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Clinical Features of Post-Covid Syndrome

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A B S T R A C T

There is no common understanding of the clinical picture of post-covid syndrome. The US regulator CDC proposes to highlight (A) persistent symptoms and conditions that begin during acute COVID-19 illness; B) new onset late complications after asymptomatic disease or a period of acute symptomatic relief or remission; (C) the evolution of symptoms and conditions that include some persistent symptoms (eg, shortness of breath) with the addition of new symptoms or conditions over time (eg, cognitive difficulties). Some manifestations may resemble other postviral syndromes such as myalgic encephalomyelitis/chronic fatigue syndrome, dysautonomia (eg, postural orthostatic tachycardia syndrome), or mast cell activation syndrome.

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Postcovid syndrome is a long-lasting (for 3 or more months) pathological manifestations after an acute period of the disease. The main signs include severe weakness, heaviness in the chest, feeling of incomplete inspiration, headaches, joint and muscle pain, sleep disturbance, depression, cognitive decline, thermoregulation disorder, etc. MThe mechanism of the post-covid syndrome may be associated with the emerging chronic inflammation of the vessels, which negatively affects the work of the nervous system in the first place, and also disrupts the functioning of internal organs. SARS-CoV-2 destroys the inner surface of blood vessels, which increases the risk of developing microthrombi in the microvasculature. COVID-19 can also have a direct destructive effect on the cells of the body, as well as cause an excessive immune response and provoke autoimmune diseases.

The aim of the study was to study the features of cerebral hemodynamics and microcirculation in patients with post-COVID syndrome.

Materials and research methods. The study included 100 young and middle-aged people from 30 to 55 years old, with a verified diagnosis of the consequences of the COVID-19 coronovirus infection, confirmed by laboratory methods of research and after negative results (PCR, ELISA) for SARS-CoV-2, after 15 - 35 weeks from the onset of the disease, which made up the main group. PThe patients of the main group were divided into subgroup I - 70 people who had a mild COVID-19 disease and subgroup II - 30 patients who had a moderate and severe disease complicated by pneumonia. The control group consisted of 20 healthy subjects of the appropriate sex and age composition who had not had a coronovirus infection or other viral infection over the past 6 months and had no acute and decompensated chronic pathology at the time of observation.

Results of the study and their discussion.

The study of cerebral blood flow in patients with postcovid syndrome at rest revealed statistically significant differences in Vmax (maximum systolic velocity) blood flow in the main extracranial vessels of the carotid artery system and intracranial vessels of the carotid and vertebrobasilar systems.

In the background study of cerebral hemodynamics in patients of subgroups 1 and 2, multidirectional changes in the linear blood flow velocity (BFR) at the extracranial level were observed.

The rate of blood flow at rest in the common carotid artery (CCA) was significantly lower in patients of

the first subgroup and was combined with venous dysgemia compared to the control group ($p < 0.001$). Thus, the blood flow in the right CCA in patients of subgroup 1 was 86.95 ± 1.95 cm/s and 91.1 ± 3.16 in the control group ($p < 0.001$); on the left CCA, the blood flow velocity in subgroup 1 was 86.8±1.96 cm/s and 92.53±3.35 cm/s in the control group ($p < 0.001$);

In patients of the second subgroup, there was an increase in speed indicators according to OSA - 95.4 ± 1.54 cm/s, significantly relative to the indicator of the control group ($p < 0.001$); on the left CCA, the blood flow velocity in the second subgroup was 95.1±1.81 cm/s ($p < 0.01$), with the control group.

Indicators of the linear velocity of blood flow in the internal carotid artery (ICA) had similar trends with LBF in the CCA. The blood flow velocity was significantly lower in patients of the 1st subgroup compared to the control group ($p < 0.001$). Thus, the blood flow in the right ICA in patients of subgroup 1 was 52.58 ± 2.07 cm/s and 62.6 ± 4.57 in the control group ($p < 0.001$); in the left ICA, the blood flow velocity in subgroup 1 was 52.75±2.2 cm/s, and 63.6±4.1 cm/s in the control group ($p < 0.001$); In patients of the second subgroup, there was an increase in speed indicators for ICA - 65.2 ± 1.73 cm/s ($p < 0.01$) relative to the control group; on the left LSA, the blood flow velocity in subgroup 2 was 65.77±1.28 cm/s, without significant differences with the control group.

When assessing the blood flow velocity in the vertebral artery (VA), it was also significantly lower in patients from subgroup 1, relative to the control group. Thus, the blood flow in the right VA in patients of subgroup 1 was 12.72 ± 0.84 cm/s ($p < 0.001$) with the control group 13.93 ± 1.53; on the left VA, the blood flow velocity in subgroup 1 was 12.74±0.84 cm/s and 14.40±1.28 in the control group ($p < 0.001$).

In patients with post-covid syndrome who had pneumonia in the acute period of the second subgroup, there was an increase in speed indicators on the right VA - 13.17 ± 1.06 cm/s without significant differences with the control group; on the left VA, the blood flow velocity in subgroup 2 was 13.39 ± 1.18 cm/s without significant differences from the control group.

The resistance indices (RI) were significantly reduced in the subgroup of patients of the first subgroup in OSA and PA and amounted to 0.69±0.01 and 0.63±0.01, respectively ($p < 0.01$). In patients from the second subgroup, an increase in RI in PA to 0.67 ± 0.01 was observed in the 2A subgroup, which is significantly higher than the control group ($p < 0.01$).

During the study, a violation of the anatomy of the vessels was noted in patients of the 2nd subgroup, with the early formation of a violation of the course of the vessels (C, S vessels), and the formation of initial signs of atherosclerotic vascular damage - a violation of differentiation into layers of the intima-media complex.

At the intracranial level, the linear velocity of blood flow in the middle cerebral artery (MCA) was assessed. A decrease in blood flow velocities was revealed both in the group of patients of the first and second subgroups of observation relative to the control group ($p<0.001$),

When assessing the venous outflow in the observation groups, all patients had signs of an increase in the velocity along the direct sinus to 50±0.8 and 57±0.6 cm/s, respectively, which were significant relative to the control group ($p<0.001$). In the veins of Rosenthal, the acceleration of shunting was up to 27 ± 0.98 and 32 ± 0.55 cm/s, respectively ($p < 0.001$). The veins of the vertebral plexuses were dilated up to 5-6 mm, the shunt reached 30 ± 0.58 cm/sec in both subgroups. In subgroup II, shunting through the middle cerebral vein was accelerated to 20±0.78 cm/sec, and in subgroup I, to 17.3±0.4 cm/sec ($p<0.001$).

In the control group, the discharge rates through the venous vessels remained within the age norms.

Thus, the study of cerebral hemodynamics in patients of the studied groups showed a significant effect of the venous component on autoregulation of cerebral blood flow. Thus, in patients who had a mild form of coronavirus infection, the velocity indicators of the venous link had significantly high values with reduced velocity indicators of the arterial vessels. Thus, a decrease in the velocity of linear blood flow through the main cerebral arteries, a decrease in the tone of arterial vessels was revealed, which is a compensatory reaction in case of difficulty in venous outflow, however, under these conditions, perfusion cerebral insufficiency is possible, which leads to transient hypoxia of the brain and, as a result, impaired blood flow autoregulation.

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