

# A 14-Year-Old Boy With Fevers, Cytopenias, and Neurocognitive Decline

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A 14-year-old boy presented to our institution with a 1-month history of neurocognitive decline and intermittent fevers. His history was significant for fevers, headaches, and a 10-lb weight loss. Previous examinations by multiple medical providers were significant only for bilateral cervical lymphadenopathy. Previous laboratory workup revealed leukopenia, neutropenia, and elevated inflammatory markers. Despite improvement in his laboratory values after his initial presentation, his fevers persisted, and he developed slowed and “jerky” movements, increased sleep, slurred speech, delusions, visual hallucinations, and deterioration in his school performance. A brain MRI performed at an outside hospital before admission at our institution was concerning for patchy, increased T2 and fluid-attenuated inversion recovery signal intensity in multiple areas, including the basal ganglia. After transfer to our institution and admission to the pediatric hospital medicine team, the patient had an acute decompensation. Our subspecialists will discuss the initial evaluation, workup, differential diagnosis, definitive diagnosis, and subsequent management of this patient.

## CASE HISTORY WITH SUBSPECIALTY INPUT

A 14-year-old boy with no significant past medical history presented to our institution with 1 month of neurocognitive decline and intermittent fevers. Before symptom onset, he was described by his family as a good student who was active in football and track. His family history was unknown because he was adopted.

The patient was initially evaluated in the emergency department (ED) for 3 days of fever, coughing, congestion, headache, decreased oral intake, and a 10-lb weight loss after exposure to a relative with coxsackie virus. His examination was significant for bilateral cervical lymphadenopathy. Laboratory workup revealed leukopenia, neutropenia, and elevated inflammatory markers (Table 1). He was discharged from the hospital with a diagnosis of viral illness with a plan

for follow-up with the hematology team.

He was seen as an outpatient by the hematology team. Repeat complete blood count had normalized consistent with a previous viral infection (Table 1).

Despite improvement in his laboratory values, his fevers persisted, and he developed slowed and “jerky” movements, increased sleep, slurred speech, delusions, visual hallucinations, and deterioration in his school performance.

Given this progression of symptoms, he was admitted to a community hospital, where laboratories revealed a recurrence of cytopenias and elevated inflammatory markers. Urinalysis results were negative for blood or protein, and urine drug screen results were unremarkable (Table 1). Chest radiograph and computed tomography (CT) scan of the chest were significant for bibasilar pneumonia. Brain MRI

## abstract

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**TABLE 1** Laboratory Data

Laboratory Test	A		B		C		D
	ED	Hematology Clinic	Hematology Clinic	Outside ED	Outside Hospital	Hospital Admission	
	November 19	November 22	November 30	December 11	December 17	December 17– January 11	
WBC count 4.5–13.5 × 10 <sup>3</sup> /UL	1.89	4.57	5.19	3.42	2.5	2.7	
Absolute neutrophil count 1.8–8.0 × 10 <sup>3</sup> /UL	0.76	3.16	2.43	—	—	1.94	
Hemoglobin 13.0–16.0 g/dL	9.5	9.6	11.3	9.8	8.5	8.8	
Reticulocyte 0.6–1.9, %	—	2.2	—	—	—	0.9	
Platelets 150–400 × 10 <sup>3</sup> /UL	107	225	366	142	150–160	261	
LDH 360–730 U/L	1813	1615	—	—	~1300	2914	
Uric acid 2.0–6.2 mg/dL	2.6	1.8	—	—	—	1.6	
Ammonia 22–48 UMOL/L	—	—	—	—	—	<9	
Urine drug screen result	—	—	—	—	Negative	—	
Creatinine kinase 60–335 U/L	—	—	—	—	—	678	
C-reactive protein <1.0 mg/dL	—	—	—	—	~45	3.3	
Ferritin 10–300 ng/mL	—	—	—	—	1335	1930	
Fibrinogen 220–440 mg/dL	—	—	—	—	—	419	
Triglyceride 45–203 mg/dL	—	—	—	—	—	81	
CSF WBC count, per mm <sup>3</sup>	—	—	—	—	10	18	
CSF glucose, mg/dL	—	—	—	—	~50	54	
CSF protein 15–45 mg/dL	—	—	—	—	99	112	
CSF opening pressure, mm Hg	—	—	—	—	—	38	
Influenza A and B antigen	—	—	—	Negative result	B antigen– positive	—	
Coxsackie A and B	—	—	—	—	Coxsackie A 1:64; coxsackie B5 1:80	—	
ANA	—	—	—	—	1:1280, speckled	—	
Soluble interleukin-2 receptor level 45–1105 U/mL	—	—	—	—	—	808	
NK cell activity	—	—	—	—	—	Decreased	

Select patient laboratory data from (A) first presentation to our ED, (B) hematology clinic follow-up on 2 dates, (C) outside hospital presentation and follow-up, and (D) hospital admission. Normal value ranges for our hospital are listed in the first column. Normal value ranges for the outside hospital were either not available or were similar to ours. UMOL/L, micromole per liter; WBC, white blood cell; —, not applicable.

was performed and was concerning for patchy, increased T2 and fluid-attenuated inversion recovery (FLAIR) signal intensity in multiple areas, including the basal ganglia.

He was subsequently transferred to our institution, where he was evaluated by the pediatric hospital medicine team. His initial examination revealed a child who was awake, alert, responsive (but slow), oriented to place, and again noted to have significant cervical adenopathy. He had a fever (38°C), mild tachycardia (100 beats per minute), mild tachypnea (24 breaths per minute), and normal blood pressure (105/67 mm Hg). On reevaluation a few hours later, the patient was difficult to arouse, nonresponsive to questioning, and appeared “lethargic and/or

altered.” His temperature, pulse, and respirations had all increased to 39.7°C, 116 beats per minute, and 26 breaths per minute, respectively, and he remained normotensive (112/63 mm Hg). He was diaphoretic. He had significant muscle weakness, had diminished deep tendon reflexes, and was unable to stand. Given concern for a stroke or bleeding, emergent head CT was performed that did not reveal any acute intracranial abnormality, including edema, hemorrhage, or herniation. He was then transferred to the intermediate care unit, and the neurology team was consulted.

#### General Pediatrics Team

We asked the neurology team to walk us through the neurologic

examination. What were the abnormal findings, and how did they lead to your differential diagnosis for the patient?

#### Drs Ariel Lyons-Warren and Sarah Risen, Neurology

When evaluating altered mental status (AMS), it is most important to distinguish decreased alertness from confusion, aphasia, or inattentiveness. This patient was sleepy, although he was aroused with minimal verbal stimulation. He was able to answer questions and follow simple commands and was oriented to person, place, and time. His language content was mostly appropriate, although at times, it was apparent he was confused.

**TABLE 2** Initial Neurologic Examination Obtained by the Neurology Team on the Day of Admission

Neurologic Examination	Finding
Mental status	
Appearance and behavior	Well groomed Dressed in a hospital gown Sitting in a chair
Speech	Slow, not slurred; age appropriate content although intermittently confused
Thought	Slow, no delusions
Alertness	Sleepy but arousable
Orientation	Oriented to person, place, mo, and y
Attention	Decreased
Cranial nerves	
I: olfactory nerve	Smell not assessed
II: optic nerve	Pupils were equal, round, and reactive to light Visual fields intact to confrontation
III, IV, VI: oculomotor, trochlear, and abducens nerves	Full extraocular movements
V: trigeminal nerves	Intact and symmetric facial sensation to light touch
VII: facial nerve	Symmetric facial movements
VIII: vestibulocochlear	Hearing intact to voice
IX, X: glossopharyngeal and vagus nerves	Palate elevates symmetrically
XI: accessory nerve	Full strength in sternocleidomastoid muscle
XII: hypoglossal nerve	Midline tongue protrusion
Motor	
Tone	Normal tone
Muscle mass	No atrophy
Strength	At least three-fifths strength in upper and lower extremities proximally and distally without evidence of focal weakness; motor examination was difficult to obtain because of slow responses and poor cooperation
Reflexes	Depressed patellar reflexes
Coordination	No evidence of dysmetria, no tremor
Sensation	Intact to light touch in upper and lower extremities
Gait	Unable to ambulate independently

In patients with AMS, it is also important to look for focal neurologic deficits. For example, asymmetric pupils can indicate increased intracranial pressure leading to herniation. His pupils were equal. On reflex and motor examination, it is most important to assess for asymmetry. This patient had symmetric lower extremity weakness, as evidenced by his inability to stand without support. Reflexes were diminished but present and symmetrical. The remainder of the examination was unremarkable (see Table 2 for the full neurologic examination).

The differential diagnosis for a patient with AMS, fever, and lower extremity weakness is broad (Table 3) and includes infectious, postinfectious, autoimmune, and oncologic etiologies. This patient's history of fever, weight loss, and

elevated inflammatory markers (Table 1) appeared to be correlated more with an evolving systemic process with secondary neurologic manifestations. Considering the acute onset of weakness with diminished lower extremity reflexes and encephalopathy (an altered state of consciousness), a process involving both the central and peripheral nervous systems was favored. This initially raised concern for specific infections, such as West Nile virus<sup>1</sup> or mycoplasma encephalitis.<sup>2</sup> Basal ganglia lesions on MRI, although nonspecific, can be seen in West Nile encephalitis.<sup>3</sup>

### General Pediatrics Team

There were also concerns for autoimmune causes for this patient's symptoms. Could this be systemic lupus erythematosus

**TABLE 3** Initial Differential Diagnosis Divided by Pathophysiology

Autoimmune
SLE (with CNS involvement)
Dermatomyositis
Primary CNS or systemic vasculitis
Other immune-mediated or inflammatory myopathies
ADEM
AE (including antibodies to N-methyl-D-aspartate receptor, VGKC, and GAD)
Multiple sclerosis and/or transverse myelitis
Guillain-Barré syndrome
Myasthenia gravis
ALPS
Infectious
Acute viral encephalitis and/or meningitis
Postinfectious viral encephalitis
Oncologic
Leukemia and/or lymphoma
Other malignancy with CNS metastasis
HLH
Paraneoplastic neurologic syndromes

GAD, glutamic acid decarboxylase.

(SLE) or autoimmune encephalitis (AE)? If so, how would you work this up?

**Drs W. Blaine Lapin and Monica Marcus, Rheumatology**

Yes, it could be. Although rheumatologic diseases are rare, given his constellation of symptoms, we were most concerned about SLE with secondary central nervous system (CNS) vasculitis, AE, and/or a hemophagocytic lymphohistiocytosis (HLH) and/or macrophage activation syndrome (MAS) spectrum disorder. Given the patient's history of subacute neurocognitive decline followed by constitutional symptoms and a sudden alteration of consciousness, we needed to perform additional testing to assess the aberrant activation of his immune system.

We recommended serologic studies to evaluate SLE, including an antinuclear antibody (ANA) profile, which revealed positive high-titer ANA, positive anti-Smith, and positive antiribonucleoprotein antibodies. A lumbar puncture was done to evaluate for opening pressure, and cerebrospinal fluid (CSF) studies were obtained to evaluate for antibodies seen in neuropsychiatric systemic lupus erythematosus (NPSLE) (his was positive for antineuronal antibody in serum and CSF). Given the concern for possible AE, serum and CSF studies were sent and had positive results for voltage-gated potassium channel (VGKC) antibody in the serum.

**General Pediatrics Team**

Given the normal head CT results, what further studies would you recommend ordering to address his rapid decline?

**Drs Lyons-Warren and Risen**

EEG should be considered next to identify subclinical seizures with rapid decline in mental status. Our patient's EEG did not reveal any focal or epileptiform features but did reveal diffuse

slowing, which is consistent with encephalopathy.

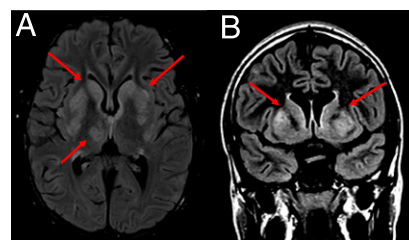
To evaluate infectious causes of AMS, patients should undergo lumbar puncture to examine CSF for glucose, protein, cell count, viral studies, and culture in addition to serum infectious evaluation. These CSF studies were normal in our patient with the exception of elevated protein levels (Table 1). Given his muscle weakness, a serum creatinine kinase level was sent and found to be mildly elevated (Table 1). An MRI of the brain and spine were performed to address concerns for an inflammatory or demyelinating disease. The distribution and shape of the inflammatory lesions can be helpful in narrowing the differential.<sup>4</sup> For example, in demyelinating diseases, T2 changes are usually restricted to the white matter. Similarly, the T2 changes in acute disseminated encephalomyelitis (ADEM) are "fluffy" compared with those in viral encephalitis. We also obtained magnetic resonance angiography of the brain to assess for CNS vasculitis. In our patient's case, spine MRI and brain magnetic resonance angiography results were negative; however, brain MRI results confirmed previously reported increased T2 and FLAIR signal intensity in cortical and deep gray matter, including the basal ganglia, as well as white matter regions (Fig 1).

**General Pediatrics Team**

Basal ganglia lesions are known to cause movement disorders. Can you elaborate on this?

**Drs Lyons-Warren and Risen**

Basal ganglia lesions can cause hyper- or hypokinetic movement disorders, reflecting increased and decreased movements, respectively. Patients can also experience changes in muscle tone, abnormal and involuntary movements, difficulty controlling the speed of their movements, or difficulty coordinating



**FIGURE 1** Axial T2 (A) and coronal FLAIR (B) brain MRIs from the day of admission revealed changes in the basal ganglia and thalamus.

movements. Although Parkinsonism is the most recognized hypokinetic disorder, basal ganglia lesions can be seen in SLE,<sup>5</sup> viral infections,<sup>6</sup> and postinfectious demyelinating diseases, such as ADEM.<sup>7</sup>

During the first few days after admission, this patient developed increased extremity tone, resting pill-rolling hand tremor, profound bradykinesia (slowness of initiation and execution of voluntary movements and speech), rigidity, and postural deficits. This was consistent with the location of his lesions on MRI.

**General Pediatrics Team**

While in the intermediate care unit, our patient's blood counts continued to decline. How do you think about a patient with pancytopenia?

**Drs Nisha Rathore and Jeremy Slone, Hematology-Oncology**

Cytopenias can be broadly thought about in 2 ways: the bone marrow is not producing a normal amount of cells, or cells are being adequately produced but destroyed. Both mechanisms can result in low peripheral cell counts. A bone marrow biopsy was eventually performed on this patient and revealed a hypocellular marrow of 40%. Cellularity of this degree could indicate suppression from an acute illness, an underlying inflammatory condition, use of certain medications, and/or malignancy. In our patient's case, a hypocellular marrow was



an indication of either a lack of production or suppression.

### General Pediatrics Team

Does your thought process change when addressing a patient with pancytopenia and AMS?

### Drs Rathore and Slone

Yes, it would. If malignancy is suspected, the infiltration occurring in the bone marrow, which subsequently leads to low blood count production, may also be occurring in the CNS. This can be seen in malignancies such as leukemia or lymphoma or in solid tumor malignancies with metastases to the bone marrow and CNS.

In clinical scenarios involving fever, elevated inflammatory markers (especially ferritin), lymphadenopathy, and cytopenias, one must also consider diseases that are associated with immune dysregulation, such as HLH. This disorder, which is caused by a failure to downregulate macrophages, results in excessive cytokine release. Cytopenias are a common end result of this immune dysregulation, and neurologic manifestations can be seen in approximately one-third of those affected with this disorder.<sup>8-10</sup> To diagnose diseases such as HLH, the patient must meet at least 5 of the following laboratory and/or clinical criteria: fever, cytopenias (hemoglobin <9 g/dL; platelets <100 K/ $\mu$ L; absolute neutrophil count <1 K/ $\mu$ L), fasting triglycerides >265 mg/dL and/or fibrinogen <150 mg/dL, tissue evidence of hemophagocytosis, decreased or absent natural killer (NK) cell activity, ferritin >500 ng/mL, and soluble CD25 (a cytokine released by T cells) level >2 SDs above the normal value for age.<sup>9</sup> In our patient, HLH was less likely given the absence of bone marrow and lymph node (LN) hemophagocytosis. However, we were definitively able to eliminate HLH because he only met 4 of the 8 criteria required

for diagnosis: fever, cytopenias, decreased NK cell activity, and ferritin >500 ng/mL.

Another disorder characterized by immune dysregulation is autoimmune lymphoproliferative syndrome (ALPS). Driven by a defect in lymphocyte apoptosis, symptoms of this disorder include lymphadenopathy, cytopenias secondary to autoimmune destruction, splenomegaly, and sometimes neurologic complications resulting in dementia.<sup>11</sup> ALPS was eliminated from the differential on the basis of the lack of typical immunohistological findings on bone marrow biopsy per the hematopathologist.

If the cytopenias are thought to be occurring from a nonmalignant etiology, the AMS is usually due to the overarching disease process. For example, our patient's initial cytopenias were thought to be related to an acute infection. Infections that affect the brain may be so severe that they cause bone marrow suppression at the same time. Similarly, states of chronic inflammation can have bone marrow-suppressive effects in addition to impacting the CNS.

### General Pediatrics Team

What findings on a peripheral blood smear would be concerning for a malignancy? Is there utility in obtaining additional CSF studies?

### Drs Rathore and Slone

In any patient who has cytopenias, a peripheral smear is essential to review. At times, malignant cells can be seen on the smear, which helps guide the direction of the workup. Our patient had a peripheral smear done at an outside facility that did not reveal any evidence of malignancy. Additionally, for a patient who is altered, examination of CSF cytology is beneficial to assess for malignant cells. Most cases of cytopenias, for which malignancy is

being considered, require biopsies of the bone marrow. In fact, 1 specific concern for our patient's case was an underlying malignancy that could be driving a process such as HLH. Because of his significant cervical lymphadenopathy, we proceeded with both LN and bone marrow biopsies. These tissue samples can be studied via flow cytometry, specific marker staining, and microscopically. Lastly, in cases with marked lymphadenopathy, imaging studies (such as a positron emission tomography [PET] or CT scans) can provide an overview of disease burden as well as allow for targeted planning of potential biopsy sites. In our patient, a PET scan revealed increased signal uptake in his cervical, axillary, and mesentery nodes.

### General Pediatrics Team

Given that our patient had diffuse lymphadenopathy on examination of unclear etiology, he underwent an LN biopsy. What does an LN biopsy add to the diagnostic workup that cannot be provided by a bone marrow biopsy?

### Dr M. Tarek Elghetany, Pathology

The patient had anemia, leukopenia, lymphadenopathy, increased lactate dehydrogenase (LDH), and increased inflammatory markers. The PET scan revealed numerous groups of enlarged LNs with increased metabolic activity, including mediastinal and supraclavicular LNs. Together with deterioration in mental status, there was a possibility of lymphoma driving an HLH-like process. Our concern was that the bone marrow would only show signs of HLH. We wanted to ensure that there were not 2 concurrent processes. The LN pathology would help address whether there was evidence of lymphoma that was driving the HLH. Superficial (right

cervical) LNs provided an easy access to diagnostic material. His biopsy revealed necrotizing lymphadenitis without neutrophils (Fig 2).

### General Pediatrics Team

In a multidisciplinary meeting with the rheumatology, neurology, and hematology-oncology teams, we were able to review the LN biopsy results with Dr Elghetany. On the basis of these results, the patient's leading diagnosis was SLE. What evidence on biopsy fortified this diagnosis?

### Dr Elghetany

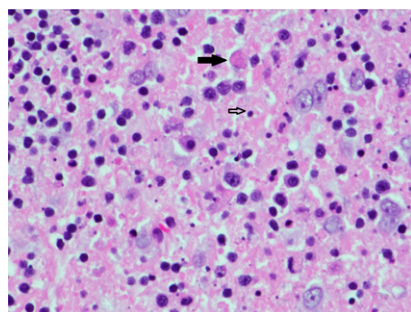
The presence of extensive LN necrosis with a predominance of nuclear dust and virtual absence of neutrophils (Fig 2) are common findings in immunologically related disorders, such as Kikuchi disease and SLE.<sup>12</sup>

### Drs Lapin and Marcus

On the basis of our review of the pathology specimen along with the results of the ANA profile, we concluded that the patient best fit the diagnosis of SLE.

### General Pediatrics Team

What is the classification criteria for SLE, and how does our patient satisfy that criteria?



**FIGURE 2**

Histology of LN with hematoxylin and eosin stain at  $\times 400$ . The LN reveals extensive background necrosis with an absence of neutrophils. Also present are plasma cells with cytoplasmic immunoglobulins, also known as Mott cells (black arrow) and nuclear dust (hollow arrow).

### Drs Lapin and Marcus

To establish a diagnosis of SLE, a patient must meet at least 4 of 11 American College of Rheumatology criteria, which were originally developed for research purposes and includes (1) malar rash, (2) discoid rash, (3) photosensitivity, (4) oral ulcers, (5) arthritis, (6) serositis, (7) renal disorder (proteinuria or cellular casts), (8) neurologic disorder (seizures or psychosis), (9) hematologic disorder (hemolytic anemia, leukopenia, lymphopenia, or thrombocytopenia), (10) immunologic disorder (positive antiphospholipid antibodies, anti-Smith antibodies, or double-stranded DNA), and (11) positive ANA.<sup>13</sup> This patient met criteria for SLE with the following findings: (1) positive ANA, (2) immunologic disorder (positive anti-Smith antibody), (3) neurologic disorder, and (4) hematologic disorder (leukopenia). At time of diagnosis, the patient also had evidence of MAS given his persistent fever, lymphadenopathy, leukopenia and anemia, and elevated ferritin.

### General Pediatrics Team

What is MAS, and how is it different from HLH?

### Drs Lapin and Marcus

MAS and HLH are both caused by excessive activation and expansion of macrophages and T cells, leading to an overwhelming inflammatory reaction. MAS and HLH are on a disease spectrum.<sup>13</sup> MAS is always seen as a complication of an underlying rheumatic disease. Most commonly, it is associated with systemic onset juvenile idiopathic arthritis. Less frequently, it may be seen in patients with SLE and Kawasaki disease. It occurs in  $\sim 1\%$  of SLE patients. MAS is characterized clinically by fever, hepatosplenomegaly, lymphadenopathy, severe cytopenias, liver disease, coagulopathy, and encephalopathy.<sup>13</sup> HLH can be

divided into primary (familial) or secondary (reactive) HLH. Primary HLH is caused by rare autosomal recessive genetic defects of the cytolytic pathway and usually presents within the first several years of life. Secondary HLH usually affects older children and most commonly is triggered by an infection, such as Epstein-Barr virus, or by an oncologic process.<sup>13</sup> On a cellular level, uncontrolled proliferation of T cells and macrophages leads to decreased NK cell and cytotoxic T-cell function. The hallmark of MAS is seen on bone marrow examination, where morphologically benign macrophages and lymphocytes exhibit the hemophagocytic activity of other blood cells. This can be identified by using staining for CD163 (an anti-CD163 haptoglobin receptor antibody and marker of cells of monocyte and/or macrophage lineage). The increase in macrophages can also be detected in the serum because patients have increased soluble CD25 and/or CD163 levels.<sup>14</sup> Laboratory features of MAS and HLH are often indistinguishable. Common laboratory results include a decline of at least 2 cell lines (usually platelets first), a falling erythrocyte sedimentation rate because of decreased fibrinogen levels, elevated serum transaminases and bilirubin, as well as decreased serum albumin. Other classic laboratory abnormalities include elevated ferritin, LDH, and triglyceride. CSF pleocytosis with mildly elevated protein may be seen.<sup>13,15</sup>

### General Pediatrics Team

Did this patient have features of NPSLE given his AMS and encephalopathy? How do you diagnose NPSLE, and what are the autoantibodies seen in this disease?

### Drs Lapin and Marcus

The reported incidence of NPSLE varies greatly between 10% and

95%<sup>16–18</sup> in pediatric patients. NPSLE is more frequent in the pediatric population and typically presents at diagnosis<sup>19,20</sup>; however, patients may develop NPSLE at any time. It has 19 manifestations in total, but patients may present with >1 manifestation at once. Headache is the most common manifestation.<sup>16,20</sup> Other striking manifestations include psychosis, cognitive dysfunction, acute confusional state, mood disorders, cerebrovascular disease, seizures, and movement disorders.<sup>13,16–18</sup> Tissue damage in SLE is generally caused by autoantibodies, and this holds true for NPSLE. The most common antibodies in NPSLE include antineuronal antibodies, antiphospholipid antibodies, ribosomal P antibodies, and N-methyl-D-aspartate receptor antibodies.

Our patient's symptoms of increased extremity tone, tremors, profound bradykinesia, and AMS and cognitive dysfunction, in addition to his basal ganglia lesions on MRI and the antineuronal antibodies detected in the CSF, was consistent with the diagnosis of NPSLE. Typical brain MRI findings seen in patients with NPSLE include cerebral and cerebellar volume loss or atrophy, white matter hyperintensities, gray matter lesions, and infarctions, or in some cases, brain MRI results may be normal.<sup>21–23</sup>

### General Pediatrics Team

Why was the patient treated with rituximab? Was this meant to treat his SLE or MAS?

### Drs Lapin and Marcus

Actually, the patient had VGKC antibodies detected in the serum by using 2 separate assays. VGKC antibodies are classically associated with AE. AE is a group of neuropsychiatric disorders that present acutely or subacutely and are characterized by alterations in consciousness, cognitive decline, seizures, abnormal movements,

or psychosis and may be associated with underlying systemic or CNS autoimmune disorders or paraneoplastic syndromes. When present in serum and/or CSF, they can cause a phenotype that is characterized by seizures and memory loss.<sup>12,24</sup> Rituximab is a monoclonal anti-CD20 antibody against B cells and is used in rheumatic diseases, in which autoantibodies play a pathogenic role.<sup>25</sup> In this patient, rituximab was chosen as adjuvant therapy given the presence of autoantibodies and the phenotypic similarity to AE.<sup>26</sup>

### General Pediatrics Team

What was the outpatient management plan for this patient?

### Drs Lapin and Marcus

At the time of discharge from the hospital, the patient continued to exhibit dysphagia, dysarthria, Parkinsonism, left hemiparesis, and spasticity. His neurocognitive and expressive deficits were greater than his receptive language deficits. He completed 3 weeks of intensive inpatient rehabilitation to address impairments in mobility, feeding (swallowing coordination), performance of activities of daily living, speech and language, and cognition. Consistent with the reports in the literature for outcomes of NPSLE,<sup>20,27,28</sup> he made great strides. He completed outpatient rehabilitation therapies and is now independent in activities of daily living. He resumed classes via home-bound instruction and completed the school year. Six months after completing inpatient rehabilitation, neuropsychological evaluation revealed average intellectual, academic, social, and adaptive skills but below-average visuomotor and/or sensory motor, executive function, and attentional skills. He requires ongoing academic accommodations.

### ABBREVIATIONS

ADEM: acute disseminated encephalomyelitis  
 AE: autoimmune encephalitis  
 ALPS: autoimmune lymphoproliferative syndrome  
 AMS: altered mental status  
 ANA: antinuclear antibody  
 CNS: central nervous system  
 CSF: cerebrospinal fluid  
 CT: computed tomography  
 ED: emergency department  
 FLAIR: fluid-attenuated inversion recovery  
 HLH: hemophagocytic lymphohistiocytosis  
 LDH: lactate dehydrogenase  
 LN: lymph node  
 MAS: macrophage activation syndrome  
 NK: natural killer  
 NPSLE: neuropsychiatric systemic lupus erythematosus  
 PET: positron emission tomography  
 SLE: systemic lupus erythematosus  
 VGKC: voltage-gated potassium channel

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