Case report

Neurological Complications of COVID-19 Vaccination: A Case Report of Generalized Convulsive Status Epilepticus

ABSTRACT

Generalized convulsive status epilepticus (GCSE) is a life-threatening condition characterized by prolonged seizure activity that affects both sides of the brain. Despite its high mortality rate, GCSE is a relatively rare complication of COVID-19 vaccination. In this case report, we presented a 28-year-old male with no known history of neuropsychiatric disorders who developed GCSE following the first dose of the mRNA COVID-19 vaccine. It is plausible that the COVID-19 vaccine played a role in the development of GCSE in this patient. This case report also provides brief review potential association between COVID-19 vaccination and GCSE.

Keywords: Generalized convulsive status epilepticus (GCSE), mRNA COVID-19 vaccine, COVID-19 vaccination.

1. INTRODUCTION

Generalized convulsive status epilepticus (GCSE) is a life-threatening neurological condition characterized by sustained generalized tonic-clonic seizures lasting longer than 5 minutes. It is a rare complication of COVID-19 infection and vaccination, with a high mortality rate[1]. The incidence of GCSE ranges from 1.29 to 73.7 per 100,000 people per year, accounting for up to 70% of all cases of status epilepticus worldwide[2]. The exact mechanism by which COVID-19 infection and vaccination may trigger GCSE is not yet fully understood. However, there are several possible explanations. One possibility is that the vaccine may lead to an autoimmune response that attacks the brain and causes inflammation[3]. Another possibility is that the vaccine may trigger an allergic reaction that leads to swelling of the brain and seizures[4].

Patients who experience GCSE should be immediately transported to the hospital for emergency treatment. Treatment for GCSE typically involves the use of antiseizure medications to stop the seizure activity[5]. The case report presented in this study describes a male patient who developed GCSE after receiving the mRNA COVID-19 vaccine. The patient had no known history of neurological disorders, suggesting that the vaccine may have played a role in the development of GCSE. This case report highlights the importance of awareness of the rare but serious possibility of GCSE following COVID-19 vaccination. In addition to the case report, we also provide a brief review of the literature on COVID-19 vaccine-related GCSE. It is important to be aware of the rare possibility of developing GCSE following vaccination, especially in patients with no underlying neurological disorders.

2. PRESENTATION OF CASE

A 28-year-old male with no known history of neuropsychiatric disorders presented to the hospital one day after receiving the mRNA COVID-19 vaccine with two episodes of generalized tonic-clonic seizures, each lasting 5 minutes. The seizures occurred 7 hours apart, and the patient was unconscious during the seizures but fully awake after them and between the two seizures before admission to the hospital. The patient had no history of neurological or psychiatric disorders, tobacco

smoking, alcohol consumption, or illicit drug use. He was not taking any special medications, and his family history was unremarkable.

On arrival at the hospital, the patient was fully awake and alert, with a Glasgow Coma Scale score of E4V5M6. His vital signs were within normal limits, and his physical examination was unremarkable, with no focal neurological deficits noted. Laboratory results abnormalities showed leucocytosis, elevated renal function, elevated liver enzymes (Table 1).

Table 1. Laboratory findings with normal value range

Parameter	Value	Normal Value	Unit
Complete Blood Count			
Hemoglobin	13	13.4-17.7	g/dL
Leukocyte	14.76	4.3-10.3	10^3/uL
Hematocrit	38.1	40-47	%
Thrombocyte	321	142-424	10^3/uL
Diff Counts			
Eosinophil	0.0	0-4	%
Basophil	0.1	0-1	%
Neutrophil	82,4	51-67	%
Lymphocyte	6.9	6.9	%
Monocyte	10.6	10.6	%
Hemostasis Test			
Plasma prothrombin time	10.3	9.4-11.3	
Activated partial thromboplastin time	26.6	24.6-30.6	
International Normalized Ratio	0.99	<1.5	
Fibrinogen	390.1	154.3-397.9	mg/dL
D-Dimer	1.46	<0.5	
Liver Function Test			
Aspartate aminotransferase	75	0-40	U/L
Alanine aminotransferase	84	0-41	U/L
Renal Function Test			
Urea	42.7	16.6-48.5	mg/dL
Creatinine	3.09	<1.2	mg/dL
Inflammation Markers			
C-reactive protein	4.17	<0.3	mg/dL
Procalcitonin	3.41	<0.5	ng/dL
Serum Electrolytes			
Sodium	134	136-145	mmol/L
Potassium	3.81	3.5-5.0	mmol/L
Chloride	112	98-106	mmol/L
Blood Glucose	118	<200	mg/dL
SARS-CoV-2 Reat-time PCR	Negative	Negative	

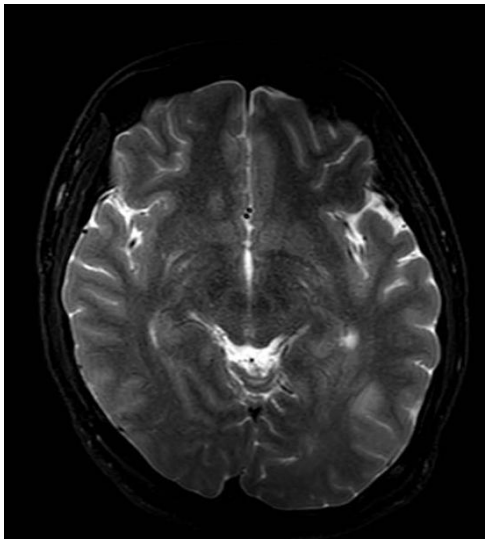

Figure 1.Magnetic resonance imaging (MRI) revealed a hyperintense lesion on T2-weighted and fluid-attenuated inversion recovery (FLAIR) image in the left temporal lobe, suggestive of a post-ictal state.

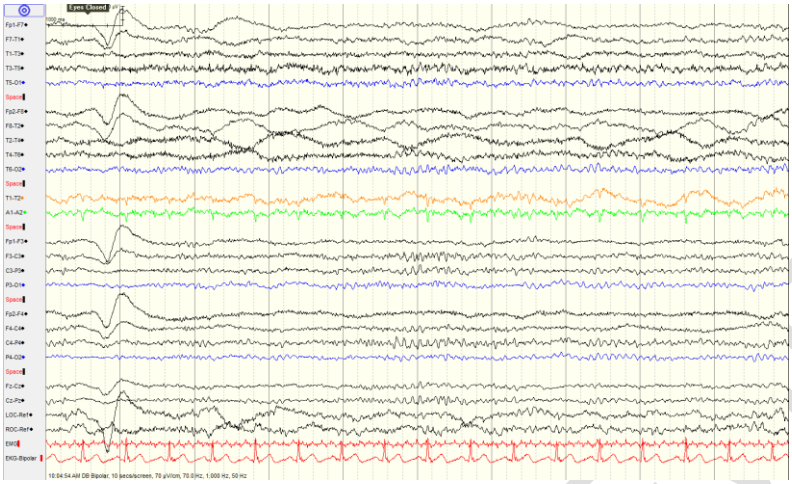

Figure 2.The electroencephalogram (EEG) recording is normal. No epileptogenic activity was recorded.

The patient's electrocardiogram (ECG) and chest X-ray were normal. Brain magnetic resonance imaging (MRI) without contrast revealed a gyrus lesion in the left temporal lobe, bilateral frontotemporal lobe white matter lesions, and bilateral ethmoidal sinusitis. Electroencephalography (EEG) showed normal findings. The patient was diagnosed with GCSE, acute kidney injury (AKI) stage II due to prolonged fluid depletion, leukocytosis due to reactive changes, and elevated liver enzymes due to reactive changes. The patient was treated with a loading dose of phenytoin 900 mg in the emergency room and oral phenytoin thereafter for maintenance. The seizure resolved, and there were no focal neurological deficits found. The patient was discharged after the sixth day of hospitalization with oral phenytoin maintenance.

3. DISCUSSION

GCSE is a life-threatening medical condition characterized by prolonged seizure activity that affects both sides of the brain. It is defined by the ILAE as a general seizure with a duration of 5 minutes or longer, or two or more general seizures without recovery of consciousness between them. GCSE can lead to serious complications, including neuronal death, neuronal injury, and alteration of neuronal networks.The patient in the case report presented with a generalized motor onset tonic-clonic seizure, which is a type of seizure that begins with stiffening of the body followed by rhythmic jerking movements. This patient presented with a generalized motor onset tonic-clonic seizure, characterized by loss of consciousness and bilateral muscle stiffness followed by rhythmic jerking of the extremities[1]. The seizure lasted for more than 5 minutes, meeting the criteria for GCSE according to the International League Against Epilepsy (ILAE). In our patient, the absence of a drug abuse screening test is a potential confounder. However, the patient's history revealed no use of illicit drugs, smoking, or alcohol consumption. Additionally, the normal physical examination findings suggested no evidence of drug abuse.

Electroencephalography (EEG) is mandatory to exclude nonconvulsive seizures. Normal EEG result in this patient confirmed that status epilepticus has ended with no continuation of seizure activity. However, systemic review of EEG findings in patients with COVID-19 infection found that a high number of patients have abnormal background activity[6]. Limited data are available on the EEG findings in status epilepticus patients with COVID-19 vaccination[7]. The reported findings have varied from normal to nonconvulsive focal status epilepticus.

Neuroimaging is a valuable tool for identifying the underlying cause of seizures. In our patient, a head MRI without contrast revealed a gyriform lesion in the left temporal lobe with bilateral frontotemporal lobe white matter lesions, suggesting post-ictal resolution. Seizures are associated with high cellular glucose consumption that is not adequately supported by blood flow, resulting in reduced energy storage and failure of the sodium-potassium adenosine triphosphatase (ATP) pump. Excitotoxic effects from glutamate release lead to N-methyl-D-aspartate (NMDA) receptor-mediated calcium and fluid influx into the cell, which can be visualized as restricted diffusion on MRI[8]. MRI findings in patients with status epilepticus following COVID-19 vaccination have been unremarkable, while those with COVID-19

infection may exhibit encephalitis-like patterns that may be secondary to an inflammatory response rather than direct viral invasion[9].

The current evidence-based recommendation for seizure control in GCSE is to administer an intravenous loading dose of a longer-acting antiseizure drug (Grade 1B recommendation). This recommendation is based on the results of the Established Status Epilepticus Treatment Trial (ESETT), which showed that fosphenytoin, valproate, and levetiracetam are all equally effective for this purpose[10]. The recommended loading dose of phenytoin for GCSE is 20 mg/kg. If seizures persist after the loading dose, an additional 5-10 mg/kg of phenytoin can be administered 10 minutes later, up to a maximum cumulative dose of 30 mg/kg[11].

The exact mechanism by which COVID-19 vaccination triggers GCSE is not fully understood, but is thought to involve pro-inflammatory cytokines entering the brain and activating microglia and astrocytes, which can lead to seizures[12]. The recent association of GCSE with COVID-19 infection and vaccination has raised concerns about the underlying pathophysiological mechanisms of this potentially life-threatening condition. First hypothesis is that the virus or vaccine may trigger an autoimmune response that targets the brain, leading to inflammation and neuronal injury[13]. COVID-19 infection and vaccination-associated GCSE have showed the elevated levels of pro-inflammatory cytokines in their cerebrospinal fluid[14]. Second hypothesis is that the virus or vaccine may induce an allergic reaction that results in cerebral edema and seizures[15]. Some patients with COVID-19 infection and vaccination-associated GCSE have evidence of mast cell activation and eosinophil infiltration in their brain tissue[16]. Third, that COVID-19 infection and vaccination may increase the risk of GCSE by interacting with other factors, such as underlying neurological disorders or other infections[17]. Patients with COVID-19 vaccination-associated GCSE have a higher prevalence of epilepsy and other neurological disorders than the general population[18–20]. Vaccination-associated GCSE is a rare complication, but it is important to note that it can occur. Given the rarity of this complication, it is important to acknowledge the rare possibility of adverse events, including GCSE. Clinicians should monitor patients for signs and symptoms of GCSE, especially following the first dose of the vaccine.

4. CONCLUSION

This case report is a valuable contribution to the literature on COVID-19 vaccine-related adversities. It highlights the importance of awareness of this rare but serious complication, even in patients with no prior history of neurological problems. Further research is needed to investigate the mechanism of neuropathological dysfunction underlying COVID-19 vaccine-related adversities and develop better strategies for prevention and treatment.

CONSENT

Per international standard or university standard,patient(s) written consent has been collected andpreserved by the author(s).

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