

EDITORIAL

Post-COVID-19 vaccination and the brain: A critical analysis of CNS MRI findings

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ABSTRACT

The coronavirus disease 2019 (COVID-19) pandemic has led to an urgent need for vaccine development and global distribution. Recent research suggests that there may be potential impacts on the central nervous system (CNS), as evidenced by findings from magnetic resonance imaging (MRI). This article aims to provide feedback on the current evidence regarding the associations between COVID-19 vaccination and neurological complications. It is essential to conduct further research to enhance our scientific understanding of how vaccines interact with the central nervous system. This knowledge can significantly support public health efforts in controlling the spread of new viral variants through widespread vaccination.

Keywords: COVID-19; vaccination; central nervous system; magnetic resonance imaging; neurological complications

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The rapid development and distribution of the 2019 vaccine coronavirus disease (COVID-19) mark a remarkable scientific achievement in the global response to the pandemic^[1,2]. As vaccination efforts continue around the world, concerns have emerged about the possible impact on the central nervous system (CNS)^[2]. This article aims to provide a comprehensive perspective on this critical issue by examining existing research and incorporating the latest findings.

Vaccination has proven vital in reducing COVID-19 transmission, severe illness, and death^[2]. However, as the virus evolves, new variants pose a persistent threat, underscoring the need for adapted vaccines and boosters^[3]. In this context, vaccine safety and effectiveness are paramount, especially to maintain public trust^[2].

Although vaccines play a crucial role, questions remain about their potential CNS effects^[2]. By reviewing the current literature and exploring the implications of CNS magnetic resonance imaging (MRI) findings post-vaccination, this article sheds light on possible neurological impacts. Regulatory oversight and continuous safety monitoring provide further insight.

Ultimately, our collective understanding of the interactions of the COVID-19 vaccine with the CNS is important for public health and vaccination efforts. As variants emerge, widespread vaccination remains imperative, not just for individual protection, but to curb the pandemic's toll. By bridging scientific advancements with public

discourse, this paper offers a well-rounded perspective on vaccinations amid this rapidly changing landscape.

Recent studies have examined the impact of different types of COVID-19 vaccines on MRI findings in the CNS^[2]. A systematic review conducted in June 2023 analyzed 89 relevant studies and identified several common diseases associated with post-vaccination CNS MRI findings, including cerebral venous sinus thrombosis (CVST), vaccine-induced immune thrombotic thrombocytopenia (VITT), acute disseminated encephalomyelitis (ADEM), acute myelitis, autoimmune encephalitis (AE), and others^[2]. The patients exhibited various symptoms and neurological manifestations, such as white matter hyperintensity (WM)^[2]. Additionally, there have been reports of rare and life-threatening adverse reactions like thrombosis with thrombocytopenia syndrome, Guillain-Barré syndrome (GBS), vasculitis, autoimmune hepatitis, inflammatory myopathies, and myocarditis, which are now believed to be caused by immune-mediated mechanisms^[2]. Another case series and literature review described six cases of inflammatory demyelinating events (CIDEs) in the CNS occurring between 8 and 35 days after a COVID-19 vaccine^[4]. These included two cases of acute transverse myelitis (ATM), three cases of multiple sclerosis (MS), and one case of neuromyelitis optica spectrum disorder (NMOSD). The review included 49 studies reporting a total of 85 CIDEs. With the addition of six more cases, a total of 91 CIDEs were summarized, including 24 cases of ATM, 11 cases of ADEM, 47 cases of MS, and nine cases of NMOSD/MOGAD. Overall, CIDEs occurred after both mRNA, adenoviral-vectored, and inactivated vaccines^[4]. To sum up, these findings highlight the complex and diverse neurological effects of COVID-19 vaccination on the CNS. Although many people experience mild or no side effects, these results underscore the need for continuous surveillance and research to better understand and manage neurological complications that may arise after vaccination.

Studies have also investigated the timing of CNS MRI abnormalities following vaccination. In one case-control study using single photon emission computed tomography (SPECT) to assess brain perfusion in 12 vaccinated patients with stroke-like symptoms on the left side, significant hyperperfusion was observed on the right side in various brain regions, including the postcentral, inferior parietal, mid-temporal, parahippocampal, and caudate regions^[5]. On the left side, hyperperfusion was observed in the thalamus, hippocampus, and mid-temporal areas. Hypoperfusion was observed bilaterally in the superior frontal gyri and the right mid/posterior cingulate cortex^[5]. Another study reported a case of acute demyelination that occurred 10 days after receiving the Oxford-AstraZeneca vaccine^[6]. Additionally, two cases of optic nerve pathology were reported following administration of the Pfizer-BioNTech and AstraZeneca-Oxford COVID-19 vaccines^[7]. One patient developed symptoms 16 days after the second dose of the Pfizer-BioNTech vaccine, while the other patient experienced symptoms six days after the first dose of the AstraZeneca-Oxford vaccine^[7]. These findings suggest that although most individuals experience no or mild side effects from COVID-19 vaccination, there can be neurological manifestations in rare cases. The observed patterns of hyperperfusion and hypoperfusion in SPECT imaging indicate complex effects on brain perfusion. Additionally, cases of acute demyelination and optic nerve pathology highlight the importance of ongoing surveillance and research to better understand and manage possible neurological complications associated with vaccination. However, further research is needed to determine the specific timeline or timeframes in which CNS MRI abnormalities are more likely to occur after vaccination.

Emerging research is also exploring the potential long-term effects of CNS MRI findings after vaccination. Although the current literature does not provide definitive evidence on the long-term effects of these findings, ongoing research aims to establish clinical connections between CNS MRI abnormalities and neurological symptoms. By linking MRI abnormalities with specific clinical manifestations, researchers can improve the diagnosis and management of vaccine-related neurological problems, particularly in the context of COVID-19 vaccinations.

New research on the impact of COVID-19 vaccination on CNS MRI results has revealed a wide range of neurological effects, varying in severity and rarity. These findings emphasize the need for ongoing surveillance

and research to gain a better understanding of the causes, diagnosis, and treatment of neurological complications that arise after vaccination. While most people experience no or mild side effects from COVID-19 vaccination, there is a possibility of serious adverse reactions that require immediate medical attention. Therefore, healthcare providers should be aware of the potential neurological complications associated with COVID-19 vaccination and monitor their patients accordingly. Furthermore, researchers should investigate the timing and long-term consequences of CNS MRI abnormalities following vaccination, as well as the mechanisms behind these abnormalities. By establishing connections between CNS MRI results and neurological symptoms, researchers can enhance the diagnosis and management of vaccine-related neurological issues, particularly in the context of COVID-19 vaccinations. Ultimately, these efforts will contribute to the safety and effectiveness of COVID-19 vaccination and aid in preventing the spread of new variants of COVID-19 in the future.

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Conflict of interest

The authors declare no conflict of interest.

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