



Vascular Manifestations of Post-covid Syndrome

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Abstract

Coronavirus infection is an acute infectious disease caused by the coronavirus SARS-CoV-2, which proceeds from asymptomatic carriage of the virus to terminal states. Characterizes the development of the clinical picture of not only acute respiratory infection, but also specific thrombohemorrhagic reactions of an immune nature with lung damage by the type of thrombovasculitis and thrombosculitis, the nervous system with the defeat of both the central nervous system by the type of acute encephalopathy and, arterial and venous cerebral infarction, hemorrhage in the brain, and peripheral nervous system in the form of neuropathy. Cephalic and musculo-tonic syndromes, systemic damage to the autonomic nervous system, which is manifested by damage not only with the cardio-vascular system, but also the gastrointestinal tract, liver, kidneys, endocrine organs, reproductive system organs, skin, intoxication and multiple organ failure.

Keywords: COVID-19; Neurological and Systemic Disorders; Post-covid Syndrome

Introduction

Neurological complications of COVID-19 occur in about half of hospitalized patients. In 80% of patients, the disease is mild, the most severe forms developed in elderly patients (60 years or more). Among the sick patients, concomitant diseases such as diabetes mellitus (20%), arterial hypertension (15%), other cardiovascular diseases (15%) are often noted. Almost 70% of people 3 - 6 months after the appearance of the first symptoms of SARS-CoV-2 infection, one or more organs are affected.

It has been shown that post-covid symptoms can be both in adults and children who develop during or after an infection consistent with COVID-19, last more than 12 weeks and are not explained by an alternative diagnosis.

Purpose of the Study

To study the systemic vascular manifestations of post-covid syndrome.

Materials and Methods

On the basis of the center of post-covid rehabilitation of the diagnostic center of the Tver State Medical University of the Ministry of Health of Russia, 50 patients who underwent MILD and moderate COVID-19 in the outcome of the disease were examined $107,1 \pm 1,3$ days. The average age of patients was 52.2 ± 2.6 years, while the clinical manifestations of the disease were more often manifested in women (67%), less often in men (33)%. Among patients, those who had COVID-19, only 26 (52%) had confirmation of COVID-19 by PCR examination of nasopharyngeal swabs, 16 (31)% of pa-

tients had a chest CT scan with confirmation of lung tissue damage from 10% to 50%, respectively, 9 (17%) patients had signs of infection without VERIFICATION by PCR or CHEST CT. Among patients who went to outpatient appointments for the effects of covid, it was reported that 6 (12%) were treated with COVID-19 inpatient treatment, respectively, 44 (88%) received treatment on an outpatient basis. Confirmation of the qualitative or quantitative level of Ig M or G of COVID-19 after more than 30 days from the infection was received only in 37 (74%) patients.

Analysis of the results of laboratory control was carried out on the basis of a blood test of clinical, biochemical, CRP, PTI, D-dimer.

Statistical processing of the results of the study was carried out by the method of variational statistics and correlation analysis on the IBM PC PENTIUM computer using the Microsoft Excel 7.0 software package.

Results and Discussion

There are different definitions of post-covid syndrome, regulating the local and systemic manifestations of the disease. The most informative is the NICE classification, where COVID-19 is defined when signs and symptoms of COVID-19 are recorded for up to 4 weeks; the symptoms of COVID-19 are longer signs and symptoms of COVID-19 last from 4 to 12 weeks and the symptoms that develop during or after a COVID-19-related infection last more than 12 weeks and are not explained alternative diagnosis.

One of the main morphological elements of damage in the acute phase of COVID-19 is generalized thromboculitis, which at first can be caused by a direct damaging effect of the virus on endothelial cells. Contribution to the pathogenesis of complications of the disease and the formation of post-covid syndrome is made by antiphospholipid syndrome - this is due to the fact that the virus, multiplying in many tissues and organs, uses phospholipids of the host organism for its shell, which, combining with the proteins of the surface (capsid) of the virus, represent a target for antibodies. It is possible that antibodies can help the virus penetrate into immune cells on the principle of antibody-dependent increase in infection (ADE). It can be assumed that autoimmune (immunocomplex) processes that cause disturbances in glia cells play a role in the development of brain tissue damage.

In the pathohistological study, po data literature, in the brain against the background of the formation of post-covid syndrome, diffuse and focal changes of various sizes are detected, up to the development of cerebral infarctions in thrombosis of large vessels, microangiopathy, vasculitis, diapedesis and drain hemorrhages, sometimes with the development of hemorrhagic stroke and hematomas. In the soft meninges, destructive-productive vasculitis is detected with impaired vascular patency, extra vasal deposition of fibrin, in addition, lymphoid perivascular a bright and shell infiltration. Histopathological analysis of brain tissue showed microglial nodules and phagocytosis of neurons (neuronophagy) in the brain stem and less often in the cortex and limbic structures associated with lymphocytic infiltration. However, among patients who underwent COVID-19 who underwent an MRI of the brain, there were no specific manifestations, among them were: focal images of brain matter, mixed hydrocephalus was often detected and atrophy of the cerebral cortex not associated with age, areas of leukoareosis.

In the clinical blood test, most patients retained increased ESR, thrombocytosis, minor leukocytosis; in the biochemical analysis of blood: increased transaminases (AST, ALT) of varying severity, hyperglycemia, hypercreatininemia, increased CRP.

Among the main clinical manifestations of post-covid syndrome, generalized and respiratory symptoms are detected: the prevailing majority of patients (86%) have general weakness, fatigue, a decrease in daily activity and ability to work, in addition, long-lasting shortness of breath not associated with impaired functional activity and myocardium, cough, chest congestion in 31% of patients. the consequence of the disease was a violation of the regulation of body temperature 31%, which manifested itself as the presence of prolonged subfebrile, and vice versa hypothermia, as well as tide at night or during the day 28%, quite frequent was weight loss 33%, increase and soreness lymph nodes 17%.

Cardiovascular symptoms in the form of tightness in the chest, chest pain and 31%, palpitations 78%, changes in blood pressure 63%, pain and in the heart 39%, rhythm disturbances 36%, were not due to gross violations of the function of the myocardium or conducting system, however, according to ECHO_KG, indirect signs were obtained diastolic dysfunction of LV and LP in the form of a decrease in the global longitudinal strain of less than 20% and an increase in pressure in the pulmonary artery. This suggests that

rather this symptomatology is due to damage to vagus and leads to a large variety of symptoms, and also determine their undulating nature. In fact, this is an imbalance of the parasympathetic and sympathetic systems - hence problems with heart rate, orthostatic reactions, sleep problems, a semblance of panic attacks, as well as anxiety disorders.

Gastrointestinal symptoms are accompanied by abdominal pain, nausea, diarrhea, anorexia and decreased appetite in 20% of those examined. At the same time, musculoskeletal symptoms are recorded more often in the form of pain in muscles, bones and joints 63.9%. Dermatological symptoms are in the form of skin rashes and rashes on the skin. 21%, impudent hair 37%, burning, tightening I skin 28%, murasek on the skin 42%, ineivilov naveins, soreness and veins in 21%. In addition, in part patients revealed a violation of potency, libido 10%, violation of the menstrual cycle 21% (from women), frequent urination 25%. Symptoms from the senses are characterized in the form of ear pain and, noise, congestion in the ears up to 23%, narushenii vision up to 47%.

Loss of taste and smell, lack of smell in patients with post-covid cinderohm may be associated with the defeat of the olfactory bulb virus, responsible for the perception of aromas and the transmission of information about them to other parts of the central nervous system and the formation of autoimmune inflammation in the conductive pathways. This is due to the fact that the virus is neurotropic, that is, getting into the nervous system through olfactory receptors in the upper nasal concha, can directly damage brain structures such as the limbic system, hypothalamus, cerebellum and others.

In addition, the olfactory bulb not only fixes smells. It contains dopamine, a neurotransmitter of pleasure and motivation. The coronavirus is thought to reduce its levels, also affecting the production of serotonin and acetylcholine. All this leads to the appearance of apathy, bad mood and depressive states. The infected deteriorate concentration, fatigue occurs, cognitive functions decrease. Often they experience increased anxiety, suffer from insomnia, which is due to the fact that hemostasis disorder also causes changes in the level of circulating serotonin, which in turn causes painful migraines, deep depressive states.

Among the psycho-emotional manifestations of post-covid syndrome, a violation of biorhythms in the form of insomnia, drowsi-

ness and 63% during the day is often fixed, 38% is unusual, anxiety and 72%, depression and 32%, which is often accompanied by suicidal thoughts.

Thus, among the manifestations of post-covid syndrome, the most diverse and most common are the defeat of the nervous system, both vegetative and somatic with all the variety of its manifestations. The pathogenesis of lesions of the nervous system is rather due to the fact that the virus, acting on receptors that are involved in regulating blood pressure, causes a bradykinin storm. The vessels expand and become more permeable, plasma accumulates in the tissues, causing edema and acting on nociceptors causes pain. Also associated with post-covid syndrome is mast cell activation syndrome (MCAS) - when mast cells secrete an excessive number of mediators, which leads to chronic inflammation, leading to damage to both the central and peripheral nervous system, which is clinically manifested by a headache of 51%, dizziness 53%, gait disturbance 23%, symptoms of peripheral neuropathy (tingling with pins, needles and numbness). One of the most common manifestations are cognitive impairment (68%), which is not always associated with age in the form of "brain fog", loss of concentration or memory problems, which is apparently due to the fact that the virus, multiplying in the vascular endothelium, causes hypercoagulation. The presence of microthrombi in the bloodstream incapacitates abundantly vesiculated organs - such as the endocrine glands (thyroid gland, adrenal glands, pituitary gland, gonads and others), the heart, kidneys and brain, which leads, among other things, to cerebral ischemia [1-7].

Conclusion

The study showed that the basis of post-covid syndrome is generalized thrombovasculitis, accompanied by autoimmune (immunocomplex) process, calling dis orders in glia cells, the formation of microangiopathy, destructive-productive vasculitis s violation of vascular patency, extravasal deposition of fibrin, lymphoid and perivascular and shell infiltration to it, which explains the mosaic and variety of manifestations of both the central nervous system, which are manifested by damage to the ox of the brain, cortex and limbic structures, as well as the peripheral non-vomiting system, who are waiting for a variety of vegetative somatics to their manifestations.

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