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Transverse myelitis after Johnson & Johnson COVID-19 vaccine: illustrative case

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BACKGROUND Transverse myelitis is a rare neurological occurrence with varied presentation. Imaging is necessary to properly diagnose this condition; however, identifying the cause of this condition may often be difficult.

OBSERVATIONS An otherwise healthy patient presented to the clinic with peculiar neurological symptoms without an obvious underlying cause. Imaging evidenced no significant structural defects but did lead to discovery of cord enhancement compatible with a diagnosis of transverse myelitis. Corticosteroid treatment was initiated rapidly to address this pathology, and the patient recovered without deficits. To identify the underlying cause, patient medical history was reviewed thoroughly and compared with existing literature. Previous tuberculosis infection could be a less likely cause of the neurological symptoms. However, recent vaccination with the Johnson & Johnson coronavirus disease 2019 (COVID-19) vaccine could be a more likely cause of the transverse myelitis, which has been rarely reported.

LESSONS Transverse myelitis after COVID-19 infection has been an escalating phenomenon. However, transverse myelitis after COVID-19 vaccination is a rare occurrence that is also on the rise. Given the increased rates of vaccination, transverse myelitis should not be overlooked as a potential pathology, due to the severity of neurological impairment if this condition is not treated rapidly.

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KEYWORDS transverse myelitis; Johnson & Johnson COVID-19 vaccine; rapid corticosteroid initiation

As the novel coronavirus disease 2019 (COVID-19) remains the predominant public health issue, many turn to vaccinations as a means of defense. As of September 2021, almost 50% of the US population have been "fully vaccinated" with an emergency use–authorized COVID-19 vaccine. For the 165 million individuals in this group, complication rates have been exceedingly low but are present nonetheless.[1] Less than 3% of adverse events reported to the Centers for Disease Control and Prevention's Vaccine Adverse Event Reporting System (VAERS) database relate to neurological complications.[2] However, reports of rare pathologies subsequent to COVID-19 vaccination are rising, especially in the realm of neurological disorders.[3]

Transverse myelitis is a rare neurological condition that may originate from an inflammation-driven mechanism. Diagnosis is driven by confirming that symptoms originate from the spinal cord. After excluding structural causes, imaging will lead to visualization of abnormal cord signal. In most cases, this condition responds well to proper treatment. However, transverse myelitis can cause rapid loss of function, especially if not recognized and managed immediately.[4]

As of November 15, 2022, there exists only 1 case report detailing transverse myelitis subsequent to vaccination with the Johnson & Johnson COVID-19 vaccine (Janssen Pharmaceutical Company).[5] In this case report, we present another case, of a patient who came into the clinic with bilateral sensory deficits. Imaging evidenced a high possibility of transverse myelitis, which guided rapid treatment, culminating in successful patient recovery. The purpose of this report is to document a rather unique presentation of transverse myelitis, which is a rare sequalae of COVID-19 vaccination. However, as COVID-19 infection and vaccinations continue, more patients may present with varied symptoms of transverse myelitis to a neurosurgical clinic, as this patient did. Documenting the various types of presentation, discussing treatment, and reviewing the available literature may be valuable to neurosurgical providers.

ABBREVIATIONS COVID-19 = coronavirus disease 2019; DTR = deep tendon reflex; MRI = magnetic resonance imaging; TB = tuberculosis.

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Illustrative Case

A 56-year-old male patient presented to the clinic with a chief complaint of episodic bilateral arm numbness. The patient denied arm weakness, arm pain, and neck pain. While the numbness is not worse in the nighttime, he does mention that the numbness sometimes wakes him from sleep. Coughing does not worsen his pain, and there is neither bladder nor bowel incontinence. At this time, the patient has not found anything that makes his symptoms better or worse. The patient tested positive for COVID-19 in December 2020, although recovery was uneventful. In May 2021, the patient received the Johnson & Johnson COVID-19 vaccine. The symptoms associated with his chief complaint developed approximately 2 months after receiving the vaccine.

The patient has a past medical history of tuberculosis (TB) infection, which was diagnosed 25 years ago. He has not had surgery previously and has not been to physical therapy or a chiropractor recently. His mother passed away at age 60 due to heart disease; there is no other significant family history. This individual currently smokes cigars socially and drinks socially. While the patient is 6 feet tall and weighs 210 pounds, he is not obese. Physical examination showed 5/5 strength for all 4 extremities; deep tendon reflexes (DTRs) were 2+ in all 4 extremities. The arm numbness was confirmed to start at the elbow and includes digits 1 and 2, bilaterally. Gait was stable, clonus was not present, and, other than for the regions of interest, sensation is otherwise intact.

Two weeks preceding the patient visit, cervical magnetic resonance imaging (MRI) was performed (Fig. 1). Imaging evidenced severe cord edema from C1 to T1–2 with associated cord expansion. At C4–5, there is a right-sided disc protrusion causing moderate spinal stenosis with cord effacement. Additionally, the thecal sac measures 7 mm at this level. At the C5–6 and C6–7 levels, there is evidence of moderate foraminal stenosis, bilaterally. Radiological evaluation confirmed these findings, while listing possible differentials of transverse myelitis, neuromyelitis optica, or a viral myelitis. Along with recommendation for follow-up and referral for contrast MRI, oral corticosteroid treatment was rapidly initiated. One week after treatment, another cervical MRI was performed. The radiology interpretation noted decreased extent of the abnormal enhancing signal within the cervical cord, compatible with resolving transverse myelitis. Over the time course of multiple weeks, symptoms improved, and the numbness completely resolved within 6 weeks. These findings are summarized in Table 1.

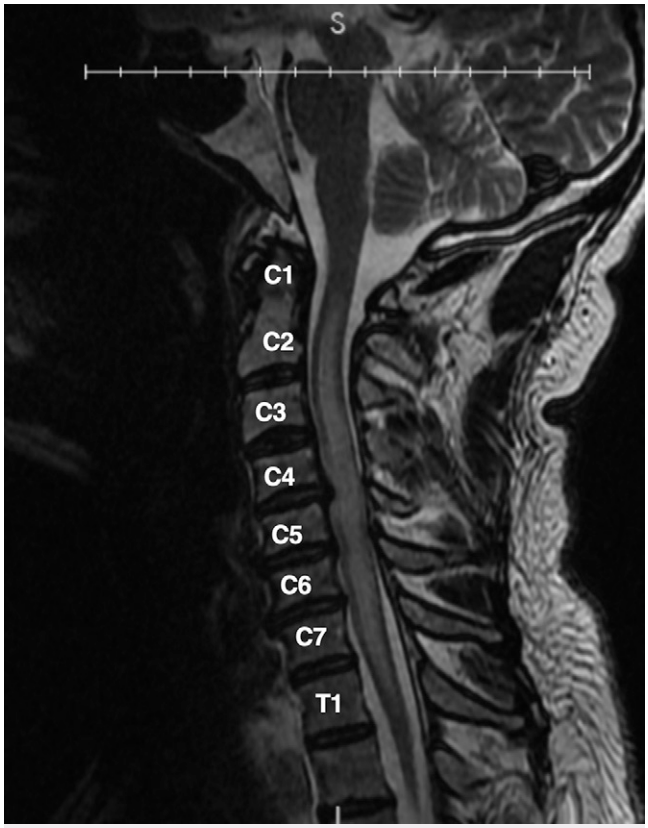

FIG. 1. Sagittal T2-weighted MRI showing severe cord edema from C1 to T1–2. Signal enhancement is visible in the cervical spinal cord, and the thecal sac at C4–5 measures 7 mm. Note: A thecal sac less than 14 mm is concerning for spinal cord compression.

Discussion

Observations

Although the exact incidence of transverse myelitis is not known, it is estimated that up to 3 new cases per 100,000 people are diagnosed yearly, although this number varies based on the population of interest.[6] Transverse myelitis cases can be classified as idiopathic or secondary to another disease; however, the exact percentages are still a topic of discussion.[4] While men and women are affected almost equally, transverse myelitis incidence appears to peak between ages 10 and 19 and between ages 30 and 39.[7] The prognosis of this disease is rather varied and depends on factors such as rate of symptom progression, quality of nerve conduction, possibility of spinal shock, and speed of treatment initiation. A heuristic summarizes that one-third of patients recover with no disability, one-third recover with moderate disability, and one-third recover with severe disability.[8] The thoracic cord is most often involved, accounting for approximately 70% of cases. Cervical cord lesions occur in 20% of cases, and lumbar cord lesions occur in 10% of cases. The first-line treatment for transverse myelitis is rapid initiation of glucocorticoid treatment (mechanism). Other treatments may include, but are not limited to, plasma exchange, intravenous immunoglobulin, cyclophosphamide, mycophenolate, or rituximab.[9] These anti-inflammatory medications attempt to rectify the possible mechanism of transverse myelitis, which can be considered to be inflammatory in nature. Although the exact mechanism warrants further study, inflammatory cascades can lead to widespread axonal degeneration, which may involve both white matter and gray matter. Increased rates of transverse myelitis in patients with inflammatory conditions further strengthens this paradigm. Postinfection processes, circulating antibodies, abnormal levels of interleukins, and local aquaporin disturbance may also play a role in the pathogenesis of this condition.[10] Effort has been made to generate standardized diagnostic criteria for transverse myelitis; however, the authors of these guidelines do concur that the entire evaluation may not apply to all patients. Patients impacted by transverse myelitis may present with a varied neurological symptom, which may sometimes progress rapidly without treatment. These can include motor, sensory, and/or autonomic dysfunctions stemming from the spinal cord. These dysfunctions typically occur bilaterally at clearly defined sensory levels, and T2-weighted MRI will indicate cord hyperintensity. All these criteria were met in our patient's case; however, in our

TABLE 1. Neurological examination upon initial presentation, during 2-week follow-up (2 weeks after initiation of corticosteroid treatment), and during 6-week follow-up

	Initial Presentation	2-Wk Follow-Up	6-Wk Follow-Up
Mental status	Alert & oriented ×3	Alert & oriented ×3	Alert & oriented ×3
Cranial nerves			
I–XII	Intact	Intact	Intact
Motor (strength)			
Left-upper extremity	5/5	5/5	5/5
Right-upper extremity	5/5	5/5	5/5
Left-lower extremity	5/5	5/5	5/5
Right-lower extremity	5/5	5/5	5/5
Other pain	No clonus	No clonus	No clonus
Sensory			
Left-upper extremity	Numbness begins at elbow, extends to digits 1 & 2	Numbness is gradually improving in the previously affected distribution	Numbness completely resolved
Right-upper extremity	Numbness begins at elbow, extends to digits 1 & 2	Numbness is gradually improving in the previously affected distribution	Numbness completely resolved
Left-lower extremity	Normal sensation	Normal sensation	Normal sensation
Right-lower extremity	Normal sensation	Normal sensation	Normal sensation
Other pain	None reported	None reported	None reported
Deep tendon reflexes (DTRs)			
Left-upper extremity	2+	2+	2+
Right-upper extremity	2+	2+	2+
Left-lower extremity	2+	2+	2+
Right-lower extremity	2+	2+	2+
Coordination & gait	Normal coordination, stable gait	Normal coordination, stable gait	Normal coordination, stable gait

case, there was also evidence of a compressive lesion, which must be ruled out according to the guidelines.[11]

As the patient had a history of previous TB infection, the coincidence of TB and transverse myelitis warrants examination. Although rare, there do appear to be a handful of case reports detailing TB-associated transverse myelitis. One notable case report detailed thoracic transverse myelitis with imaging findings similar to the MRI findings in our case. In the presence of active TB infection, the patient displayed an abnormal Babinski sign and had strength of 0/5 for the lower extremities.[12] One paper compiled 4 case presentations for patients experiencing TB-associated symptoms, all with abnormal cerebrospinal fluid findings. While the case presentations were varied, especially with regard to DTR, all 4 cases displayed limb strength of 0/5 for the limbs in question.[13] Other case reports of TB-associated transverse myelitis presented similarities, with abnormal limb strength and abnormal reflexes. This contrasts with the case presentation of our patient, who displayed neither abnormal reflexes nor weakness. Additionally, as the initial TB infection occurred 25 years ago, TB becomes a less likely cause for the transverse myelitis observed. When considering multiple etiologies for transverse myelitis, factors such as recency of an inciting etiology should be considered.

There have been reports of transverse myelitis associated with a variety of vaccines.[14–16] Multiple case reports have detailed transverse myelitis occurring after COVID-19 vaccinations as well. However, all of the available cases detailed abnormal reflexes, and almost all the case reports discovered severe motor deficits. Additionally, the neurological dysfunctions occurred rapidly, within 2 to 6 days after vaccination.[17–19] These case reports are discrepant from our patient case, both in terms of presenting symptoms and time course. The differences cannot be fully explained by vaccine brand alone. As of January 30, 2022, a PubMed Clinical query with the keywords “Johnson & Johnson” and “transverse myelitis” yielded 1 other case report. In that report, the patient presented 10 days after receiving the single-dose vaccine, a longer time window than in other cases. Additionally, that patient did not present with weakness, which is similar to the presentation for our patient. However, all 4 extremities had 3+ DTRs, and bilateral Babinski signs were present, contrasting with the physical examination results of our patient.[5] Ultimately, transverse myelitis presentation after COVID-19 vaccination may vary widely, necessitating thorough evaluation. New cases should continue to be documented, as better conclusions may be drawn from increased availability of data.

While transverse myelitis after vaccination is rare, this phenomenon appears to be on the rise. Reviewing adverse events data available as of May 20, 2022, there were 124 cases of transverse myelitis as a result of the AstraZeneca COVID-19 vaccine in the United Kingdom.[20] Thirty-seven cases of transverse myelitis occurred as a result of the Pfizer–BioNTech COVID-19 vaccine, and

there were 7 cases of transverse myelitis as a result of the Moderna–BioNTech COVID-19 vaccine.[21,22] No data were listed within this UK database for the Johnson & Johnson COVID-19 vaccine at this time. While the exact number of doses given for each vaccine manufacturer was not available, it must be considered that approximately 50 million individuals have achieved "full vaccination" in the United Kingdom. While hundreds of cases of transverse myelitis warrants attention, those numbers are miniscule compared with the millions of individuals who were vaccinated against COVID-19 without adverse effects. While this case report focuses on vaccination-associated transverse myelitis, COVID-19 infection–associated transverse myelitis is the larger concern. A 2021 paper compiled the case reports of 43 patients afflicted with transverse myelitis after COVID-19 infection and 3 cases occurring postvaccination. Interestingly, 100% of the patients presented with severe motor deficits, presenting with either paraplegia or quadriplegia.[23] Additionally, numerous case reports exist detailing transverse myelitis after COVID-19 infection.[24–27] At this time, it is difficult to determine if COVID-19 infection–associated transverse myelitis yields more severe symptoms than COVID-19 vaccination–associated transverse myelitis. However, it is important to understand that, in the COVID-19 era, transverse myelitis is not restricted to a postvaccination sequela, although reporting will be biased. As there is a database of COVID-19 vaccine–associated adverse effects, but no organized national database of COVID-19 infection–associated adverse effects, vaccine-associated adverse effects will more often be reported. However, this should not give way to misinformation, as vaccination benefits appear to outweigh risks.

Lessons

COVID-19 vaccination, although a recommended practice, is not without risks. Transverse myelitis is a rare neurological occurrence, but data detailing this occurrence after COVID-19 vaccination are sparse. Although presentation can be variable, outcomes improve if this pathology is recognized early. Prompt treatment and management of symptoms may allow for a successful recovery, as in this patient's case. Ultimately, due to COVID-19 infection and COVID-19 vaccination, occurrences of transverse myelitis may increase within patient populations.

References

1. Alfaro S, Sen-Crowe B, McKenny M, Elkbuli A. A closer look at U.S COVID-19 vaccination rates and the emergence of new SARS-CoV-2 variants: it's never late to do the right thing. *Ann Med Surg (Lond).* 2021;69:102709.
2. Malhotra HS, Gupta P, Prabhu V, Kumar Garg R, Dandu H, Agarwal V. COVID-19 vaccination-associated myelitis. *QJM.* 2021;114(8): 591–593.
3. Patone M, Handunnetthi L, Saatci D, et al. Neurological complications after first dose of COVID-19 vaccines and SARS-CoV-2 infection. *Nat Med.* 2021;27(12):2144–2153.
4. Simone CG, Emmady PD. *Transverse Myelitis.* StatPearls; 2022.
5. Tahir N, Koorapati G, Prasad S, et al. SARS-CoV-2 vaccination-induced transverse myelitis. *Cureus.* 2021;13(7):e16624.
6. West TW, Hess C, Cree BA. Acute transverse myelitis: demyelinating, inflammatory, and infectious myelopathies. *Semin Neurol.* 2012; 32(2):97–113.
7. Altrocchi PH. Acute transverse myelopathy. *Arch Neurol.* 1963;9: 111–119.
8. Krishnan C, Kaplin AI, Pardo CA, Kerr DA, Keswani SC. Demyelinating disorders: update on transverse myelitis. *Curr Neurol Neurosci Rep.* 2006;6(3):236–243.
9. West TW. Transverse myelitis—a review of the presentation, diagnosis, and initial management. *Discov Med.* 2013;16(88): 167–177.
10. Pittock SJ, Lucchinetti CF. Inflammatory transverse myelitis: evolving concepts. *Curr Opin Neurol.* 2006;19(4):362–368.
11. Transverse Myelitis Consortium Working Group. Proposed diagnostic criteria and nosology of acute transverse myelitis. *Neurology.* 2002;59(4):499–505.
12. Ortega-Rosales A, Delgado-Torres N, Burneo-Rosales C. A rare neurological complication of tuberculosis: Transverse myelitis. *IDCases.* 2019;17:e00564.
13. Sahu SK, Giri S, Gupta N. Longitudinal extensive transverse myelitis due to tuberculosis: a report of four cases. *J Postgrad Med.* 2014; 60(4):409–412.
14. Zafar Z, Hafeez MH, Butt MURA. Elusive tuberculous meningitis with rare neurological complication of longitudinally extensive transverse myelitis: a case report. *Spinal Cord Ser Cases.* 2021; 7(1):82.
15. Jain RS, Kumar S, Tejwani S. A rare association of tuberculous longitudinally extensive transverse myelitis (LETM) with brain tuberculoma. *Springerplus.* 2015;4:476.
16. Agmon-Levin N, Kivity S, Szyper-Kravitz M, Shoenfeld Y. Transverse myelitis and vaccines: a multi-analysis. *Lupus.* 2009;18(13): 1198–1204.
17. Gao JJ, Tseng HP, Lin CL, Shiu JS, Lee MH, Liu CH. Acute transverse myelitis following COVID-19 Vaccination. *Vaccines (Basel).* 2021;9(9):1008.
18. Khan E, Shrestha AK, Colantonio MA, Liberio RN, Sriwastava S. Acute transverse myelitis following SARS-CoV-2 vaccination: a case report and review of literature. *J Neurol.* 2022;269(3): 1121–1132.
19. McLean P, Trefts L. Transverse myelitis 48 hours after the administration of an mRNA COVID-19 vaccine. *Neuroimmunol Rep.* 2021;1:100019.
20. UK Government. COVID-19 AstraZeneca Analysis Print. 2022. Accessed May 29, 2022. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1039820/COVID-19_vaccine_AstraZeneca_analysis_print.pdf
21. UK Government. COVID-19 mRNA Pfizer- BioNTech vaccine analysis print. 2022. Accessed May 29, 2022. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1039819/COVID-19_mRNA_Pfizer-_BioNTech_vaccine_analysis_print.pdf
22. UK Government. COVID-19 Moderna Vaccine Analysis Print. 2022. Accessed May 29, 2022. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1039821/COVID-19_vaccine_Moderna_analysis_print.pdf
23. Román GC, Gracia F, Torres A, Palacios A, Gracia K, Harris D. Acute transverse myelitis (ATM): clinical review of 43 patients with COVID-19-associated ATM and 3 post-vaccination ATM serious adverse events with the ChAdOx1 nCoV-19 vaccine (AZD1222). *Front Immunol.* 2021;12:653786.
24. Shahali H, Ghasemi A, Farahani RH, Nezami Asl A, Hazrati E. Acute transverse myelitis after SARS-CoV-2 infection: a rare complicated case of rapid onset paraplegia. *J Neurovirol.* 2021;27(2): 354–358.
25. Bakir M, Rebh F. Acute transverse myelitis following COVID-19 infection: a rare case from Saudi Arabia. *Cureus.* 2021;13(9):e17658.
26. Ahmad SA, Salih KH, Ahmed SF, et al. Post COVID-19 transverse myelitis: a case report with review of literature. *Ann Med Surg (Lond).* 2021;69:102749.
27. Vasconcelos TMF, Oliveira DN, Ferreira GM, et al. Covid-19 post-infectious acute transverse myelitis responsive to corticosteroid therapy: report of two clinical cases. *J Neurovirol.* 2021;27(5): 791–796.

Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Williamson, Dickerman. Acquisition of data: Williamson. Analysis and interpretation of data: Mathew. Drafting the article: Mathew. Critically revising the article: Mathew, Dickerman. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Mathew. Administrative/technical/material support: Mamo.

Supplemental Information

Previous Presentations

Abstract presented previously at JPS Research Symposium, John Peter Smith Hospital, Fort Worth, TX, June 3, 2022.
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