

In the main group, changes in blood laboratory values were observed, with the most prominent being elevated levels of blood enzymes—LDH, CPK, AST, and ALT. Among these, CPK and LDH were the most significant, which elevated levels indicating prolonged tropism of the virus toward vascular endothelium. The levels of SARS-CoV-2-specific IgG antibodies in both groups reflected the degree of immunological response and overall immune status.

Keywords

post-COVID syndrome; cardiovascular diseases; clinical and laboratory diagnostics.

INTRODUCTION

As well as the necessity for further studies in this direction, is beyond question, given the high mutability of the virus and the ability of viruses in this group to accumulate effects and form associations with existing microorganisms in the body. This exacerbates the patient's pathological history, leads to frequent complications, prolongs the course of illness, worsens the prognosis, and results in a wide variety and heterogeneity of symptoms. As a consequence, some well-established laboratory norms are being challenged—for instance, the expected duration of the presence of specific blood immunoglobulins, as well as the levels of commonly used enzymatic markers such as creatine phosphokinase (CPK) and lactate dehydrogenase (LDH). Under normal, non-COVID conditions, these markers typically remain within standard ranges. For example, patients with a history of arterial hypertension (AH) alone generally do not exhibit elevated levels of CPK or LDH in their blood.

Literature data on this subject remain highly contradictory. According to some authors, complete "recovery" following COVID-19

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occurred in approximately 20 million individuals [1]. However, other experts, particularly practicing clinicians, argue that symptoms may persist for an extended period, vary in intensity, and lead to serious consequences, including significant alterations in organ structure and function [2,3].

The term post-COVID syndrome or long COVID was first introduced by Greenhalgh Trisha et al. (2020), referring to the persistence of symptoms for more than three weeks after the onset of initial symptoms (subacute COVID-19), and more than 12 weeks in the case of chronic COVID-19 [2]. Thus, post-COVID syndrome is considered present when a patient continues to experience symptoms or a combination thereof for 12 weeks following the elimination of the majority of virulent SARS-CoV-2 particles, and when these symptoms cannot be explained by the presence of other diseases [3].

It is well known that PCS may develop not only after a COVID-19 infection but also as a result of certain vaccinations. It is possible that the development of PCS is linked to the activation of monocytes by the SARS-CoV-2 spike protein and the prolonged persistence of viral components in the human body, which may contribute to an increased number of relapses [3]. Approximately 70–80% of recovered individuals report ongoing symptoms and a decreased quality of life, with frequent involvement of cognitive functions [3,4].

One theory explaining the development of PCS suggests direct endothelial damage caused by the virus, which subsequently affects tissues, organs, and virtually all body systems [4,5]. The prolonged persistence of the virus and retention of its remnants in monocytes and CD4+ lymphocytes trigger their hyperstimulation, leading to heightened immune system activation. This is caused by the continuous need to eliminate foreign proteins and viral RNA fragments [6].

According to the age classification adopted by the World Health Organization (WHO), individuals aged 60 to 74 years are considered elderly. WHO experts also note the ongoing "aging of the planet," with older adults now comprising 13.2% of the global population.

According to [7,8], most elderly individuals currently live in middle-income countries. At the same time, the degree of comorbidity among the aging population increases in direct proportion to age and in inverse proportion to quality of life. This trend is evident based on several key criteria, primarily the number and severity of diseases. For example, among older adults who have recovered from COVID-19, there is a significant increase in the frequency of asymptomatic and atypical forms of myocardial infarction and angina pectoris. Assessing clinical symptoms in this group can be particularly challenging due to limited physical activity, memory impairment, the presence of multiple comorbid conditions [7], and anxiety related to COVID-19, all of which may hinder proper clinical evaluation. A review of numerous studies on the management of patients post-COVID-19 has shown that the clinical manifestations of post-COVID syndrome are highly variable and may present with differing degrees of severity [9].

Objective of the Study: The aim of this study was to identify clinical and laboratory indicators associated with the development of PCS as a prolonged complication of COVID-19 in elderly patients with arterial hypertension.

Materials and Methods: This study was conducted in accordance with bioethical standards for medical research and consisted of both clinical and laboratory components. Elderly patients (aged 60 and above) were examined at two Centers for Active Longevity in the Turksib District of Almaty—a district recognized as ecologically polluted.

A total of 145 patients aged over 60 years were examined and subsequently divided into two groups based on the presence or absence of PCS.

The main group included 51 individuals (47 women and 4 men), with a mean age of 69 years (ranging from 61 to 78 years).

The control group consisted of 94 individuals (80 women and 14 men), with a mean age of 72 years (ranging from 60 to 93 years). All patients had arterial hypertension and a history of various comorbid conditions. The diagnosis of arterial hypertension was made based on patient-reported episodes of elevated blood pressure, in accordance with the clinical protocol of the Ministry of Health of the Republic of Kazakhstan.

Hypertension stage 1 was diagnosed in the presence of systolic blood pressure ranging from 140–159 mmHg and/or diastolic blood pressure from 90–99 mmHg; stage 2 was diagnosed with systolic pressure of 160–179 mmHg and/or diastolic pressure of 100–109 mmHg; stage 3 was diagnosed when systolic pressure was ≥180 mmHg and/or diastolic pressure was ≥110 mmHg.

The clinical component of the study included patient surveys based on medical records and initial interviews of individuals who had previously contracted COVID-19. The aim was to assess their general medical history, possible consequences of the infection, and symptoms of PCS in accordance with the World Health Organization (WHO) criteria [10]. The clinical case definition of post-COVID-19 condition was adopted via the Delphi consensus on October 6, 2021

The diagnosis of post-COVID syndrome (PCS) was established based on a comprehensive assessment of all patients according to the following three criteria:

- A history of probable or confirmed COVID-19 infection;
- Persistence of symptoms for at least two months following the onset of COVID-19;
- Inability to explain the symptoms by an alternative diagnosis (as per the National Institute for Health and Care Excellence, NICE).

The study groups were formed strictly on a voluntary basis.

Exclusion criteria included: significant cognitive impairment; refusal to participate in the study; acute infectious diseases; and exacerbation of chronic therapeutic conditions.

All patients with arterial hypertension were receiving standard treatment in accordance with the requirements of the authorized regulatory body.

The second part of the study consisted of laboratory investigations.

Laboratory testing was conducted at the licensed clinical diagnostic center "LLP Omicron-3D."

Blood samples were collected from patients in the morning on an empty stomach in a volume of 12 mL for the following analyses:

- Biochemical and ELISA testing – 5.5 mL of whole blood;
- Complete blood count (CBC) – 2 mL with dry EDTA anticoagulant.

CBC was performed using automated analyzers (Abacus, 2020), following standard procedures.

All biochemical tests were conducted using the "VK-2000" analyzer (2024) with reagents registered in the Republic of Kazakhstan from the company "Human," Germany, in accordance with commonly accepted methods.

Enzyme-linked immunosorbent assay (ELISA) was performed using test systems from CJSC "Vector-Best," registered in the Republic of Kazakhstan. Results were recorded using the "Stat Fax - 2100" device (2016).

Statistical analysis was performed using SPSS Statistics 26. Normality of distribution for variables in Tables 1 and 2 was assessed using the Shapiro–Wilk test. Descriptive data were presented as mean (standard deviation) for normally distributed variables, median (range) for non-normally distributed variables, and % (number of participants in category/total number of participants in group) for categorical data. Between-group comparisons were made using Student's t-test for normally distributed continuous variables, the Mann–Whitney U test for non-parametric continuous variables, and Fisher's exact test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

The study was approved by the Local Ethics Committee of the Kazakh-Russian Medical University (Protocol No. 18, 2023).

RESULTS

The results of the study were structured into the following blocks: 1) characteristic complaints of diagnostic significance; 2) clinical manifestations of varying nature and prevalence in the study groups; 3) types and frequency of comorbid conditions in the groups; 4) results of clinical and diagnostic assessments, categorized according to the presence or absence of PCS in patients.

Table 1 presents the data on patient-reported complaints at the time of consultation.

In the main group, the most frequently reported complaints were: profuse sweating – 19.61% (10/51), fatigue – 19.61% (10/51), dyspnea – 17.65% (9/51), memory impairment – 13.73% (7/51), palpitations – 11.76% (6/51), chest pain – 11.76% (6/51), headache – 11.76% (6/51), cough – 11.76% (6/51). The average time of symptom onset was approximately 2 months.

In the control group, a significant portion of patients reported no complaints – 39.36% (37/94). The most commonly reported symptoms included: dizziness – 8.51% (8/94), labile blood pressure – 8.51% (8/94), fatigue – 7.45% (7/94), arthralgia – 6.38% (6/94).

Statistically significant differences between the groups were observed in the following complaints: profuse sweating (p = 0.001), fatigue (one- tailed p = 0.031), dyspnea (p = 0.004), memory impairment (p = 0.001), cough (p = 0.023), sleep disturbances (p = 0.042), hair loss (p = 0.042), absence of complaints (p = 0.001) (table 1).

Table 1. Clinical manifestations of post-COVID syndrome (patient-reported complaints)

Clinical manifestations / complaints	Main group (%) (n = 51)	Control group (%) (n = 94)	p-value (two-tailed)	p-value (one-tailed)
Profuse sweating	19.61 (10/51)	0.00 (0/94)	0.001	0.001
Fatigue	19.61 (10/51)	7.45 (7/94)	0.055	0.031
Dyspnea	17.65 (9/51)	3.19 (3/94)	0.004	0.004
Memory impairment	13.73 (7/51)	0.00 (0/94)	0.001	0.001
Palpitations	11.76 (6/51)	3.19 (3/94)	0.067	0.049
Chest pain	11.76 (6/51)	3.19 (3/94)	0.067	0.049
Headache	11.76 (6/51)	6.38 (6/94)	0.345	0.207
Cough	11.76 (6/51)	2.13 (2/94)	0.023	0.023
Arthralgia	7.84 (4/51)	6.38 (6/94)	0.741	0.492
Anxiety	7.84 (4/51)	1.06 (1/94)	0.052	0.052
Sleep disturbances	5.88 (3/51)	0.00 (0/94)	0.042	0.042
Hair loss	5.88 (3/51)	0.00 (0/94)	0.042	0.042
Dizziness	5.88 (3/51)	8.51 (8/94)	0.747	0.416
Blood pressure lability	5.88 (3/51)	8.51 (8/94)	0.747	0.416
Abdominal pain	3.92 (2/51)	3.19 (3/94)	1.000	0.578
Depressed mood	3.92 (2/51)	1.06 (1/94)	0.283	0.283
Numbness in left arm	3.92 (2/51)	0.00 (0/94)	0.122	0.122
Hearing impairment	3.92 (2/51)	4.26 (4/94)	1.000	0.645
Uterine prolapse	3.92 (2/51)	0.00 (0/94)	0.122	0.122
Anxiety (repeated entry)	3.92 (2/51)	0.00 (0/94)	0.122	0.122
Lower back pain	1.96 (1/51)	1.06 (1/94)	1.000	0.581
Lower limb edema	1.96 (1/51)	4.26 (4/94)	0.657	0.422
Visual disturbances	1.96 (1/51)	3.19 (3/94)	1.000	0.560
Gastrointestinal disturbances	3.92 (2/51)	2.13 (2/94)	0.613	0.440
No complaints	9.80 (5/51)	39.36 (37/94)	0.001	0.001

Analysis of comorbidities revealed differences in the frequency of associated diseases between the main and control groups. In the main group, the most prevalent conditions were hypertension (92.16%), type 2 diabetes mellitus (50.98%), coronary artery disease with stable angina (41.18%), chronic pancreatitis (21.57%), chronic pyelonephritis (15.69%), thyroid diseases (13.73%), chronic bronchitis (11.76%), and arrhythmia (11.76%). In the control group, the most frequent conditions were hypertension (83.52%), type 2 diabetes mellitus (25.27%), coronary artery disease with stable angina (21.98%), diseases of the stomach and esophagus (20.88%), chronic pyelonephritis (17.58%), and chronic pancreatitis (10.99%).

Analysis of pathology frequency showed that patients in the main group had a significantly higher incidence of type 2 diabetes (p = 0.013) and chronic heart failure (p = 0.002). It should also be noted that the number of patients with chronic pancreatitis in the main group was twice as high as in the control group.

Hypertension was present in the vast majority of patients in both groups. The number of patients without comorbidities in the control group was four times higher than in the main group, which is likely due to the low number of patients without comorbidities (10.75%) among examined.

Notably, pathologies of the esophagus and stomach were more prevalent in the control group (more than twice as frequent).

The results of the comorbidity study in both patient groups are presented in Table 2.

Table 2. Frequency of comorbid diseases

Indicators	Main Group	Control Group	p-value (two-tailed)	p-value (one-tailed)
Arterial Hypertension, %	92.16 (47/51)	83.52 (76/91)	0.09	0.054
Type 2 Diabetes, %	50.98 (26/51)	25.27 (23/94)	0.002	0.001
Ischemic Heart Disease. Angina Pectoris, %	41.18 (21/51)	21.98 (20/94)	0.013	0.01
Stomach and Esophagus Pathologies, %	9.8 (5/51)	20.88 (19/94)	0.159	0.081
Chronic Pyelonephritis, %	15.69 (8/51)	17.58 (16/94)	1	0.517
No Comorbidities, %	1.96 (1/51)	8.79 (8/94)	0.16	0.111
Chronic Pancreatitis, %	21.57 (11/51)	10.99 (10/94)	0.87	0.064
Chronic Bronchitis, %	11.76 (6/51)	9.89 (9/94)	0.777	0.44
Chronic Cholecystitis, %	7.84 (4/51)	8.79 (8/94)	1	0.58
Thyroid Pathology, %	13.73 (7/51)	7.69 (7/94)	0.247	0.176
History of Myocardial Infarction, %	7.84 (4/51)	6.59 (5/94)	0.741	0.492
Varicose Veins of Lower Extremities, %	3.92 (2/51)	5.49 (4/94)	1	0.527
Osteoarthritis, %	7.84 (4/51)	5.49 (4/94)	0.72	0.394
Prostatitis, %	0 (0/51)	4.4 (4/94)	0.298	0.173
Fatty Liver Disease, %	3.92 (2/51)	4.4 (4/94)	1	0.645
History of Stroke, %	0 (0/51)	4.4 (4/94)	0.298	0.173
Upper Respiratory Tract Pathology, %	0 (0/51)	4.4 (4/94)	0.298	0.173
Kidney Cysts, %	1.96 (1/51)	2.2 (2/94)	1	0.717
Gout, %	1.96 (1/51)	2.2 (2/94)	1	0.717
Arrhythmia, %	11.76 (6/51)	0 (0/94)	0.002	0.002
Chronic Cystitis, %	3.92 (2/51)	0 (0/94)	0.122	0.122
Chronic Heart Failure, %	3.92 (2/51)	0 (0/94)	0.122	0.122

Laboratory data of the patients showed the following. The average values of the components of the complete blood count (CBC) in both groups were similar, with the exception of the inflammatory markers (Table 3). For instance, the number of neutrophilic granulocytes in some patients of the control group (18%) was 1.5 times higher (on the lower gradient) compared to the main group, which, along with the elevated total white blood cell count in these patients, indicates a possible subacute inflammation.

Notably, there was a large number of eosinophils in the blood of some patients from both groups, which might suggest the development of autoimmune reactions, leading to complications in the progression of the primary disease.

Finally, the quantitative fluctuations of lymphocytes in the blood of the patients. The lower gradient of lymphocyte counts in both groups was approximately the same, and in the case of patients with PCS, it may indicate either normal or insufficient development of the specific immune response. The upper gradient of this parameter in the main group of patients exceeds that in the control group by 1.43 times, which may indicate the presence of immune response hyperstimulation.

Table 3. General blood test results of elderly patients with post-COVID syndrome.

Parameters	Main group n = 51	Control group n = 94	p-value
Hemoglobin level, g/L	135.03 (12.01)	134.97 (15.55)	0.943
Erythrocytes, 10^{12}/L	4.5 (3.56; 6.09)	4.45 (3.56; 6.72)	0.95
Platelets, 10^9/L	249 (116; 440)	253.5 (2.79; 466)	0.747
Leukocytes, 10^9/L	5.68 (2.46; 13.17)	5.5 (2.69; 16.44)	0.934
Band neutrophils, %	1 (1; 3)	1 (1; 3)	0.97
Segmented neutrophils, %	58 (33; 70)	58 (50; 72)	0.811
Eosinophils, %	3 (2; 10)	3 (2; 36)	0.592
Monocytes, %	3 (2; 4)	3 (2; 4)	0.821
Lymphocytes, %	34 (22; 60)	33 (20; 42)	0.893
ESR, mm/h	9 (3; 30)	11 (2; 45)	0.39

Studying immunological indicators in groups of patients who have had COVID-19 was of great interest because the immune status plays an important role in

the mechanism of developing clinical manifestations of post-COVID syndrome (PCS).

We analyzed the quantitative content of immunoglobulin G to SARS-CoV-2 in the blood of patients. In both groups, these values exceeded the normal limits, with the threshold set at up to 10 BAU/ml. Even the average values were high, reflecting the degree of development of the specific immune response to COVID-19. The results are presented in Table 4.

Table 4. Immunological and biochemical blood test results of elderly patients with PCS.

Parameters	Main group n = 51	Control group n = 94	p-value
IgG, BAU/ml	167.54 (48.24; 471.41)	158.99 (11.94; 405.01)	0.974
Glucose, mmol/L	5.23 (3.9; 8.3)	5.2 (3.8; 10)	0.765
Total cholesterol level, mmol/L	5.21 (0.69)	5.27 (0.82)	0.468
Urea level, mmol/L	5.1 (2.7; 10)	5.3 (2.9; 10.2)	0.227
Creatinine level, µmol/L	84.9 (51; 130.8)	82.9 (53.1; 129.3)	0.797
LDH, U/L	305.9 (182.7; 689.5)	343.1 (174.3; 759.2)	0.12
CK, U/L	171.1 (94.3; 403.2)	173.7 (97.5; 463.9)	0.613
Glycated hemoglobin, %	6.3 (5.3; 8.9)	6.3 (4.9; 10.7)	0.457
ALT, U/L	32.6 (19.9; 112.4)	34.4 (9.32; 80.4)	0.804
AST, U/L	30.8 (19.3; 174.2)	30.8 (16.4; 109.5)	0.931
Alkaline phosphatase, U/L	217.8 (130.5; 320.7)	229.9 (128.5; 315.2)	0.188
Total protein, g/L	74.92 (6.39)	74.12 (6.39)	0.988

The level of Immunoglobulin G (IgG) to SARS-CoV-2 in the blood of patients in the main group was 167 BAU/ml, which was not significantly different from the same indicator in the control group (IgG level 158 g/L, $p>0.9$). It is noteworthy that the lower gradient of this indicator in the main group was more than 4 times higher than in the control group, while the upper gradient was only 17% higher.

Levels of biochemical blood markers, such as glucose, total cholesterol, urea, creatinine, alkaline phosphatase, total protein, and glycosylated hemoglobin, did not significantly different between the two groups. Of particular interest were the enzyme levels in the blood of elderly patients: ALT, AST, LDH, and CPK.

For instance, the lower gradient of ALT levels in the main group exceeded that of the control group by 2.31 times, and AST levels by 17%. The upper gradient of ALT levels in the main group was 1.4 times higher, and AST levels were 1.6 times higher, which likely characterizes the emergence of comorbidities and complications arising in PCS.

The lower LDH levels in the blood of patients in both groups fluctuated within the same range, but the upper limits were 10% higher in 8% of the control group patients and 34% of the main group patients, indicating the presence of hidden subacute processes and myocardial damage.

Similarly, the analysis of the lower and upper gradients of CPK levels in the blood of patients in both groups showed that the lower levels were roughly the same, but the upper levels were 15% higher in 11% of control group patients and 23% of main group patients.

These results likely suggest the emergence of additional foci of inflammation, leading to increased strain on the immune system, an elevated risk of COVID-19 relapses, changes in the immune status, and ultimately the creation of a “vicious cycle” of diseases.

DISCUSSION

Analyzing the results of the presented studies, it should be noted that the most common complaints among patients in the control group were: blood pressure lability (8.51%), dizziness (8.51%), weakness (7.45%), and leg edema (4.26%). It is also worth mentioning that the number of patients without complaints in this group was more than four times higher compared to the main group.

The main complaints in the group of patients with PCS were: excessive sweating, weakness, and shortness of breath, reported by 17-20% of patients. Memory loss, arrhythmia, chest pain, headache, and cough were noted by 11-13% of patients in this group. Arthralgia and anxiety were reported by up to 8% of patients. Hair loss, dizziness, and blood pressure lability were mentioned by up to 6% of patients. Abdominal pain, mood disorders, numbness of the left arm, hearing loss, uterine prolapse, and gastrointestinal issues were noted by less than 4%. The frequency of lumbar pain, edema of the lower limbs, and visual disturbances was about 2%. No complaints were reported by 9.8% of patients, which is four times less than in the control group.

All complaints from patients in the main group were associated with the previous COVID-19 infection.

It should be noted that in our study, the number of women significantly exceeded the number of men. This explains the distribution of complaint frequencies.

When analyzing the literature data, which largely coincide with the results of our research, it is worth mentioning the chronic fatigue syndrome, which, according to [11,12,13,14], is most characteristic of the female population. This syndrome contributes to the development of neuropsychological disorders and is a risk factor for the onset of PCS after COVID-19.

Currently, there is data both on direct viral damage to neurons and glial cells and on neurological manifestations caused by the systemic response to the viral infection. Viruses can enter the central nervous system through two different pathways: hematogenous, crossing the blood-brain barrier, and retrograde axonal transport along motor and sensory neurons. A “Trojan horse” mechanism is also described, where the virus enters the brain via circulating lymphocytes. CNS damage caused by the systemic response to COVID-19 may be explained by the development of hypoxia due to respiratory failure, as well as the development of the systemic inflammatory response syndrome [15].

It is well established that the female sex is considered a potential risk factor for the development of PCS due to higher immune responses and hormonal changes in postmenopausal women [15].

Excessive sweating, observed in patients in the present study, can be attributed to a group of asthenovegetative disorders, which are commonly seen after illness. The second most common symptom among these patients was shortness of breath. Cough was observed in 11.76% of cases, and it persisted for 7-9 months.

The most common cardiovascular manifestations were chest pain and palpitations, with frequencies of 13.3% and 9.3%, respectively [16]. The frequency of cardiovascular system involvement depends on the severity of the course of COVID-19. It was found that three months after the onset of COVID-19, 71% of patients with mild disease, 93% with moderate disease, and 95% with severe disease had cardiovascular involvement [17]. According to cardiac magnetic resonance imaging, ongoing myocarditis was detected in 60% of patients more than two months after the initial diagnosis, regardless of the severity of the acute illness [16].

According to [18, 19, 20], obesity is a risk factor for the development of PCS in patients predisposed to obesity. In our study, the frequency of obesity in elderly patients was 78%.

When analyzing immune response, it was noted that it may vary in different patients and depend on many factors, which differ from patient to patient. This, in turn, suggests that when evaluating immune response, all indicators should be considered in complex, and improvements should be judged based on the speed, smoothness, and stability of the return to normal levels of the indicators, as well as the degree of response to the applied treatment (objectively), confirmed by the subjective feelings of the patient.

CONCLUSION

Regarding biochemical indicators, the results for the levels of CPK and LDH in the blood of patients are of interest. Elevated LDH levels were found in 34% of patients in the main group. As is known, the primary role of total LDH in the blood is to detect tissue damage. The enzyme plays a crucial role in energy production by breaking down glucose under anaerobic conditions.

A significant increase in CK levels in the blood of 23% of patients who survived COVID-19 in the main group may indicate biochemical shifts in the tissues of the heart and skeletal muscles, to which SARS-CoV-2 has a tropism, as do most viruses of its group. This results in direct cytotoxic damage to the myocardium, suppressing the activity of the ACE2 enzyme, which performs a cardioprotective function as an antifibrotic, antioxidant, and anti-inflammatory factor, protecting against endothelial dysfunction.

It can be hypothesized that these patients in the main group may be developing myocardial dystrophy, which suggests the need for long-term dynamic monitoring of clinical and laboratory indicators.

Thus, the results obtained in the groups of patients who had COVID-19 suggest changes in their immunological, clinical, mental, and physical status.

The results obtained in our study allow us to make the following conclusions:

- The consequences of COVID-19 are most commonly observed in patients with a burdened comorbid background, such as hypertension, type 2 diabetes, chronic heart failure, and those who have suffered a myocardial infarction.
- The most characteristic and pronounced symptoms accompanying post-COVID syndrome were excessive sweating, fatigue, weakness, shortness of breath, and memory impairment. Relatively less frequently observed symptoms included tachycardia, headaches, chest pain, and cough.
- Elevated levels of LDH and CPK in the blood, found in 34% of the main group and 11% of the control group patients who survived COVID-19, indicate biochemical shifts in myocardial tissue and the emergence of additional inflammation foci.
- Increased levels of immunoglobulin G (IgG) to SARS-CoV-2 in the blood of elderly patients likely indicate immune response strain in the main group of patients who have had COVID-19.

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