Child Neurology Open
Volume 9: 1-4

DOI: 10.1177/2329048X221074549
journals.sagepub.com/home/cno
SAGE

A Pediatric Case of Sensory Predominant Guillain-Barré Syndrome Following COVID-19 Vaccination

Yunsung Kim, PhD[1], Zahra Zhu, BA[1], Puneet Kochar, MD[2], Patrick Gavigan, MD[3], Divpreet Kaur, MD[4], and Ashutosh Kumar, MD[5]

Abstract

Over six billion doses of Coronavirus Disease 2019 (COVID-19) vaccines have been administered worldwide. Amidst the global COVID-19 vaccination campaign, vaccine-related side effects are of ongoing concern and investigation. According to the Centers for Disease Control and Prevention (CDC) and the United States Department of Health and Human Services, three main conditions in adults have surfaced in association with receiving the COVID-19 vaccines. These include thrombosis with thrombocytopenia syndrome (TTS), a rare syndrome involving venous or arterial thrombosis and thrombocytopenia, Guillain-Barre syndrome (GBS), and myocarditis. While a number of GBS cases in adults have been published, to our knowledge, only one pediatric case of COVID-19 vaccine-related GBS has been reported. Herein we describe a case of sensory predominant GBS following the Pfizer-BioNTech COVID-19 vaccine in a 16-year-old female presenting with bilaterally ascending upper and lower extremity numbness and paresthesia.

Keywords

COVID-19, GBS, pediatric, COVID-19 vaccine, pfizer-BioNTech COVID vaccine

Received October 24, 2021. Received revised December 17, 2021. Accepted for publication December 26, 2021.

Introduction

The emergence of a global pandemic from the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) led to a rapid development of multiple vaccines. Considering the severity of the pandemic, the Food and Drug Administration (FDA) issued emergency use authorizations allowing vaccine dissemination to the public. The Pfizer-BioNTech and Moderna COVID-19 vaccines were approved in December 2020. Shortly after in February 2021, the Janssen vaccine was approved for use. While the Moderna and the Janssen COVID-19 vaccines are authorized for use in persons 18 years or older, the Pfizer-BioNTech COVID-19 vaccine has been approved for administration in persons 5 years or older.[1]

With data provided through the Vaccine Adverse Events Reporting System (VAERS), the Centers for Disease Control and Prevention (CDC) and United States Department of Health and Human Services have reported three main adverse events in association with COVID-19 vaccines. Thrombosis with thrombocytopenia syndrome (TTS)[4] - a rare syndrome involving venous or arterial thrombosis and thrombocytopenia - and Guillain-Barre syndrome (GBS)[5] have been reported in connection to the Janssen vaccine. Myocarditis has been reported in connection with the Pfizer and Moderna COVID-19 vaccines.[6]

Of the reported side effects seen in the pediatric population, myocarditis remains the predominant adverse event. Dionne.

[1]Penn State College of Medicine, Hershey, PA, USA
[2]Department of Radiology, Penn State Health Milton Hershey Medical Center, Hershey, PA, USA
[3]Division of Pediatric Infectious Disease, Penn State Health Milton Hershey Medical Center, Hershey, PA, USA
[4]Department of Neurology, Penn State Health Milton Hershey Medical Center, Hershey, PA, USA
[5]Department of Pediatrics and Neurology, Penn State Health Milton Hershey Medical Center, Hershey, PA, USA

Yunsung Kim, PhD, Zahra Zhu, BA, Co-first authors

Corresponding Author:
Ashutosh Kumar, Department of Pediatrics and Neurology, Penn State Health Milton Hershey Medical Center, 90 Hope Drive, Hershey, PA 17033, USA.
Email: akumar5@pennstatehealth.psu.edu

et al. first reported seven 14 to 19-year-old males who developed symptomatic myocarditis following their second Pfizer-BioNTech COVID-19 vaccine dose.[7] In the adult population, GBS has especially been associated with the receipt of the Janssen vaccine. Over 98 cases of GBS in people 18 years and older following the receipt of Janssen vaccine were reported to VAERS between February and June 2021. Due to an unexpectedly high number of GBS cases, the FDA issued a warning in July 2021.[8] Classically, GBS is characterized by progressive ascending weakness, as well as sensory disturbances and diminished or absent deep tendon reflexes. GBS related to COVID-19 vaccination has been described to have variable clinical presentation, ranging from facial and/or limb weakness to sensory disturbances such as paresthesia and numbness.[9]

Although neurological involvement with COVID-19 infections among pediatric patients has been reported,[10] to our knowledge, only one pediatric case of vaccine-related neurological side effects exists in the literature[11]. As vaccination efforts progress, the continued reporting of adverse events will allow the CDC and the FDA to closely monitor and assess the safety of the vaccine. To that end, we describe a sensory predominant variant of Guillain-Barré Syndrome in a pediatric patient presenting to the emergency department two days after receiving her second dose of the Pfizer-BioNTech COVID-19 vaccine.

Case Presentation

A previously healthy and athletic 16-year-old female presented to the emergency department (ED) with three weeks of ascending numbness and paresthesia of her bilateral lower and upper extremities. She received her second dose of Pfizer–BioNTech COVID–19 vaccine two days prior to symptom onset. Her symptoms began with intermittent paresthesia in her feet. Within a few days, she noticed persistent paresthesia in her feet and hands as well as difficulty with running while playing sports. For the next three weeks, her symptoms continued to worsen with paresthesia up to her elbows and knees, decreased sensation in bilateral lower extremities, and difficulty with gait especially going up a ramp or stairs. The progressive difficulty with ambulation prompted the patient to present to the emergency department.

On neurological examination, she had intact mental status and cranial nerves. Motor exam showed normal bulk, normal tone, and 5/5 strength in all muscle groups. Deep tendon reflexes were 1 + for brachioradialis and patellar tendon bilaterally. Reflexes at biceps, triceps, and Achilles tendons could not be elicited. Babinski reflex was down-going bilaterally. Her sensation was intact to light touch, temperature, and proprioception in all four extremities. Decreased sensation to pinprick was noted at the fingertips and from ankle to knee on the medial and lateral aspects of the shin bilaterally. Vibratory sensation was diminished at bilateral big toes, knees, thumbs, and elbows. Coordination was intact bilaterally with no dysmetria observed with finger-to-nose or heel-to-shin testing. Lastly, mild ataxia was noted on toe and tandem walking.

MRI study showed mild thickening and enhancement of the anterior and posterior spinal nerve roots of the cauda equina, consistent with Guillain-Barré syndrome (Figure 1). Lumbar puncture was performed with normal opening pressure. Cerebrospinal fluid (CSF) study was significant for albuminocytologic dissociation with nucleated cell of 1 and elevated protein at 112 mg/dL (albumin 86 mg/dL). CSF glucose was also elevated at 79 mg/dL. CSF IgG was elevated to 9.3 mg/dL with 4 identical gamma restrictive bands that were observed both in CSF and serum, which is indicative of systemic rather than intracerebral gamma globulins. IgG index was normal at 0.53. Other lab findings including complete blood count, complete metabolic panel, creatinine phosphokinase, vitamin D, free T4, thyroid stimulating hormone, antinuclear antibody, C-reactive protein, erythrocyte sedimentation rate, ferritin, B12, Lyme antibody, anti-aquaporin-4 IgG, and GQ1b antibody were unremarkable. Her COVID–19 PCR was negative. COVID-19 antibody was not tested. Because three weeks have passed since symptom onset and the mild severity of the symptoms, the patient did not receive intravenous immune globulin (IVIG) treatment and was discharged with continued follow-up with neurology and physical therapy treatment.

One month later, the patient was seen at the outpatient clinic and reported overall improvement of symptoms. Paresthesias were no longer present; however, she continued to have intermittent numbness in her legs bilaterally below the knees which contributed to her unsteady gait. On exam, improved sensation was noted with diminished pinprick only at the heels. Vibratory sensation was decreased at the big toes, but normal ankle and thumb. Deep tendon reflexes were unchanged from initial presentation. Due to the prolonged course of the disease, electromyography/nerve conduction study was performed at 6 weeks after initial presentation to ED, to rule out possible chronic inflammatory demyelinating polyneuropathy (CIDP). There was prolonged latency and slowed conduction velocity in multiple sensory and motor nerves (Table 1), consistent with partially-compensated demyelinating polyneuropathy without active denervation consistent with a history of GBS.

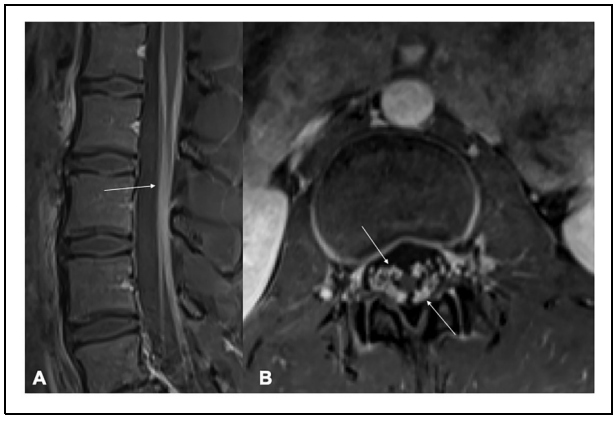

Figure 1. Sagittal (A) and axial (B) post contrast T1 fat saturated images demonstrate mildly thickened and enhancing cauda equina nerve roots (white arrows).

Table 1. Nerve Conduction Study.

Sensory Nerve Conduction				
Nerve/ Sites	Peak Lat (ms)	NP Amp (uV)	Distance (mm)	Onset Vel (m/s)
L Median	4.11 (≤3.70)	17.3 (≥ 20.0)	140	45.6 (≥50.0)
L Ulnar	4.53 (≤3.50)	15.1 (≥ 10.0)	140	42.7 (≥ 50.0)
L Radial	2.71 (≤2.90)	11.2 (≥ 15.0)	100	51.9 (≥ 50.0)
L Sural	3.39 (≤4.20)	8.4 (≥ 6.0)	140	53.8 (≥ 40.0)
L Superficial Peroneal	3.18 (≤4.40)	6.2 (≥ 6.0)	140	56.0 (≥ 40.0)
Motor Nerve Conduction				
Nerve/ Sites	Latency (ms)	Amplitude (mV)	Distance (mm)	Velocity (m/s)
L Median: Wrist	5.57 (≤4.40)	5.1 (≥ 4.0)	195	42.5 (≥ 49.0)
L Ulnar: Wrist	4.17 (≤3.50)	10.6 (≥ 6.0)	170	41.3 (≥ 49.0)
L Peroneal: Ankle	8.02 (≤6.10)	4.5 (≥ 2.0)	275	40.9 (≥ 41.0)
L Tibial: Ankle	5.78 (≤6.10)	2.9 (≥ 3.0)	365	35.2 (≥ 41.0)

The results did not meet electrophysiologic criteria for CIDP or GBS.

Another month later, the patient was seen at a follow-up appointment and was shown to have made almost complete recovery back to functional baseline with some residual diminished vibratory sensation in her big toes and diminished reflexes.

Discussion

Guillain-Barré Syndrome (GBS) is a rare, immune-mediated polyneuropathy with an annual global incidence of 1 to 2 per 100,000 person-years.[12] Symptoms classically associated with GBS are symmetric weakness and diminished sensation or paresthesia, but clinical presentation is diverse and multiple variants have been identified. The course of the disease is progressive for 1 to 3 weeks after onset of symptoms, with the most concerning complication being respiratory insufficiency. Prognosis is difficult to ascertain, as there is a wide range of rate and extent of recovery. Some patients make complete recovery while 20% of severely affected patients have limited mobility 6 months after the disease onset.[13]

Majority of the cases of GBS are preceded by an acute illness such as an upper respiratory infection or diarrhea. Specifically, *cobacter jejuni* has been identified to be the organism associated with about 30% of GBS cases.[14] In 1976, mass immunization against influenza A H1N1 subtype A/NJ/76 was associated with increased incidence of GBS. Since then, no other vaccines have been shown to be a clear trigger of GBS.[15]

With rapid vaccinations against SARS-CoV-2, the concerns for GBS first arose with ChAdOx1 nCoV-19 (Oxford/ AstraZeneca), which is not approved for use in the U.S. Recently, through the analysis of VAERS data, Janssen/ Johnson & Johnson COVID-19 vaccine was also reported to have a small but statistically significant increase in risk for GBS with an estimated absolute rate increase of 6.36 per 100,000 person-years in adults.[5] However, authors caution that this finding is a preliminary result due to the nature of the reporting system and GBS cases that are considered presumptively positive.

In this paper, we present a pediatric case of sensory predominant Guillain-Barré Syndrome after receiving the Pfizer-BioNTech COVID-19 vaccine. She presented with a stocking-glove distribution of paresthesia and mild ataxia without any weakness or ophthalmoplegia. Initial differential also included Lyme disease, multiple sclerosis, vitamin deficiency, and Miller Fisher syndrome. Imaging and lab findings were most consistent with the diagnosis of GBS with predominantly sensory presentation. Idiopathic or asymptomatic infectious causes of GBS cannot be completely ruled out, especially in the absence of more extensive diagnostic testing; however, with the recent vaccination and absence of any other clinical signs or lab findings, the vaccine is most likely to be the trigger for our patient. It is also important to note that the patient made full functional recovery three months after initiation of symptoms. To date, this is the first case reported of GBS in a pediatric patient after receiving the Pfizer-BioNTech vaccine. As we expand the vaccination to younger populations, further study is needed to establish a causal link between the Pfizer-BioNTech vaccine and GBS.

Ethics Approval and Informed Consent

Our institution does not require ethical approval for reporting individual cases or case series. Verbal informed consent was obtained from the patient and a legally authorized representative for their anonymized information to be published in this article.

Funding

None.

Declaration of Conflict of Interest

Authors have no conflict of interest to declare.

Author Contributions

Yunsung Kim and Zahra Zhu drafted and edited the manuscript, Puneet Kochar provided the radiology interpretation and edited the manuscript, Patrick Gavigan contributed to the interpretation of results and edited the manuscript, Divpreet Kaur interpreted the nerve conduction study and edited the manuscript, Ashutosh Kumar contributed to the conception of the paper and edited the manuscript.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

Ethical Approval

Not applicable, because this article does not contain any studies with human or animal subjects.

ORCID iDs

Yunsung Kim https://orcid.org/0000-0002-6935-390X
Zahra Zhu https://orcid.org/0000-0003-0571-438X

Trial Registration

Not applicable, because this article does not contain any clinical trials.

References

1. Woodworth KR, Moulia D, Collins JP, et al. The advisory committee on immunization Practices' interim recommendation for Use of pfizer-BioNTech COVID-19 vaccine in children aged 5–11 years — United States, November 2021. *MMWR Morb Mortal Wkly Rep*. 2021;70(45):1579-1583. http://dx.doi.org/10.15585/mmwr.mm7045e1
2. Oliver SE, Gargano JW, Scobie H, et al. The advisory committee on immunization Practices' interim recommendation for Use of janssen COVID-19 vaccine — United States, February 2021. *MMWR Morb Mortal Wkly Rep*. 2021;70(9):329-332. http://dx.doi.org/10.15585/mmwr.mm7009e4
3. Oliver SE, Gargano JW, Marin M, et al. The advisory committee on immunization Practices' interim recommendation for Use of moderna COVID-19 vaccine — United States, December 2020. *MMWR Morb Mortal Wkly Rep*. 2021;69(5152):1653-1656. http://dx.doi.org/10.15585/mmwr.mm695152e1
4. MacNeil JR, Su JR, Broder KR, et al. Updated recommendations from the advisory committee on immunization practices for Use of the janssen (johnson and johnson) COVID-19 vaccine after reports of thrombosis with thrombocytopenia syndrome Among vaccine recipients — United States, April 2021. *MMWR Morb Mortal Wkly Rep*. 2021;70(17):651-656. http://dx.doi.org/10.15585/mmwr.mm7017e4
5. Woo EJ, Mba-Jonas A, Dimova RB, Alimchandani M, Zinderman CE, Nair N. Association of receipt of the Ad26.COV2.S COVID-19 vaccine with presumptive Guillain-Barré syndrome, February-July 2021. *JAMA*. 2021;326(16):1606–1613. http://dx.doi.org/10.1001/jama.2021.16496
6. Salah HM, Mehta JL. COVID-19 Vaccine and myocarditis. *Am J Cardiol*. 2021;157:146-148. http://dx.doi.org/10.1016/j.amjcard.2021.07.009
7. Dionne A, Sperotto F, Chamberlain S, et al. Association of myocarditis With BNT162b2 messenger RNA COVID-19 vaccine in a case series of children. *JAMA Cardiol*. 2021;6(12):1446–1450. http://dx.doi.org/10.1001/jamacardio.2021.3471
8. Rosenblum HG, Hadler SC, Moulia D, et al. Use of COVID-19 vaccines after reports of adverse events Among adult recipients of janssen (johnson and johnson) and mRNA COVID-19 vaccines (pfizer-BioNTech and moderna): update from the advisory committee on immunization practices — United States, July. *MMWR Morb Mortal Wkly Rep*. 2021;70(32):1094-1099. http://dx.doi.org/10.15585/mmwr.mm7032e4
9. Min YG, Ju W, Ha Y-E, et al. Sensory guillain-barre syndrome following the ChAdOx1 nCov-19 vaccine: report of two cases and review of literature. *J Neuroimmunol*. 2021;359:577691. http://dx.doi.org/10.1016/j.jneuroim.2021.577691
10. Sandoval F, Julio K, Méndez G, et al. Neurologic features associated With SARS-CoV-2 infection in children: a case series report. *J Child Neurol*. 2021;36(10):853-866. http://dx.doi.org/10.1177/0883073821989164
11. Malamud Emily, Otallah Scott I, Caress James B., Lapid Daniel J. Guillain-Barré Syndrome After COVID-19 Vaccination in an Adolescent. *Pediatric Neurology*. 2022;126:9–10. http://dx.doi.org/10.1016/j.pediatrneurol.2021.10.003
12. Sejvar JJ, Baughman AL, Wise M, Morgan OW. Population incidence of guillain-barré syndrome: a systematic review and meta-analysis. *Neuroepidemiology*. 2011;36(2):123-133. http://dx.doi.org/10.1159/000324710
13. Yuki N, Hartung H-P. Guillain–barré syndrome. *N Engl J Med*. 2012;366(24):2294-2304. http://dx.doi.org/10.1056/NEJMra1114525
14. Poropatich KO, Walker CLF, Black RE. Quantifying the association between Campylobacter infection and guillain-barré syndrome: a systematic review. *J Health Popul Nutr*. 2010;28(6):545-552. http://dx.doi.org/10.3329/jhpn.v28i6.6602
15. Lehmann HC, Hartung H-P, Kieseier BC, Hughes RA. Guillain-Barré syndrome after exposure to influenza virus. *Lancet Infect Dis*. 2010;10(9):643-651. http://dx.doi.org/10.1016/S1473-3099(10)70140-7