

STRUCTURAL AND FUNCTIONAL BRAIN ALTERATIONS AS TRIGGERS OF ISCHEMIC STROKE IN COVID-19 PATIENTS

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Abstract. Stroke remains one of the major causes of long-term disability worldwide, significantly impairing motor abilities, sensory perception, and emotional-cognitive functions. By the end of the acute phase, approximately 85% of stroke survivors experience persistent motor dysfunction and speech disturbances such as aphasia. In some individuals infected with COVID-19, the onset of acute ischemic stroke may be linked to specific structural and functional alterations in the brain. This article explores the possible mechanisms by which COVID-19-related neurological changes contribute to stroke development.

Keywords: COVID-19, ischemic stroke, brain function, neurological complications, structural changes, neurovascular events.

Introduction. Neurologists from the United States compared the risk of ischemic stroke in patients with COVID-19 and the flu. It turned out that in the first case it is 7.6 times higher. Scientists also identified an excess of specific markers for the development of cerebrovascular accident in the blood of those coronavirus patients who eventually developed a stroke. (1) Russian experts believe that the study expands understanding of the characteristics, mechanisms and short-term outcomes of acute cerebral circulation in patients with COVID-19. This means that it can help doctors prevent the development of such a pathology. (3,5,6)

Neurologists from the Clinical and Translational Neuroscience Division of the Feil Family Brain and Consciousness Research Institute at Weil Cornell College of Medicine and other American institutions have published an article assessing the risks of ischemic stroke in patients with influenza and coronavirus. They studied data from 1,916 people with COVID-19 who received care in the emergency room or hospitalized in two clinical hospitals in New York. Then doctors compared them with data from a similar sample of patients with influenza.

Of all patients with coronavirus infection, 31 (1.6%) had an acute cerebrovascular accident of the ischemic type (ischemic stroke). In the group of patients with influenza, stroke was observed in only three patients out of 1486 (0.2%). After adjusting for age, gender and race, the likelihood of ischemic stroke with coronavirus was 7.6 times higher than with flu.

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The complex biological nature of disorders leading to stroke is a consequence of the interaction of many risk factors, including both non-modifiable (age, gender, race and ethnicity, heredity, etc.) and modifiable factors (high blood pressure, diabetes, high cholesterol, atrial fibrillation, overweight, lifestyle). Modifiable risk factors are responsible for no more than 60% of the general population risk of ischemic stroke. [10]

The 2019-2020 coronavirus infection pandemic has demonstrated not only the high aggressiveness of the new infectious agent, but also its ability to cause severe cardiovascular complications. In recent decades, ischemic stroke has been one of the leading causes of death in older age groups (Mozaffarian D., Benjamin E., Go A. et al., 2016). A generalization of the first results of treatment of victims of coronavirus infection showed that the development of IS in such patients is very likely. The high mortality rate in elderly patients infected with COVID-19 is partly associated with the development of fatal cardiovascular complications, the most severe of which is stroke (7,14).

An analysis of the few available publications that mention the problem of COVID-associated ischemic stroke can show not only the significance of the problem, but also reveal the mechanisms of acute cerebral ischemia. Prevention of acute cerebrovascular accidents (ACVI) in those infected with COVID-19 seems to be one of the important clinical tasks that need to be addressed in conditions of high workload in specialized hospitals and a shortage of specialists.

According to the data of the first publications, which analyzed the neurological complications of coronavirus infection, acute cerebrovascular accidents (ACVI) were found in 6% of patients. The first generalizations of clinical observations show that syndromes of thrombotic occlusion of large arteries prevail in the structure of pathogenetic subtypes of ischemic stroke (IS). In addition, a high incidence of impaired consciousness (more than 15% according to Mao L. 2020) may indicate the possibility of diffuse brain damage of the type of acute (toxic, hypoxemic, ischemic) encephalopathy. [12]

To clarify the pathogenesis of acute cerebral ischemia, it is now customary to distinguish pathogenetic subtypes of IS in accordance with the TOAST etiological classification. According to this classification, about 80% of all AIs are distributed between the main subtypes - atherothrombotic (atherosclerotic disease of large arteries), cardioembolic (the main cause is atrial fibrillation), lacunar (microangiopathy is a disease of small arteries). Formally, CVA against the background of coronavirus infection can be classified as "other established causes". However, there are several important arguments against this formal allocation. These arguments call for a more detailed analysis of the causes and mechanisms of COVID-associated ischemic stroke. [11] The first argument is based on the assumption that this form of stroke is not associated with atherosclerosis, and therefore has an original pathogenesis and a completely different etiology. [6,8] The second argument is based on facts indicating the participation of an active inflammatory process in the pathogenesis of COVID-associated ischemic stroke. Finally, the third argument comes from the established practice of treating such patients. In contrast to standard methods of treatment based on the use of antiplatelet and lipid-lowering therapy to prevent atherothrombosis, anticoagulants show better results in patients with coronavirus infection (does not comply with current clinical guidelines) [4].

Analysis of clinical data shows that patients suffer a stroke in the acute period of coronavirus infection against a background of hyperthermia and often pneumonia. Stroke is characterized by a large-focal lesion in the carotid vascular system, more like a syndrome of thrombotic occlusion of a large artery. A significant difference between COVID-dependent atherothrombotic IS is the absence of a connection between a thrombus and an atherosclerotic plaque and the presence of signs of inflammation of the vascular wall. D.McNamara (2020) draws attention to the inflammation and edema of the arteries of the vascular basin in which cerebral infarction develops, which can be regarded as acute vasculitis. Inflammation and edema of the vascular wall directly or indirectly associated with exposure to a virus or an autoimmune reaction is possible, but not an obligatory sign of the development and generalization of the infectious process. Moreover, neurological syndrome associated with inflammation of large arteries is more rare than a regularity.

Analysis of the first data containing a comparison of the clinical picture of stroke and the results of laboratory tests can, to some extent, explain the fact and frequency of the development of large artery disease syndrome. L. Mao et al. (2020) present an analysis of laboratory data from 124 patients who were hospitalized with coronavirus infection. The average age of the patients was 54 years, the severe course of the disease was noted in 59%. Cerebrovascular syndromes were detected in 6% of patients, all in the group with severe course.

Determination of predictors and biomarkers of an aggressive course of the disease

is an important scientific and practical task, the solution of which will allow avoiding such severe complications as stroke. However, the possibility of such hyperreactivity suggests the use of active immunosuppression when signs of vasculitis appear.

The hypercoagulable status of patients with coronavirus infection is another important factor in changing the stable course of diseases associated with atherosclerosis.

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