

Features of the Manifestation of Various Neurological Complications in Patients Who Have Undergone Covid-19

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ABSTRACT

The article analyzes the features of the manifestation of various neurological complications in patients who have had a coronavirus infection. Coronavirus infection can affect the neurological system of the body, causing various symptoms and complications. The virus can enter the nervous system through blood vessels and neural pathways, causing inflammation and damage to nerve cells. Some of the most common neurological symptoms associated with coronavirus infection include headache, smell and taste, coordination disorders, weakness, fatigue, and sleep problems. It is also reported about rare cases when the coronavirus can cause encephalitis (inflammation of the brain), acute myelitis (inflammation of the spinal cord) and other serious neurological complications.

The author notes that neurologists today face an unprecedented need to understand and treat the neurological consequences of the long-term development of COVID-19. Today, there is a need for international cooperation between medical societies, rapid and transparent transfer of research data, as well as further mandatory fundamental research to understand the pathophysiological correlates of the long-term development of COVID. In addition, taking into account the growing public demand for evidence-based interventions, it is time for scientists to join forces with each other and to develop preventive and therapeutic strategies for COVID-19 survivors in order to mitigate the consequences for the community.

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INTRODUCTION

The 2019 coronavirus disease (COVID-19) caused by Severe Acute Respiratory syndrome coronavirus 2 (SARS-CoV-2) is a multi-organ and multi-system disease in a global pandemic with more than 500 million confirmed cases and 6 million deaths.¹

Coronavirus infection can cause neurological complications, although they are relatively rare. These are encephalitis - inflammation of the brain, which can lead to impaired consciousness, seizures and other neurological symptoms; headache - a more frequent neurological complication that may be associated with hypoxia (insufficient oxygen supply to the brain) or high fever; acute myelitis - inflammation of the spinal cord, which can lead to paralysis and other disorders motor function; hypoxic encephalopathy is a condition that occurs when there is a lack of oxygen in the brain and can lead to impaired consciousness and other neurological symptoms; acute dysarthric syndrome is a condition that occurs when the brain is damaged and leads to speech impairment; hyperosmolar coma is a condition that occurs when the balance of electrolytes in the body is disturbed and can lead to coma

These complications may be associated with a severe course of coronavirus infection, as well as with the presence of concomitant diseases and risk factors. However, they are rare, and most patients with coronavirus infection do not experience neurological complications.²

KEYWORDS:

COVID-19, neurological complications, variants of manifestation, severity of the course.

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COVID-19 has a high incidence because SARS-CoV-2, especially one of its variants, Omicron, is highly contagious, can be transmitted in several ways and has a high mortality rate in severe cases due to respiratory failure and fatal cardiovascular cases

Since the neurological system is susceptible to SARS-CoV-2 infection, it is impossible to ignore the various manifestations of the neurological and psychiatric systems (NPS) during its acute and subsequent phases. Clinical studies indicate a high risk of N/P disorders in patients with COVID-19 and post-COVID-19, and also found that their outcomes were positively associated with the severity of COVID-19 [2]. These clinical manifestations occur due to direct invasion of SARS-CoV-2 into the central nervous system (CNS), often complicated by systemic hypoxia, dysfunction of the activity of the renin-angiotensin system and other relevant pathological changes [3]. These changes can remain long-term and permanently cause symptoms associated with the central nervous system after COVID-19, such as difficulties with memory, attention and concentration, persistent headaches, prolonged loss of sense of smell and taste, persistent muscle pain and chronic fatigue. Mild mental confusion and coma are among the most serious adverse outcomes of neuropathological manifestations in patients with COVID-19. Manifestations of NPS in COVID-19 patients are diverse and differ at different stages of their course. Although laboratory studies and neuroimaging results are useful for quantifying disease progression, risks, and patient prognosis, large-scale and ongoing multicenter cohort clinical studies are needed to assess the effects and interactions of COVID-19 on NPS.

Most patients with coronavirus infection do not experience neurological symptoms, and even if they occur, they usually have a mild character and go away on their own. However, in some patients, neurological symptoms may remain after recovery, so it is important to pay attention to any changes in the state of health and consult a doctor in a timely manner

The aim of the work is to analyze the features of the manifestation of various neurological complications in patients who have suffered a coronavirus infection.

RESEARCH METHODS

To consider the stated topic, an analysis of the literary array was carried out as part of the study of the main problem, for this purpose, comparative and retrospective research methods were used in the work

RESULTS

Complications after coronavirus infection can be diverse and include both physical and psychological manifestations. Some patients may have long-lasting effects after recovery from COVID-19. The most common complications after coronavirus infection include:

- respiratory complications: some patients after COVID-19 may have breathing and coughing problems, as well as other respiratory problems;
- cardiac complications: COVID-19 can affect the cardiovascular system, causing an increased risk of

developing cardiovascular diseases such as arrhythmia and cardiomyopathy;

- neurological complications: COVID-19 can cause various neurological manifestations, including headache, loss of sense of smell and taste, as well as brain strokes;
- psychological complications: COVID-19 can affect mental health, causing depression, anxiety and post-traumatic stress syndrome;
- muscle and joint complications: some patients may experience muscle and joint pain after COVID-19;
- Digestive problems: COVID-19 can cause digestive problems such as diarrhea and nausea;
- skin problems: Some patients may experience skin problems after COVID-19, such as rash and redness.³

COVID-19 can also cause other complications, such as an increased risk of thrombosis and kidney damage.

It is important to note that long-term consequences after COVID-19 can have a significant impact on the patient's quality of life and require professional medical supervision and treatment. If you experience any complications after COVID-19, it is important to consult a doctor for advice and treatment [4]

In addition, some studies show that COVID-19 can cause long-term neurological consequences, such as depression, anxiety and memory loss. These effects may continue even after the patient has fully recovered. It is important to note that neurological manifestations in patients with COVID-19 can be caused not only by the direct impact of the virus on the nervous system, but also by other factors associated with infection, such as oxygen starvation, inflammation, immune responses and toxic effects of drugs

Doctors are particularly concerned about the occurrence of a number of syndromes and neurological diseases against the background of coronavirus infection, which can have long-term consequences for patients. Thus, one of the manifestations of neurological consequences may be the occurrence of Gaines-Barre syndrome

Gaines-Barre syndrome is a rare neurological disease that can occur in some patients after a coronavirus infection. This is an autoimmune disease in which the body's immune system begins to attack nerve cells, which leads to a malfunction of the nervous system. Most patients with Gaines-Barre syndrome develop the first symptoms a few days or weeks after the COVID-19 disease. Symptoms may include muscle weakness, numbness or burning in the extremities, impaired coordination of movements and other neurological symptoms [5]. This disease can lead to a violation of the function of the respiratory system, which requires immediate treatment in a hospital. The treatment of Gaines-Barre syndrome involves the use of immunoglobulins or plasmapheresis to suppress the activity of the immune system and reduce inflammation in the nervous system.

Despite the fact that Gaines-Barre syndrome is a rare complication of coronavirus infection, its appearance in patients can lead to serious complications and a long period of rehabilitation. Therefore, it is important to closely monitor

your health and consult a doctor if you have neurological symptoms or other problems after a coronavirus infection

In addition to Gaires-Barre syndrome, some patients may experience other neurological complications after coronavirus infection, such as myasthenia gravis, anxiety and depressive disorders, headache, disorientation, seizures, sleep disorders, and others

Coronavirus infection can also be dangerous for patients with established postencephalitis or Parkinson's disease. In patients with postencephalitis, which is caused by the herpes virus, an increased risk of developing severe COVID-19 and complications from it was found. At the same time, the coronavirus can worsen neurological manifestations of postencephalitis, such as sleep disorders, headache, muscle cramps, etc. Patients with Parkinson's disease, which is a chronic neurological disease, may also have some problems with coronavirus infection. For example, coronavirus can worsen the symptoms of Parkinson's disease, such as trembling, muscle weakness, movement coordination disorders, and others. In addition, coronavirus can lead to a deterioration in the general condition of patients with Parkinson's disease, which can affect their quality of life and increase the risk of complications. In general, patients with neurological diseases such as postencephalitis and Parkinson's disease should be especially careful and take all necessary precautions to avoid contracting coronavirus infection. In case of any changes in health, you should consult a doctor for advice and prescribe the necessary treatment.⁶

Ischemic stroke is one of the most serious neurological complications that can occur in patients with COVID-19. This type of stroke is associated with a violation of the blood supply to the brain, which leads to mental and physical disorders. Studies have shown that the risk of ischemic stroke in patients with COVID-19 is several times higher than in those who have not contracted this virus. According to preliminary data, some patients may develop a stroke in the early stages of COVID-19 disease, but more often it manifests itself in later stages, when the patient has already suffered a severe period of the disease and is in the recovery stage. These patients may have a brain hemorrhage or the formation of blood clots that block the blood vessels of the brain. Therefore, it is very important that patients with COVID-19 monitor their health, especially if they have risk factors for stroke, such as high blood pressure, diabetes or high cholesterol. If a patient has symptoms of a stroke, it is necessary to seek medical help immediately.⁷

Unfortunately, cases of stroke after coronavirus have been described in many clinical studies. For example, a study conducted in China found that 5.9% of patients with COVID-19 had a stroke. Another study conducted in Italy found that 2.5% of patients with COVID-19 had a stroke.

One case describes a case of hospitalization of a man aged 44 with a diagnosis of COVID-19. This patient developed a stroke a few days after the onset of the disease, although he had no risk factors for stroke, but high blood pressure was present, which could cause stroke.⁸ Another study describes a 57-year-old woman who was diagnosed with COVID-19 and who developed a stroke on the 15th day after the onset of the disease. The patient had high blood pressure and diabetes, which are risk factors for stroke.⁹ Cases of stroke have also been described in

patients with COVID-19 who were on artificial ventilation due to a severe form of the disease. They can develop thrombosis in the blood vessels, which leads to the development of stroke. These clinical cases emphasize the need for careful monitoring of the health of patients with COVID-19, especially those who have risk factors for stroke, as well as timely diagnosis and treatment of stroke, if it does develop

Another clinical case was described in August 2020. A 70-year-old man was hospitalized due to acute speech delay and weakness of the right side of the body. The patient was also diagnosed with fever and cough, and later he was confirmed to have COVID-19 infection. Magnetic resonance imaging (MRI) of the brain showed a heart attack in the left internal carotid artery. The patient was treated with anticoagulants and anticoagulant therapy, and after 8 days was discharged with partial restoration of motor function.¹⁰

Several clinical cases of stroke in young patients after COVID-19 infection have also been described. In particular, in October 2020, researchers described two patients a 24-year-old woman and a 38-year-old man who had symptoms of COVID-19, and then developed an ischemic stroke. Both patients were hospitalized in the intensive care unit and were treated with anticoagulants and anti-inflammatory drugs. Partial recovery of motor function was observed in both patients.

In general, although coronavirus infection can lead to various neurological complications, including stroke, the exact mechanisms of this interaction are still not fully understood and require further research.

Encephalopathy is a broad term describing brain dysfunction that can be caused by various factors, including infections. There are reports that patients with COVID-19 may develop encephalopathy as a complication. Symptoms of encephalopathy may include confusion, difficulty concentrating, memory impairment, sleep disturbance, and depression. In more severe cases, more serious symptoms may occur, such as seizures, hallucinations and a decrease in consciousness. One of the putative mechanisms of encephalopathy development in patients with COVID-19 is hypoxia caused by pneumonia and other respiratory complications. In addition, immune disorders caused by infection can lead to an inflammatory reaction in the brain, which can also lead to encephalopathy. Some studies describe cases of encephalopathy in patients with COVID-19. For example, the literature describes a case when patients with COVID-19 developed delirium, which was associated with a more severe course of the disease and increased mortality. Another study is devoted to the description of cases of myelitis in patients with COVID-19, which can be classified as a form of encephalopathy. Although encephalopathy is not the most common complication of COVID-19, but due to possible serious consequences, such as impaired cognitive functions and deterioration of mental health, it is a subject of active research and monitoring by the medical community.¹¹

Clinical cases of encephalopathy after coronavirus are described in scientific articles and reports of medical institutions around the world. For example, one study describes the case of a 55-year-old man who was admitted to the hospital with symptoms of COVID-19. Despite the treatment, the patient began to experience panic attacks, disorientation in space and

time, and other symptoms characteristic of encephalopathy. It was found that the patient had elevated protein levels in the fluid surrounding the brain, which indicated an inflammatory process in the central nervous system.

Another study describes the case of a 47-year-old woman who began experiencing headache, dizziness, nausea, insomnia and other symptoms after she suffered COVID-19. After neuroimaging tests, the patient was found to have encephalopathy with impaired memory, attention and spatial orientation [12]. In addition, the Centers for Disease Control and Prevention (CDC) report in the USA, cases of encephalopathy have been described in patients with COVID-19 who had no other risk factors for this disease. Thus, although encephalopathy is a rare complication of COVID-19, it can occur both in the early stages of the disease and after recovery it is ambiguous and requires further research. Some studies show that some patients in the early stages of COVID-19 may experience neurological symptoms, such as headache, loss of smell, loss of taste, and others, but these symptoms may be associated with general symptoms of the disease, and not with direct damage to the nervous system [13]. However, there are some reports that COVID-19 can cause neurological complications such as stroke, encephalopathy, muscle disorders and others that can occur both at the initial stage of the disease and at later stages. Some studies also indicate that patients with severe COVID-19, especially the elderly, may have a higher risk of neurological complications. For example, one study found that patients hospitalized with severe COVID-19 have a higher risk of developing mental disorders such as depression and anxiety.

Another study found that 36.4% of the 214 hospitalized COVID-19 patients in China had neurological symptoms such as headache, dizziness, seizures, paresis and others. 7.5% of patients were diagnosed with stroke. The authors of the study noted that neurological symptoms may be the first manifestations of COVID-19, especially in patients with a severe form of the disease. The third group of authors noted that 18% of patients hospitalized with COVID-19 had mental disorders such as depression, anxiety, anxiety and others. In patients with severe form of the disease, the risk of developing mental disorders was higher.

A study conducted in Canada showed that 3.5% of patients with COVID-19 had neurological complications such as strokes, seizures, paresis and others. In patients with severe form of the disease, the risk of neurological complications was higher.¹⁴

Another medical study noted that patients who have undergone COVID-19 may experience neurological complications, such as headache, dizziness, loss of sense of smell and taste, neuropathy, and others. The authors of the study noted that these complications can be caused not only by direct damage to the nervous system by coronavirus, but also by other factors such as inflammation, hypoxia and others. A study conducted in the United States showed that patients who have undergone COVID-19 may experience a long-term fatigue syndrome, which can last at least several weeks to several months after recovery from the coronavirus. In some patients, this syndrome is accompanied by neurological symptoms, such as headache, dizziness, lethargy, difficulty concentrating, and others. A study conducted in Italy has shown that patients who have undergone COVID-19 may have an autoimmune disease of the

nervous system, such as Guillain-Barre syndrome. This disease can lead to paralysis, respiratory failure and other serious consequences. A study conducted in Iran showed that patients with COVID-19 may experience sleep disorders, cognitive decline, and other neurological complications.¹⁵

The general conclusions from these studies indicate that COVID-19 can lead to various neurological complications, both in the initial and late stages of the disease. These complications may be associated with direct damage to the nervous system by the coronavirus, as well as with other factors such as inflammation, hypoxia, and others. In addition, patients with a severe form of the disease have a higher risk of neurological complications. Therefore, it is important to take into account neurological symptoms in patients with COVID-19 and to carry out timely diagnosis and treatment of neurological complications

Also, many studies indicate that neurological complications may be associated with long-term health consequences for patients, even after recovery from COVID-19. For example, some patients may experience memory problems, cognitive disorders, anxiety, depression, and other neurological problems even after they have completely gotten rid of the infection. There is also the possibility that COVID-19 may increase the risk of developing certain neurological diseases in the future. For example, studies have shown that patients who have undergone coronavirus have an increased risk of developing Alzheimer's disease and other forms of dementia.¹⁶

Despite the fact that many questions about the neurological complications of COVID-19 still need to be studied in more detail, there is a lot of evidence that this virus can have serious neurological consequences. Therefore, it is important to pay attention to neurological symptoms in patients with COVID-19 and conduct research to better understand how this virus affects the nervous system and how neurological complications can be prevented.

DISCUSSION

One of the factors contributing to the development of neurological complications of COVID-19 is the long-term development of coronavirus infection. Prolonged development of coronavirus infection (COVID-19) is understood as a condition in which a patient continues to experience symptoms of the disease for several weeks or months after he has recovered from the acute phase of infection. This condition is also known as long-term COVID-19 syndrome

Many patients who have suffered COVID-19, usually 2-3 weeks after the onset of symptoms of the disease, their condition improves and they begin to recover. However, some patients may have various symptoms, such as fatigue, cough, shortness of breath, headaches, muscle weakness, sleep disorders, digestive problems, low mood and other neurological manifestations. This syndrome can have a significant impact on the quality of life of patients and requires additional medical supervision and treatment. The exact mechanisms underlying the long-term COVID-19 syndrome are still not fully understood, and an active study of this condition is currently underway. There is also a long-term neurological deficit - this is a condition when patients retain neurological

symptoms even after discharge from the hospital and achieve clinical stability after a coronavirus infection. This may include symptoms such as headache, dizziness, sensitivity changes, muscle weakness, and mental disorders. The study of long-term neurological deficits in patients with COVID-19 is still in its initial stage. However, there are already reports of neurological complications that may continue even after recovery from infection. One study found that 34% of 153 patients with COVID-19 had various neurological disorders, such as drowsiness, insomnia, cognitive disorders and anxiety, within 6 months of the onset of infection. In another study, experts noted that some patients with COVID-19 continue to experience headache, fatigue and muscle weakness after recovering from infection.¹⁷

There are also a number of reports on the development of chronic fatigue syndrome in patients after COVID-19. This syndrome is manifested by prolonged fatigue, weakness and problems with memory and concentration, which can last several months after recovery from infection. Thus, a long-term neurological deficit in patients with COVID-19 is a serious complication that can continue even after recovery from infection. Further research is needed to understand the mechanisms of this condition and determine the best ways to treat and manage symptoms

From a variety of studies conducted in various countries of the world, it has been revealed that neurological complications of coronavirus infection can develop in patients of different age groups, genders and concomitant diseases. However, there are factors that may increase the likelihood of neurological complications in patients with coronavirus.¹⁸

According to some studies, elderly people, especially those who have concomitant diseases (for example, arterial hypertension, diabetes, cardiovascular diseases), are at risk of developing neurological complications, including stroke, encephalitis and neuromyopathy. There is also evidence of a higher risk of neurological complications in men than in women. There is a separate group of patients who are younger than 50 years old and do not have any concomitant diseases, but also face neurological complications after a coronavirus infection. Additional studies are being conducted to identify additional factors that may affect the development of neurological complications in this group of patients.¹⁹

Thus, currently, the study of demographic and sexual factors affecting the development of neurological abnormalities in coronavirus infection continues, and the results will be important for determining risk groups and developing methods for the prevention and treatment of neurological complications in patients with COVID-19

Some factors may increase the risk of neurological symptoms in coronavirus infection, including cerebrovascular diseases, constitutional factors and psychosocial stressors. Cerebrovascular diseases, such as ischemic stroke, cerebral hemorrhages and other diseases, can increase the risk of developing neurological symptoms in coronavirus infection. This is due to the fact that the coronavirus can worsen blood flow in the brain and cause an inflammatory reaction that can lead to neural death. In addition, constitutional factors, such as age and the presence of other chronic diseases, can also increase

the risk of neurological symptoms in coronavirus infection. Studies have shown that older age and the presence of other diseases, such as diabetes mellitus and hypertension, are risk factors for the development of neurological complications in coronavirus infection.²⁰

Finally, psychosocial stressors such as stress and depression can also increase the risk of neurological symptoms in coronavirus infection. This is due to the fact that stress can cause an inflammatory reaction in the body, which in turn can lead to neural death.

In addition, some constitutional factors may also affect the risk of developing neurological symptoms in COVID-19. For example, some genetic mutations may increase the risk of developing severe forms of the disease, including neurological complications. Age-related factors may also play a role, as older people are more susceptible to the development of serious neurological complications. Also, some psychosocial stressors, such as anxiety, depression and social isolation, may also increase the risk of developing neurological symptoms in COVID-19. Studies show that psychosocial factors can affect the immune system and contribute to the development of inflammation, which can affect the development of neurological symptoms. Assessment of neurological symptoms and functional status in patients with prolonged development of coronavirus infection requires the use of standardized clinical neurological and functional scales. This makes it possible to assess the severity of neurological disorders, their dynamics and the effectiveness of treatment.²¹

One of the widely used scales is the neurological deficit scale of the National Institutes of Health Stroke Scale (NIHSS), which allows you to assess the severity of cerebrovascular disorders. In addition, the Barthel Index and Modified Rankin Scale scales are used to assess the functional state of patients. Neurophysiological methods such as electroencephalography (EEG), evocation potentials (EP), electromyography (EMG) and others are also used to assess neurological disorders associated with the long-term development of coronavirus infection. These methods allow us to assess the functional state of the nervous system, identify electrophysiological disorders and give a prognosis for the restoration of neurological functions. It is important to note that the use of standardized clinical neurological and functional scales is necessary for an objective assessment of the patient's condition and decision-making on treatment and rehabilitation

Studies show that with the long-term development of coronavirus infection, patients may experience changes in blood test parameters. However, these changes are not specific and can occur in other diseases. For example, patients with a long course of COVID-19 may have an increased level of C-reactive protein, which indicates the presence of inflammation in the body. Also, in such patients, the level of ferritin may be increased, which reflects the level of iron in the body and can also be increased in inflammatory diseases

In addition, some studies show that patients with a long course of COVID-19 may experience leukocytosis (an increased number of white blood cells in the blood), thrombocytopenia (a reduced number of platelets) and an increased level of D-dimers (fragments of destroyed blood clots), which may

indicate a violation of the functions of the circulatory system. However, it should be noted that these changes may be non-specific and are not necessarily associated with the long course of COVID-19. Therefore, the diagnosis of long-term development of coronavirus infection should be based not only on blood tests, but also on other clinical, neurological and functional indicators

To exclude neurological disorders with prolonged development of coronavirus, specialized neuroimaging and neurophysiological studies can be used.

Neuroimaging techniques include computed tomography (CT) and magnetic resonance imaging (MRI) of the brain, which can reveal structural changes such as vascular infarctions, hemorrhages, brain edema and degenerative changes in the brain. Electroencephalographic examination (EEG) can also be performed to assess the electrical activity of the brain. Neurophysiological methods include electromyography (EMG) to study the electrical activity of muscles and neurostimulation to study the nervous system. These methods can help in the diagnosis of neurological disorders such as muscle weakness, paralysis and neuropathy. However, it should be noted that these diagnostic methods are not always specific to coronavirus infection and can be used to detect other neurological diseases. Therefore, a comprehensive neurological examination is necessary, taking into account clinical manifestations and anamnesis.

Neurorehabilitation is a comprehensive medical care program aimed at restoring and improving the functions of the nervous system after its damage. In case of prolonged development of coronavirus infection, neurorehabilitation can help patients who have neurological complications. Neurorehabilitation after coronavirus infection may include several methods and approaches, depending on the symptoms and complications that are observed in the patient. It can include physical and orthopedic rehabilitation, speech and cognitive therapy, psychotherapy and social support.

Physical rehabilitation can include exercises to increase muscle strength and flexibility, balance and coordination training, aerobic exercises that will help restore physical activity and reduce fatigue. Physiotherapy methods, such as massage and electrical muscle stimulation, can also be used.

Orthopedic rehabilitation may include the use of special devices and apparatuses, such as orthopedic shoes and orthoses, to help restore movement and support the body.

Speech and cognitive therapy helps patients who have problems with speech and cognitive functions to restore the connection between the brain and the body. It may include exercises to improve speech, teaching the patient new strategies for solving problems and memory training.

Psychotherapy can help patients who suffer from anxiety, depression or other mental disorders that may be associated with the long-term development of coronavirus infection. It may include cognitive behavioral therapy, meditation, and other methods. Social support includes assistance in organizing the patient's daily life, assistance in receiving social services and support from family and friends.

CONCLUSION

In general, understanding the risk factors that may increase the probability of neurological symptoms in coronavirus infection may help in identifying the highest risk group and improving strategies for the prevention and treatment of neurological complications in patients with COVID-19. Various demographic, sexual, constitutional, and psychosocial factors may affect the risk of developing neurological symptoms in COVID-19. Further studies are needed to more accurately determine the role of each of these factors in the development of neurological complications in coronavirus infection. All methods of neurorehabilitation after coronavirus infection should be carried out under the supervision of specialists and individually selected for each patient, depending on his condition and needs.

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