Diagnosing and Treating Anti-N-Methyl-D-Aspartate (NMDA) Receptor Encephalitis

Amanda Moen, M.D., pediatric neurologist

Anti-N-methyl-D-aspartate (NMDA) receptor encephalitis is an autoimmune condition in which the body produces antibodies that act against receptors in the brain, resulting in both neurologic and psychiatric symptoms. Common symptoms include personality change, psychosis, abnormal movements, seizures and autonomic dysfunction. The antibodies associated with this condition were first identified in 2005, and since then it has become recognized as one of the most common identifiable causes of encephalitis in children and young adults.

In the California Encephalitis Project, only 79 of 761 cases of encephalitis in individuals under age 30 had an identifiable etiology. Anti-NMDA receptor encephalitis accounted for 32 of those cases, and 65 percent of those patients were younger than 19. Additionally, the study showed that anti-NMDA receptor encephalitis may be more common than any single infectious cause of encephalitis, other than enterovirus.1

**KEY INSIGHTS**

- Anti-NMDA receptor encephalitis is a relatively common and treatable cause of encephalitis in pediatric patients.
- Common symptoms include personality change, abnormal movements, seizures and autonomic dysfunction.
- If these symptoms are present, an urgent child neurology evaluation is indicated and an evaluation for anti-NMDA receptor encephalitis should be initiated.
- Time-to-diagnosis and treatment of anti-NMDA receptor encephalitis have a significant impact on patient recovery and final outcome.

**Frequency of Identifiable Causes of Encephalitis in the California Encephalitis Project**

- Anti-NMDA receptor encephalitis
- Enterovirus
- Herpes Simplex Virus (HSV-1)
- West Nile Virus
- Varicella Zoster Virus

Clinical Presentation
Patients with anti-NMDA receptor encephalitis have a constellation of symptoms that are recognizable to providers familiar with the condition. However, comparisons of presentations among patients with this condition show significant variability. Most patients will exhibit multiple, but not all, possible symptoms of the condition. The order in which symptoms develop can vary from patient to patient, and not all symptoms may be present during the initial evaluation. Additionally, presentation varies by age group. Very young children present with symptoms that are distinct from those seen in teens and adults.

Psychiatric Symptoms
• The most common presenting symptoms in teenagers and adults include anxiety, insomnia, delusions, mania and paranoia. Young children tend to present with behavior changes, temper tantrums, hyperactivity and irritability, instead of overt psychotic symptoms. This initial phase is often followed by a stage with periods of alternating agitation and catatonia. Often the first provider to see the patient is a psychologist or psychiatrist.

Language Changes
• A reduction in spontaneous speech occurs in all age groups and may be a presenting symptom in pediatric patients.
• A progression to mutism is very common in pediatric patients and may also be seen in adults.

Movement Disorders
• Almost all patients will develop abnormal movements during the course of the disease. Oro-lingual-facial dyskinesias, such as chewing movements and tongue rolling, are the most characteristic movements. Abnormal movements of the trunk and extremities, including chorea, dystonia and rigidity, are also frequently seen. Young children may have ataxia or difficulty walking and may even lose the ability to walk.

Seizures
• New onset seizures are common and occur in 50 to 75 percent of patients. Common seizure types include focal seizures, motor seizures, complex partial seizures and generalized convulsions. Patients are at risk for status epilepticus—prolonged seizures lasting longer than 30 minutes.

Autonomic Dysfunction
• The most frequent autonomic manifestations include fever, tachycardia, hypertension, bradycardia and hypersalivation. A small percentage of patients develop hypoventilation, even when consciousness is preserved, and require respiratory support. Close monitoring of vital signs is recommended for all patients.

Differential Diagnosis
The differential diagnosis of anti-NMDA receptor encephalitis is broad and includes infectious causes of encephalitis, such as herpes simplex virus; acute disseminated encephalomyelitis (ADEM); inborn errors of metabolism, including urea cycle disorders; environmental toxins and medication overdoses; rheumatologic conditions, such as neuropsychiatric lupus; and primary psychiatric conditions, such as schizophrenia. Due to the extensive differential diagnosis, the diagnostic work-up of each patient must be individualized based on the presentation, and consultation with a child neurologist is recommended.

Diagnostic Tests
Cerebrospinal Fluid (CSF) Evaluation
• CSF will be abnormal in up to 90 percent of patients. More than 80 percent of patients will have positive oligoclonal bands, which are antibodies in the CSF that are not found in the serum. Up to 75 percent of patients will have elevated CSF white blood cell counts, usually with lymphocytic predominance, but neutrophilic predominance can also be seen. Approximately 10 to 15 percent of patients will have elevated protein concentrations. Anti-NMDA receptor antibodies can be found in the CSF as well as the serum.

MRI of the Brain
• For 50 percent of cases, MRIs will appear normal. The most common abnormal finding is nonspecific T2 hyperintense lesions involving the gray and/or white matter of the cortex, basal ganglia or brainstem; spine lesions are rare. The changes are usually mild and transient, but can occasionally be extensive.

References
Oro-lingual-facial dyskinesias, such as chewing movements

Language Changes

• Often the first provider to see the patient is a psychologist
• Young children tend to present with behavior changes, temper

Psychiatric Symptoms

by age group. Very young children present with symptoms that
during the initial evaluation. Additionally, presentation varies
among patients with this condition show significant variability.
Most patients will exhibit multiple, but not all, possible symptoms
with the condition. However, comparisons of presentations
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psychiatric conditions, such as schizophrenia. Due to
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Differential Diagnosis

Clinical Presentation

• Close monitoring of vital signs is recommended for
all patients.
• Up to 75 percent of patients will have elevated CSF
require respiratory support.
• 90 percent of patients will have slowing of background frequencies.
• 25 to 50 percent will have epileptic features, such as spike and
wave discharges or captured seizures.

Electroencephalogram (EEG)

• EEGs are used to assess the background activity and to evaluate
for seizures.
• Most patients with anti-NMDA receptor encephalitis will have
an abnormal EEG at some point in their disease course.
• 90 percent of patients will have slowing of background frequencies.
• 25 to 50 percent will have epileptic features, such as spike and
wave discharges or captured seizures.

Infectious Disease Evaluation

• The evaluation for viral encephalitis is individualized, and
depends on time of year and geographic location.
• Every patient should be tested for herpes simplex virus (HSV).
• The infectious disease team is often consulted to co-evaluate the
patient.

Tumor Evaluation

• The first cases of anti-NMDA receptor encephalitis were
described in young women with ovarian teratoma. In these
patients, the body’s immune response to this benign tumor resulted in production of the antibodies which cross-reacted with the patient’s brain.
• Tumors, specifically teratoma, are found in less than half of adults with this condition and become increasingly rare in younger patients.
• Every patient with anti-NMDA receptor encephalitis should undergo a tumor evaluation.

Treatment

• Medications are used to decrease the circulating disease-causing
anti-NMDA receptor antibodies and the body’s overactive immune response.
○ Methylprednisolone is an IV steroid that can be given at high
doses and is often used with IV immunoglobulins (IVIG) as
first-line therapy.
○ IVIG are pooled antibodies, given by IV, that result in the body
degrading circulating antibodies, including the anti-NMDA
receptor antibodies that are disease-causing.
○ Rituximab is a monoclonal antibody, given by IV, that targets
the body’s antibody producing cells and stops ongoing production
of anti-NMDA receptor antibodies. It is often used as a
second-line therapy for those patients whose recovery after receiving first-line treatments is inadequate.
• Other medications are often needed to treat specific
symptoms, such as seizures, abnormal movements
or psychosis.
• Rehabilitation programs, with intensive physical, occupational and speech therapy, are important to help patients regain function, and an inpatient admission to a specialized rehabilitation unit is often required.

Outcomes

At least 75 percent of patients will have substantial
recovery. The rate and degree of recovery appear to be
related to how quickly a diagnosis is made and treat-
ment is begun using appropriate immunomodulating
agents. There is limited information about cognitive and psychological outcomes in these patients; how-
ever, my experience suggests that these problems are
under-recognized in patients with otherwise excellent
neurologic recovery.

Conclusion

Anti-NMDA receptor encephalitis is a relatively
common and treatable cause of encephalitis in
pediatric patients. Any child presenting with
personality change or psychiatric symptoms should
be evaluated for co-existing neurological symptoms
such as abnormal movements or new seizures.
If these symptoms are present, an urgent child
neurology evaluation is indicated and an evaluation
for anti-NMDA receptor encephalitis should be initi-
ated. Time-to-diagnosis and treatment of anti-NMDA
receptor encephalitis have a significant impact on
patient recovery and final outcome. We welcome your
questions and referrals.

References


Additional Resources

Dalmaj J, Lancaster E, Martinez-Hernandez E, Rosenfeld MR, Balice-


Amanda Moen, M.D.

Pediatric neurologist Amanda Moen, M.D., treats children who have epilepsy and other neurological conditions. She received an M.D. from the University of Iowa’s Carver College of Medicine in Iowa City, Iowa, and completed a pediatric residency and a child neurology residency at The Children’s Hospital Colorado in Denver. Her professional interests include anti-NMDA receptor encephalitis, neuroimmunology, leukodystrophies and other metabolic and genetic neurological disorders.
Young Child With Anti-NMDA Receptor Encephalitis

History: The mother of a 4-year-old girl brought her daughter to the emergency room because of a change in behavior. She reported that the girl had seemed sad and unlike herself for one week. She first noticed her daughter having frequent episodes of crying for no apparent reason. During the preceding week, the girl also seemed more tired than normal, and she had low grade fevers to 100.1 F. Four days earlier, her mother observed that her daughter seemed to be constantly playing with her tongue, chewing on it and running it over her teeth. She also noticed that the girl seemed to be fidgeting with her hands more, “like she was anxious and couldn’t keep them still.” The patient was seen by her pediatrician and a psychologist and they felt she was depressed. Over the next two days, she stopped speaking, began sleeping very little and developed an unsteady gait. Shortly after admission to the hospital, she had a new spell that consisted of stiffening her right arm and staring.

Evaluation: On neurologic examination, the child had continuous oro-lingual dyskinesias, chorea of her upper extremities and was unable to walk. She was mute but attentive. She underwent blood work and a spinal tap. Her spinal fluid showed nine white blood cells. An extensive infectious workup was negative. MRI of the brain with and without contrast was normal. Her serum was positive for anti-NMDA receptor antibodies. An EEG was done to evaluate the episodes of staring and arm stiffness and confirmed that these events were seizures.

Treatment: She had the classic clinical presentation for a young child with anti-NMDA receptor encephalitis. Specifically, she was a young child whose change in mood/personality was accompanied by multiple neurologic symptoms including a movement disorder, mutism and seizures. Due to the clinical picture, treatment with IV methylprednisolone and IV immunoglobulins (IVIG) was initiated after CSF cultures were negative for 24 hours. She was started on oxcarbazepine for seizure control.

Outcome: She required a 10-day admission to the inpatient rehabilitation unit. At discharge, she walked independently and was able to say a few words with prompting. One month after discharge, her mother reported that the girl is still less talkative than before her illness, but this is the only remaining symptom.
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Joy Taber, M.D., is board-certified in physical medicine and rehabilitation. She cares for adult patients who have cerebral palsy, spina bifida and other childhood-onset conditions. She received a medical degree and completed her residency in physical medicine and rehabilitation at the University of Minnesota School of Medicine in Minneapolis. In addition, she served as a U.S. Air Force flight surgeon. She is a member of the American Academy of Physical Medicine and Rehabilitation, American Medical Association and Minnesota Medical Association. She sees patients at Gillette Lifetime Specialty Healthcare.