

Complications of patients with multiple sclerosis after suffering from coronavirus infection.

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ABSTRACT

Background

SARS-CoV-2 is a single-stranded RNA virus belonging to the group of acute coronaviruses, and its infection causes the disease COVID-19. Coronavirus 2(SARS-CoV-2), accompanied by severe acute respiratory syndrome in 2019, requires special attention to patients with chronic diseases, especially those with diseases such as multiple sclerosis (MS), as MS is one of the most vulnerable groups. This is due to the fact that MS patients have a higher risk that the infection will lead to a change in the course of the disease and complications due to the fact that measures for the complete treatment of the disease have not been studied.

Purpose of the study

To study and analyze the consequences of the disease in patients with multiple sclerosis who have suffered coronavirus infection using a scientific database published in peer-reviewed journals indexed in PubMed, Web of Science, Scopus and RSCI.

Results and conclusions

This has also led to global, socio-economic consequences and an increase in the number of deaths. Currently, according to the latest statistical report for 04/13/2024, the number of people infected with COVID-19 worldwide has reached 704753890 people. Epidemiological studies have shown an approximately 30% increased risk of death from vascular diseases in MS patients after COVID-19. In addition, MS patients are particularly susceptible to the complications of COVID-19. Complications of common COVID-19 infection against the background of COVID-19 often developed complicated stroke, cerebral venous thrombosis, autoimmune encephalitis, acute multiple encephalomyelitis, Guillain-Barre syndrome. Studies have shown that cognitive dysfunction is the most common symptom of post-covid and has been observed in 70% of MS patients. Thus, arterial hypertension in patients with MS, i.e. in patients with concomitant diseases, is characterized by an increased risk of developing severe and critical forms of COVID-19 infection. In this literature review, we tried to summarize the available information on complications after COVID-19 by publishing data on MS in patients with SARS-CoV-2-related pathology.

Keywords

COVID-19; concomitant conditions; multiple sclerosis; severity of coronavirus infection; central nervous system.

INTRODUCTION

Coronavirus infection (COVID-19) is a transmissible pandemic disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), leading to social and environmental consequences as well as human mortality. The novel strain of coronavirus was first identified in 2019, and the diagnosis and treatment of infected patients posed significant challenges. This disease affects multiple organ systems, including the central nervous system (CNS), and may lead to both acute and chronic complications of various disorders.

One such group at particular risk includes patients with chronic immune-mediated diseases such as multiple sclerosis (MS), which is frequently treated with immunomodulatory and immunosuppressive therapies and often leads to disability among young individuals. The disease pathogenesis involves damage to the myelin sheath of nerve fibers, resulting in impaired nerve impulse conduction and various neurological disorders². The inflammatory response induced by coronavirus infection may accelerate early and subclinical mechanisms, contributing to the development of neurodegenerative processes. The SARS-CoV-2 receptor is highly expressed

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in epithelial cells of the respiratory system as well as in neurons and glial cells, making the CNS a potential target for this coronavirus.

Based on currently available data on viral infection, it can be suggested that COVID-19 may not only exacerbate neurological syndromes but may also act as a high-risk factor contributing to neurodegenerative diseases^{3,4}. Moreover, since MS is a chronic autoimmune disease affecting the central nervous system, patients with MS are considered a vulnerable population for COVID-19. In these patients, the infection may increase relapse frequency, susceptibility to infection, alter disease progression, and contribute to increased disability⁵⁻⁷.

Patients with higher scores on disability scales, long disease duration, and progressive forms of MS may experience more severe outcomes of COVID-19. This is due to mechanisms involving hematogenous spread and neuronal dissemination, which allow viral entry into the CNS, potentially leading to severe neurological disorders and post-COVID syndrome⁸.

Aim of the study

The aim of this study was to investigate and analyze the outcomes of coronavirus infection in patients with multiple sclerosis (MS) using scientific data published in peer-reviewed journals indexed in PubMed, Web of Science, Scopus, and RSCI.

MATERIALS AND METHOD

Effect of coronavirus infection on the central nervous system (CNS). It is currently known that SARS-CoV-2 infection induces a cytokine storm syndrome, which is one of the factors leading to acute cerebrovascular events. The coexistence of cerebrovascular disorders in patients diagnosed with MS presents a significant clinical challenge. Epidemiological studies have shown that after COVID-19, the risk of mortality due to vascular complications in MS patients increases by approximately 30%.

The main symptoms of COVID-19 include fever, dry cough, fatigue, headache, diarrhea, and loss of taste or smell. However, the mechanisms underlying neurological manifestations remain unclear, although the risk of disease progression is higher compared to the general population. In patients with MS, COVID-19 significantly contributes to increased morbidity, relapse frequency, symptom exacerbation, and progression of neurological impairment, and may induce CNS

inflammation. In addition, an increase in cognitive impairment has been observed in MS patients following COVID-19 infection.

The severe impact of COVID-19 on MS progression may be associated with excessive immune activation in the context of systemic inflammation and cytokine dysregulation, which affects the CNS, particularly through disruption of the blood–brain barrier (BBB). This has been associated with increased relapse rates in the relapsing–remitting course of MS and the presence of neuroinflammation in patients [9–13]. However, these processes may arise either as indirect consequences of systemic inflammation or as a result of direct viral effects on neuronal and glial cells. Neuroinflammation may lead to acute demyelination through both short- and long-term effects on the nervous system.

Researchers have demonstrated that COVID-19 exhibits a high degree of neurotropism; therefore, the vascular system is actively involved in its pathogenesis, contributing to various complications. Neurotoxic and neuroinvasive properties have also been identified, allowing the virus to enter the CNS via hematogenous spread or peripheral nerves, disrupting the structural integrity of the BBB and increasing relapse frequency in MS patients.

Patients with MS are particularly susceptible to complications of COVID-19. Reported complications include aggravated cerebrovascular disease, cerebral venous thrombosis, autoimmune encephalitis, acute disseminated encephalomyelitis, and Guillain–Barré syndrome. Guillain–Barré syndrome represents a major concern, as it is mediated by an autoimmune response in which the immune system attacks host cells, leading to progressive sensory loss and muscle weakness.

Inflammatory processes and impaired cerebral perfusion contribute to cerebrovascular pathology. In cases of brainstem involvement, apnea may appear as an early clinical sign. Due to the neurotropic nature of the virus, acute hemorrhagic encephalitis, encephalopathy, and acute disseminated encephalomyelitis may also develop¹⁴. Clinical manifestations include impaired consciousness, hemichorea, speech disturbances, and cognitive impairment¹⁵.

Studies suggest that the outcomes of COVID-19 in MS patients are not yet fully characterized; however, common post-infection symptoms include headache, dizziness, psychiatric disturbances, and altered

consciousness. Blood pressure instability and frequent dizziness are also observed. One of the most common symptoms is olfactory dysfunction, including hyposmia or complete anosmia. Impaired smell perception significantly affects appetite, distorts taste perception, and reduces the enjoyment of food, which may lead to mood instability and prolonged depressive states.

Neurological symptoms associated with COVID-19, such as headache and coordination disorders, may overlap with MS manifestations, complicating diagnosis and treatment. Some studies have shown that COVID-19 infection is associated with increased disease activity within 18–24 months, higher disability rates, neuropsychological stress, and cognitive dysfunction [16]. In addition, post-infectious hypercoagulability has been observed, which may lead to cerebrovascular diseases¹⁷.

After the pandemic, MS patients have reported increased anxiety and stress. Psychiatric disorders, particularly depression, have also been observed, indirectly affecting treatment regimens^{18–21}. Overall, MS patients with neurological impairment or disability have experienced negative impacts on daily functioning during the pandemic, as well as on the broader socio-economic context of the global crisis²².

The impact of coronavirus infection on mental health

The COVID-19 pandemic of 2019 has led to significant psychological disturbances. Epidemiological studies have demonstrated the heterogeneous psychological effects of the pandemic. Mental health disorders associated with COVID-19 have been reported in the form of delirium, hallucinations, and altered states of consciousness.

In multiple sclerosis (MS), stem cell therapy may suppress genes involved in inflammation and apoptosis, while activating neuroprotective genes, thereby protecting spinal neurons from secondary damage^{23–27}. Indeed, compared to the general population, MS is characterized by a higher burden of depressive symptoms, sleep disturbances, and increased fatigue levels, all of which contribute to disability in this disease.

The COVID-19 pandemic has posed significant challenges to psychological resilience. Its consequences differ between patients with chronic diseases and the general population, and quarantine measures may have had a substantial psychological impact on individuals with MS. This has led to increased levels of stress

and anxiety, which in turn may exacerbate disease symptoms. Isolation, concerns about health status, and reduced physical activity have had a markedly negative impact on patients' quality of life.

However, there is still limited evidence regarding potential strategies to enhance resilience in patients with chronic conditions such as COVID-19 and MS. Therefore, patients who have experienced infection should promptly seek medical consultation for diagnosis and management. Further research is needed to better understand the neuropsychiatric effects associated with viral pandemics and to develop evidence-based strategies for improving mental health in vulnerable populations during disease exacerbations, including patients with chronic illnesses, children, and adolescents²⁸.

Studies have also shown that among patients with MS, levels of depression and anxiety increased both before isolation and during the COVID-19 pandemic²⁹.

The impact of coronavirus infection on the immune and nervous systems in patients with multiple sclerosis (MS)

MS is an autoimmune disease in which the immune system attacks the myelin sheath of nerve fibers; therefore, immune responses in these patients are dysregulated. Patients receiving immunomodulatory or immunosuppressive therapy for disease control may have a higher risk of infection and may experience a more severe course of COVID-19. In this context, immune responses may be weakened, increasing susceptibility to viral infections, including COVID-19^{30,31}. However, some studies suggest that the clinical course of COVID-19 in MS patients may vary from mild to severe depending on disease subtype, severity, and the presence of comorbidities. Further studies are required to better understand the underlying pathophysiological dynamics between COVID-19 and MS. Although vaccination does not appear to alter the course of MS, a deeper understanding of the interaction between COVID-19 and MS remains crucial for optimizing immunomodulatory treatment strategies^{32,33}.

The effect of coronavirus infection on the course of MS.

Scientific evidence suggests that viral infections may influence MS through several mechanisms. SARS-CoV-2 may increase relapse frequency in MS patients by disrupting the structural integrity of the blood–brain barrier (BBB). The virus also enhances inflammatory

processes within the central nervous system (CNS), leading to neurological dysfunction. Studies indicate that COVID-19 may affect MS progression both directly and indirectly. The virus induces acute inflammatory responses, which in turn may trigger exacerbations of MS symptoms³⁴⁻³⁶.

Patients with MS often present with comorbid conditions such as hypertension, diabetes mellitus, and other chronic diseases, which may increase the risk of developing COVID-19. For example, patients with chronic neurological diseases such as MS may be at a higher risk of COVID-19 infection compared to some other high-risk groups, including kidney transplant recipients, and may face an increased risk of irreversible outcomes^{37,38}.

In MS patients receiving immunosuppressive therapy, immune function is further suppressed, increasing susceptibility to infection and potentially worsening disease outcomes. Therefore, appropriate disease-modifying therapy is particularly important during the pandemic. On one hand, both autoimmune pathology and immunosuppressive treatment increase infection risk due to impaired immune function; on the other hand, delaying MS treatment may lead to severe CNS complications.

Immunosuppressive agents, such as T-cell depleting therapies (e.g., ocrelizumab or alemtuzumab), may weaken the body's response to viral infections and increase the risk of severe COVID-19 by reducing immune defense mechanisms. Clinical observations during the COVID-19 pandemic suggest that extended dosing intervals of ocrelizumab in relapsing–remitting MS may represent a potential risk mitigation strategy^{39,40}. However, inappropriate dosing or delayed treatment may result in severe CNS consequences. Therefore, patient monitoring and adherence to hygiene recommendations are essential strategies for reducing SARS-CoV-2 infection rates in MS patients. Monitoring is particularly important in patients treated with alemtuzumab or cladribine, as well as in those with additional risk factors such as older age, obesity, malignancy, diabetes, and heart failure⁴⁰.

The social impact of COVID-19 on patients with MS.

Previous studies examining MS patients in China, Spain, and Cuba have analyzed the social and occupational impact of the COVID-19 pandemic. During the pandemic, family support was reported to

be higher in China compared to Spain and Cuba. In all three countries, neither the number of COVID-19 cases nor relapse rates increased significantly during the period of isolation. Patients in all three countries increasingly used digital and social media platforms to maintain interpersonal communication.

Regarding economic status, the negative impact was less pronounced among Spanish MS patients compared to those in Cuba and China. Physical well-being was more favorable among patients in China, while Spanish patients were more affected due to differences in economic stability and social support⁴²⁻⁴⁴.

Laboratory findings in patients with COVID-19 and multiple sclerosis (MS)

Laboratory data analysis has demonstrated that patients with MS exhibit elevated levels of D-dimer, fibrinogen, C-reactive protein (CRP), and increased platelet activation, all of which are key components of prothrombin index alterations⁴⁵. Thus, patients with MS are characterized by a higher risk of developing severe and critical forms of COVID-19 with acute respiratory failure. Non-specific inflammatory changes are frequently observed in patients presenting with neurological manifestations associated with both COVID-19 and MS. Increased levels of neurodegeneration biomarkers may impair neurogenesis, potentially leading to long-term consequences and loss of neural integrity⁴⁶⁻⁴⁸.

Post-COVID-19 outcomes in patients with MS

To determine how to manage central nervous system (CNS) recovery after COVID-19, it is essential to understand its consequences. Viral infections such as SARS-CoV-2 affect the integrity of the blood–brain barrier (BBB) and contribute to the development of multiple pathological processes, thereby increasing the risk of complications. In MS patients, post-COVID-19 complications may include ischemic stroke, Alzheimer's disease, stroke associated with COVID-19, cerebral venous thrombosis, autoimmune encephalitis, acute disseminated encephalomyelitis, and Guillain–Barré syndrome.

These complications are associated with neurodegenerative processes and may result from multiple mechanisms, including direct viral entry through olfactory or gustatory pathways, coagulopathy, generation of reactive oxygen species, autoimmune inflammation, and chronic inflammatory responses. Recent studies suggest a relationship between

COVID-19 and several neurodegenerative disorders, including Alzheimer's disease, ischemic stroke, and MS. Moreover, immune dysregulation observed in COVID-19 shares common pathogenic mechanisms with MS, ischemic stroke, and Alzheimer's disease⁴⁹.

These processes indicate that SARS-CoV-2 infection may act as an environmental risk factor for neurological disease manifestation in susceptible individuals by disrupting immune system function. The virus induces inflammation and promotes the production of interferons and neurotoxic cytokines that damage myelin sheaths responsible for neuronal protection. The immune system may also begin synthesizing autoantibodies targeting glial cells and neurons, thereby damaging anatomical structures of the brain involved in MS pathogenesis.

Furthermore, coronavirus infection may exacerbate MS by promoting neuroinflammation through the modulation of pro-inflammatory cytokines. Increased release of pro-inflammatory cytokines contributes to enhanced coagulation activity, leading to a hypercoagulable state. This condition may result in thrombosis, reduced cerebral blood flow, and ischemic stroke. In Alzheimer's disease, severe inflammation and increased oxidative stress are well documented⁵⁰.

Quality of life impact

MS patients infected with COVID-19 experience deterioration not only in physical health but also in psycho-emotional well-being. Fear of disease progression, isolation, reduced physical activity, and the need to modify treatment regimens contribute to additional stress and depression, significantly worsening overall quality of life.

RESULTS AND DISCUSSION

Treatment strategy for MS during the pandemic.

The COVID-19 pandemic has also influenced treatment approaches for patients with multiple sclerosis (MS). It has become evident that patients receiving immunosuppressive therapy require particular caution. Many patients adjusted medication doses or temporarily discontinued treatment in order to reduce the risk of severe outcomes associated with coronavirus infection⁵¹⁻⁵³.

Drug selection.

During the pandemic, certain medications such as interferons or other immunomodulators were considered

due to their differential effects; however, they do not suppress the immune system in the same manner as other disease-modifying therapies. Despite pandemic-related restrictions, it remains essential for MS patients to continue neurological follow-up. Regular monitoring enables timely detection of symptom changes and appropriate adjustment of therapy.

Vaccination and its role in MS patients.

Vaccination is one of the key strategies in combating COVID-19. SARS-CoV-2 is a pandemic infection, and its complete elimination may take several years. Studies indicate that COVID-19 vaccination is generally safe for most MS patients; however, special recommendations may be required for individuals receiving specific disease-modifying therapies, particularly those affecting immune function. Vaccine development and optimization may take 12–18 months in ideal conditions.

COVID-19 vaccines are considered safe for MS patients and have not been shown to alter the course of the disease. However, understanding the interaction between COVID-19 and MS remains essential for optimizing immunomodulatory treatment strategies [54]. Factors contributing to vaccine hesitancy should be addressed, and physicians should actively encourage vaccination. Neurologists should inform hesitant patients about the long-term consequences of COVID-19 and emphasize the historical success of vaccination in controlling previous pandemics. Vaccination represents a critical component in protecting MS patients from COVID-19.

Current evidence suggests that vaccination is safe for most MS patients; however, individuals receiving immunosuppressive therapy should consult their physician before vaccination. Some MS treatments may reduce vaccine efficacy by affecting immune responses, although vaccination remains a key protective measure against COVID-19.

CONCLUSION

The quality of life of individuals with MS largely depends on access to healthcare and patient support. Many MS patients experienced COVID-19 infection with varying degrees of severity, often leading to

adverse health outcomes⁵⁴. However, discontinuation of disease-modifying therapies (DMTs) poses an even greater risk, as it may lead to disease progression. In patients receiving B-cell depleting therapies such as ocrelizumab, neutralizing antibody titers may be reduced, potentially affecting protection against reinfection.

In addition to vaccination, preventive measures such as mask-wearing, social distancing, and psychological support are recommended. Patients should also receive adequate emotional and social support from family members and healthcare professionals, particularly during periods of stress related to isolation or fear of illness.

Current data confirm that COVID-19 vaccination is an important protective measure for MS patients. However, issues related to vaccine selection and efficacy in patients receiving immunomodulatory therapies remain relevant. Although COVID-19 management has become a healthcare priority, chronic neurological conditions should not be neglected. The use of tele-neurology and standardized neurological assessment tools may improve the quality of care for MS patients during the pandemic⁵⁵.

Patients are advised to maintain regular medical monitoring, adhere to preventive measures (mask use, social distancing, vaccination), and continue treatment in consultation with their physicians. Monitoring of neurological status is also essential, as infection may influence disease activity.

In conclusion, COVID-19 poses a significant risk to MS patients both in terms of increased complications and potential effects on disease progression, including symptom exacerbation and neurological deterioration. Coronavirus infection may represent an additional risk factor for patients with MS, and careful management, continued treatment, and medical consultation are essential to determine optimal therapy and prevention strategies. Nevertheless, adherence to vaccination recommendations, preventive measures, and individualized treatment approaches may help reduce complications and improve prognosis in these patients.

Authors' Contributions

Toremukhamet Akbota Maratovna, Buryshov Samat Maratovich, Abasova Gauhar Begalievna — conceptualization of the study, data analysis, text editing. **Sarybayeva Kamshat Myrzabekovna, Yesen Lyazzat Meldebekovna** — participation in writing the main sections of the article. **Kozhabayeva Farida Karzhauovna, Toremukhamet Akbota Maratovna** — participation in the analysis of the study results.

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