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Clinical Observations

Rethinking the Magnetic Resonance Imaging Findings in Early Rasmussen Encephalitis: A Case Report and Review of the Literature

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ABSTRACT

OBJECTIVE: We present a child with Rasmussen encephalitis and highlight the pitfalls of diagnosis when magnetic resonance imaging (MRI) is negative for atrophy. We review the literature regarding this issue, introduce the FreeSurfer software as a potential means of noninvasive diagnosis, and discuss methods for prompt and definitive treatment. **METHODS:** In addition to the patient description, we review the English language literature regarding pathologic diagnosis of Rasmussen encephalitis using the key words Rasmussen encephalitis, focal lesions, MRI, atrophy, epilepsia partialis continua and hemiparesis in PubMed. We conducted a retrospective, volumetric analysis of our patient's MRIs using FreeSurfer. **RESULTS:** Unlike the majority of patients in the literature with Rasmussen encephalitis, our patient's initial MRI was normal and later showed only a small area of T2 and fluid-attenuated inversion recovery high signal despite the presence of epilepsia partialis continua and a rapidly deteriorating clinical course. She did not meet the Rasmussen encephalitis diagnostic criteria until biopsy was obtained but is now seizure-free after functional hemispherotomy performed six months after her initial seizure. FreeSurfer analysis did not show cortical atrophy. **CONCLUSION:** The Bien criteria have poor sensitivity for the diagnosis of Rasmussen encephalitis when the MRI is negative for atrophy. Tissue diagnosis is essential in such instances. We suggest a high clinical index of suspicion and multidisciplinary collaboration between radiology, pathology, and neurosurgery to facilitate a greater emphasis on biopsy followed by hemispherotomy as definitive therapy for individuals with early Rasmussen encephalitis.

Keywords: Rasmussen encephalitis, MRI, epilepsia partialis continua, Bien criteria, FreeSurfer

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Rasmussen encephalitis is a devastating, medically intractable epileptic encephalopathy of childhood that typically begins with focal seizures and almost invariably progresses to a state of hemiparesis, medically intractable epilepsy, and cognitive decline.[1] The only definitive treatment for Rasmussen encephalitis is surgical disconnection of the affected hemisphere from the normal hemisphere.[2] A 2005 European consensus statement was designed to aid the diagnosis and early treatment of Rasmussen encephalitis includes diagnostic criteria (Table).[3] With greater awareness and advancement of imaging technology, we are increasingly faced with the challenge of managing patients who clinically present with manifestations like those of Rasmussen encephalitis but may not have the necessary imaging characteristics to satisfy the diagnostic criteria. We present a seven-year-old child who did not satisfy the diagnostic imaging criteria but who is seizure-free after

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TABLE.
Adapted Version of the Bien Criteria for Diagnosis of Rasmussen Encephalitis[1]

Part A:	
1. Clinical	Focal seizures (with or without epilepsia partialis continua) and unilateral cortical deficit(s)
2. EEG	Unihemispheric slowing with or without epileptiform activity and unilateral seizure onset
3. MRI	Unihemispheric focal cortical atrophy and at least one of the following: • Grey or white matter T2/FLAIR hyperintense signal • Hyperintense signal or atrophy of the ipsilateral caudate head
Part B:	
1. Clinical	Epilepsia partialis continua or progressive unilateral cortical deficit(s)
2. MRI	Progressive unihemispheric focal cortical atrophy
3. Histopathology	• T cell dominated encephalitis with activated microglial cells (typically, but not necessarily forming nodules) and reactive astrogliosis • Numerous parenchymal macrophages, B cells or plasma cells, or viral inclusion bodies exclude the diagnosis of Rasmussen encephalitis

Abbreviations:
EEG = Electroencephalography
FLAIR = Fluid-attenuated inversion recovery
MRI = Magnetic resonance imaging
Rasmussen encephalitis can be diagnosed if either all three criteria of Part A or two of three criteria of Part B are present.

functional hemispherotomy performed six months after her initial presentation. We review the available English language publications that describe children with Rasmussen encephalitis with or without normal imaging and suggest alternative means of evaluating these children.

Patient Description

This 7-year-old, previously healthy, right-handed female initially presented with a simple partial seizure arising in the left foot, lasting two minutes, with an associated postictal paralysis. Her initial routine electroencephalogram (EEG) was normal. One month later, she had a secondarily generalized seizure upon awakening with onset in the left foot. Repeat EEG showed vertex spikes and was interpreted as consistent with Rolandic epilepsy. Magnetic resonance imaging (MRI) was unremarkable. She began oxcarbazepine.

Eight weeks later, her left leg twitching became continuous, even during sleep. Four months after onset, she had failed treatment with bolus doses of phenobarbital, phenytoin, and levetiracetam and was diagnosed with epilepsia partialis continua while being administered maintenance phenytoin and oxcarbazepine. Neurological examination five months after onset showed constant left leg and pelvic twitching and intermittent stiffening of the left arm. Sensory examination showed agraphesthesia and reduced two point discrimination on the dorsum of the left arm. She exhibited left hemiparesis with a tight left heel cord, inability to tandem walk, circumduction of the left leg while walking, and posturing of the left arm during running. Rasmussen encephalitis was suspected, and she was treated unsuccessfully with intravenous immunoglobulin. The possibility of hemispheric disconnection was discussed with the family. Ictal positron emission tomography imaging performed two weeks later showed asymmetrically increased uptake in the right frontal lobe and the left cerebellar cortex, likely representing contralateral cerebellar diaschisis. Video EEG confirmed unilateral, right-sided onset of the secondarily generalized seizures. Repeat non-contrasted MRI performed five months after onset was done to look for cortical atrophy but instead showed a new focus of high T2 and fluid-attenuated inversion recovery and low T1 signal in the right parafalcine region involving both the cortex and the subcortical white matter without any atrophy or ventriculomegaly (Fig 1). Diffusion tensor imaging was done with an expectation of disruption and possible decrease in the descending corticospinal tract fibers on the right but was normal. Radiological differential diagnosis for the lesion included neoplasm versus focal cortical dysplasia.

Repeat MRI one month later showed stable size and appearance of the nonenhancing lesion. At six-and-a-half months from onset, she began having focal motor seizures starting in the left leg that evolved to include the entire left side with tonic-clonic shaking of bilateral legs (left greater than right) and retained awareness. These seizures started occurring every hour, and she lost the ability to run and intermittently became unable to walk. Although clinically Rasmussen encephalitis was suspected, lesionectomy was planned as she failed Bien criteria for Rasmussen encephalitis diagnosis (Table) because of the absence of atrophy on her MRI. An open biopsy using electrocorticography and motor mapping to spare the motor cortex and delineate the margins of the resection was performed. The cortical area removed coincided with and extended lateral to the focal MRI abnormality but did not include the entire area with intraoperative spiking overlying the primary motor area. Immediately postoperatively, she continued to have epilepsia partialis continua. Pathology was consistent with Rasmussen encephalitis. Functional hemispherotomy was performed nine days after the lesionectomy. She has remained seizure-free since functional hemispherotomy.

Discussion

Rasmussen encephalitis is a devastating, medically intractable epileptic encephalopathy of childhood that typically begins with focal seizures that invariably progress[2] to a state of hemiparesis, medically intractable epilepsy, and cognitive decline. The only definitive treatment for Rasmussen encephalitis is surgical disconnection of the affected hemisphere from the normal hemisphere.[3] A European consensus statement was published in 2005[1] to aid in the diagnosis and early treatment of Rasmussen encephalitis, often referred to as the “Bien criteria” (Table).

Our patient illustrates both the variable temporal course of Rasmussen encephalitis and the potential radiographic findings in the early stages of this disease. There has been intense interest in delineating the MRI findings in Rasmussen encephalitis because of the relative noninvasiveness of MRI over brain biopsy. There are only a few studies in the literature that include the serial evolution of MRI findings in Rasmussen encephalitis. Bien et al.[4] reviewed 39 serial MRIs from 10 patients with Rasmussen encephalitis. Five of these patients were imaged early in the disease, from 0.2 to 10.5 months after onset. All MRIs showed some pathologic finding. It was in this article that a staging system for the MRI findings of Rasmussen encephalitis was proposed, with progression from stage 0 to 4. Although no patients in this study were considered stage 0 (normal brain volume and signal), it was found that the median time to stage 1 (focal