

Guillain-Barré Syndrome in a Child With COVID-19 Infection

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Guillain-Barré syndrome (GBS) is characterized by a monophasic, ascending, and symmetrical paralysis with areflexia that progresses over days to weeks. It is typically a postinfectious autoimmune process that leads to destruction of myelin. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), originated in Wuhan, China, in late 2019 and rapidly spread around the world, causing a pandemic of novel coronavirus disease 2019 (COVID-19). There have been scattered reports of adults with possible GBS and concurrent evidence of COVID-19, but no previous reports in children. The patient is an 8-year-old boy who presented to the emergency department with progressive, ascending weakness with areflexia. He was intubated for airway protection because of poor secretion control. MRI of the spine revealed abnormal enhancement of posterior nerve roots. A lumbar puncture revealed albuminocytologic dissociation with 1 nucleated cell per mm³ and a protein level of 620 mg/dL. Electrodiagnostic findings were compatible with sensorimotor demyelinating polyneuropathy. The lumbar puncture, MRI, and electrodiagnostics were all consistent with GBS. Results of SARS-CoV-2 nucleic acid amplification and SARS-CoV-2 immunoglobulin G antibody tests were positive. Treatment was initiated with intravenous immunoglobulin; he received a total of 2 g/kg. His neurologic examination revealed improvement in the subsequent days. He was extubated after 4 days of intubation. This case is the first reported case of a child with GBS in the setting of an acute COVID-19 infection. This case reveals the wide scope of presentations of COVID-19 and postinfectious processes. Clinicians should constantly have a high level of suspicion for COVID-19.

Guillain-Barré syndrome (GBS) is the most common cause of severe, acute weakness in children, and acute inflammatory demyelinating polyradiculoneuropathy (AIDP) is the most common subtype in the western world.¹ GBS is characterized by a monophasic, ascending, and symmetrical paralysis that progresses over days to weeks and is associated with areflexia. AIDP is typically a postinfectious autoimmune process believed to be caused by molecular mimicry to peripheral nerves leading to inflammation and destruction of

myelin. Preceding infection can be identified in the majority of cases. The most common infectious triggers are minor respiratory illness, but gastrointestinal illnesses, other viral syndromes, and immunizations have also been associated with GBS.²

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), originated in Wuhan, China, in late 2019 and rapidly spread around the world, causing a pandemic of novel coronavirus disease 2019 (COVID-19). The majority of pediatric disease is asymptomatic, but the common clinical

abstract

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presentations of COVID-19 are fever, malaise, and respiratory symptoms, which can range from mild cough to severe pneumonia and occasional gastrointestinal symptoms.^{3,4} However, COVID-19 can present with a wide variety of other symptoms, including neurologic symptoms in up to one-third of adult patients.⁵ Ageusia and anosmia are some of the most common neurologic presentations of those with COVID-19; however, others include encephalopathy, encephalitis, stroke, acute disseminated encephalomyelitis, and neuroinflammatory autoimmune diseases.^{6,7}

There have been scattered reports of adults with possible GBS and concurrent evidence of COVID-19.⁸⁻¹³ There have not been any previously reported cases on GBS in children with evidence of COVID-19.

CASE

The patient was a previously healthy Hispanic 8-year-old boy who presented to an emergency department with progressive weakness. He had suffered a fall onto his buttocks 1 week before presentation, after which he had lower back pain but was able to ambulate. Over the next couple days, he began to experience bilateral lower extremity weakness that progressed to paralysis and the inability to walk. He was evaluated at a local emergency department, where lumbar spine and right ankle radiographs were determined to be normal; he was discharged from the hospital. Over the next few days, his weakness worsened as he began to develop upper extremity weakness and dyspnea. He again presented to a local emergency department, and the results of head and cervical spine computed tomography scans were negative. The patient was transferred to a tertiary care children's hospital for further evaluation.

The patient denied any recent illnesses within the past 2 months; including fever, upper respiratory infection, cough, shortness of breath, rash, diarrhea, or emesis. The patient did not have urinary or fecal incontinence, but he had not passed a bowel movement in 3 days and reported difficulty voiding. He had lower back pain and bilateral foot paresthesia. Other family members denied any recent respiratory or febrile illness. The father was an essential employee and worked outside the home daily. The patient had only left home once for a visit to a local grocery store 3 weeks before presentation, during which he wore a mask.

At the time of admission to the pediatric floor, the patient was afebrile with blood pressure of 139/97 mm Hg, heart rate of 135 beats per minute, respiratory rate of 35 breaths per minute, and oxygen saturation of 95% on room air. He appeared anxious but was alert and oriented. He was dyspneic, only able to speak 2 to 3 words at a time. Cranial nerves were intact except for intermittent left esotropia and dysconjugate gaze concerning for possible left sixth nerve palsy. Overall muscle strength was diminished with 3/5 in the upper extremities and 2/5 in the lower extremities. He had bilateral pronator drift. Deep tendon reflexes were absent in upper and lower extremities bilaterally. Sensation was intact to light touch, but proprioception of the distal lower extremities was abnormal. Baseline negative inspiratory force was -60 mm Hg.

The patient rapidly developed increased secretions with poor clearance and cough. He was transferred to PICU because of difficulty clearing secretions and worsening negative inspiratory force of -40 . He was intubated for airway protection and further workup.

An MRI of the spine was done and revealed abnormal enhancement of

the posterior nerve roots from the T11 level through the cauda equina (Fig 1). A lumbar puncture was also performed. The cerebrospinal fluid (CSF) revealed albuminocytologic dissociation with 1 nucleated cell per mm^3 , 3 red blood cells per mm^3 , and a protein level of 620 mg/dL. Results for the Gram-stain, culture, and rapid meningitis-encephalitis multiplex panel (BioFire Diagnostics, Salt Lake City, UT) were negative.

Electrodiagnostic testing performed 12 days after symptom onset revealed prolonged distal latencies and low amplitude responses in the upper and lower extremities, with the tibial and median nerve responses in the demyelinating range, decreased conduction velocities in the peroneal and median nerves, and significant temporal dispersion but overall normal conduction velocity in the tibial nerve. The sural sensory nerve conduction was absent. Needle examination revealed absent activation of the anterior tibialis muscle but no abnormal resting activity and some activation of the vastus lateralis muscle with normal motor unit potentials (Tables 1 and 2). These findings were compatible with a sensorimotor demyelinating polyneuropathy.

A diagnosis of GBS, AIDP form, was established. The patient underwent infectious evaluation for a trigger of the GBS. Results of the respiratory viral polymerase chain reaction (PCR) panel (BioFire FilmArray Respiratory Panel 2) of tracheal aspirates and respiratory viral culture were negative. Results of blood, urine, and stool cultures were negative.

The result of the patient's SARS-CoV-2 nucleic acid amplification was positive on 2 separate samples on hospital days 1 and 5. SARS-CoV-2 immunoglobulin G antibody was detected in his serum. Further workup related to COVID-19 revealed a C-reactive protein level of 8.3 mg/



FIGURE 1 MRI images of lumbar and sacral spine. A and B, Sagittal T1-weighted MRI of the spine precontrast (A) and postcontrast (B) revealing enhancement of the posterior nerve roots involving the distal cord and cauda equina.

dL, erythrocyte sedimentation rate 51 of mm/hour, interleukin 6 level of 23.6 pg/mL (normal ≤ 6.3 pg/mL) and D-dimer level of 527 ng/mL. Workup was also notable for leukocytosis (14 200 cells per mm^3) with neutrophilia (11 400 cells per mm^3). Results of the hepatic function

panel and electrolyte, fibrinogen, and ferritin levels were normal. The patient did not meet Centers for Disease Control and Prevention criteria for multisystem inflammatory syndrome in children.¹⁴ The patient's CSF was tested by real-time PCR targeting the SARS-CoV-2 *E* and *RdRp*

TABLE 1 Nerve Conduction Studies

	Distal Latency	Amplitude	Conduction Velocity
Motor nerve conduction			
Left median nerve			
Wrist	8.7 ms ($n < 4.4$)	2.0 mV	—
Elbow	14.0 ms	1.4 mV ($n > 4$)	37.7 m/s ($n > 49$)
Left peroneal nerve			
Ankle	7.6 ms ($n < 6.5$)	1.0 mV	—
Knee	15.3 ms	0.6 mV ($n > 2$)	38.9 m/s ($n > 44$)
Left tibial nerve			
Ankle	8.6 ms ($n < 5.8$)	1.7 mV	—
Knee	16.5 ms	0.5 mV ($n > 4$)	43.0 m/s ($n > 41$)
Sensory nerve conduction			
Left sural nerve			
Calf	—	0 μV ($n > 6$)	—

—, not applicable.

genes, and the result was found to be negative.¹⁵

Treatment was initiated with intravenous immunoglobulin (IVIg) on day 2 of hospitalization. The patient was given a total of 2 g/kg of IVIg over 48 hours. His examination revealed improvement over the next several days after IVIg with 4+ /5 upper extremity strength and 3/5 lower extremities bilaterally. The patient was extubated on hospital day 5 and transferred to the floor the next day on room air. Intensive physical, occupational, and speech therapy were initiated.

The patient was transferred to the inpatient rehabilitation unit 3 weeks after completion of IVIg with a projected stay of at least 8 weeks. At the time of publication, 6 weeks after IVIg, he continues to demonstrate slow improvement. He has regained bilateral dorsiflexion and plantarflexion, the ability to sit independently, and is working on ambulating in parallel bars with 2-person assistance. He was serial tested for SARS-CoV-2 for clearance and had 2 negative test results on hospital days 27 and 31.

DISCUSSION

With this case, we illustrate the first reported case, to our knowledge, of a child with GBS in the setting of an acute SARS-CoV-2 infection. GBS in a child has been reported associated with other forms of coronavirus.¹⁶ The patient presented with classic symptoms of GBS with back pain followed by symmetric ascending weakness with loss of reflexes. The workup subsequently was consistent with GBS, AIDP form. The CSF had elevated protein without pleocytosis, there was enhancement of the posterior nerve roots in the cauda equina on MRI, and electrophysiological findings (electromyogram) revealed a demyelinating process.

TABLE 2 Electromyogram

Muscle	Rest Activity				Voluntary Activity			
	Insertional Activity	Fibrillation	Positive Sharp Waves	Fasciculation	Duration	Amplitude	Polyphasic	Recruitment
Left anterior tibial	NL	0	0	0	—	—	—	Poor activation
Left vastus lateralis	NL	0	0	0	NL	NL	0	NL

NL, normal; —, not applicable.

The association between COVID-19 and GBS has been described previously in case reports of adults with a wide spectrum of GBS variants, including demyelinating, axonal, and Miller-Fisher in connection with COVID-19.^{8–12,17,18} Parainfectious GBS, as in our patient, and typical postinfectious presentations have been seen.^{13,19} SARS-CoV-2 and other coronaviruses, severe acute respiratory syndrome and Middle East respiratory syndrome specifically, have been revealed to have neurotropic nature and lead to diseases of the central and peripheral nervous system.²⁰ The lack of SARS-CoV-2 in the CSF is consistent with other reports.¹³ The exact nature and mechanisms of these phenomena have yet to be determined.

With this case, we illustrate the ever-widening scope of presentations of COVID-19 and associated complications. Clinicians need to constantly have a high level of suspicion for COVID-19 in all patients admitted to the hospital, especially in patients with unexplained symptoms. Children with an unexplained neurologic process should be tested for SARS-CoV-2. Repeat PCR testing or antibody testing may also be required because of imperfect sensitivity of the SARS-CoV-2 PCR testing. If COVID-19 is not diagnosed, there may be a missed opportunity for antiviral treatment, and there will be increased risk of exposure and infection for hospital staff.

More study of the spectrum of neurologic disease due to COVID-19 is needed. There is an ongoing, observational study of the neurologic complications related to SARS-CoV-2

infection being done through the Neurocritical Care Society.

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ABBREVIATIONS

AIDP: acute inflammatory demyelinating polyradiculoneuropathy
 COVID-19: novel coronavirus disease 2019
 CSF: cerebrospinal fluid
 GBS: Guillain-Barré syndrome
 IVIg: intravenous immunoglobulin
 PCR: polymerase chain reaction
 SARS-CoV-2: severe acute respiratory syndrome coronavirus 2

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