Diagnosis of Acute Disseminated Encephalomyelitis with Proton MR Spectroscopic Imaging

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Purpose
Acute disseminated encephalomyelitis (ADEM) often manifests with striking neurologic signs and symptoms, yet the diagnosis itself is woefully vague. Lack of a well defined nosology, and the absence of specific diagnostic testing, has hampered research into pathophysiology and treatment. Although the differential diagnosis is large, ADEM is compared most frequently to multiple sclerosis (MS). Early differentiation of these two disorders is important, as prognosis and treatment differs. The purpose of the study was to assess the diagnostic value of quantitative MR spectroscopy (MRS) findings in childhood ADEM by comparing with normal controls and X-linked adrenoleukodystrophy.

Materials & Methods
MRS findings were compared between five children with ADEM (age: 6-15 years), 15 healthy control children (age: 3-19 years), and seven patients with X-ALD (age: 5-15). All patients were scanned on a 1.5 T clinical system. Diagnosis of ADEM was based on the clinical characteristics and MR findings. All patients made a complete recovery at follow-up. The lesions in X-ALD were limited to the parieto-occipital periventricular white matter. The MR protocol consisted of routine brain MR images (sagittal T1-, axial T2-weighted) and quantitative 3 or 4 slice proton MRS (TR4 slice 2300, TR3 slice 1700, TE 280, 32 x 32 x 256 matrix, 15 mm slice thickness) in the axial plane. Metabolic images of N-acetyl aspartate (NAA), creatine (Cr), and choline (Cho) were generated and metabolite concentrations were determined.

Results
The mean NAA concentration in ADEM lesions was lower than in healthy controls in the frontal and parietal white matter, in the dorsal parietal, motor, and medial premotor cortices, and the putamen (all p < 0.01). NAA also was reduced in ALD lesions compared to healthy controls (p < 0.0001). NAA levels were not significantly different between ADEM and ALD lesions. There was no significant difference in choline between ADEM and healthy controls, but choline was significantly higher in ALD lesions than in both
healthy controls and ADEM lesions (p < 0.01). Regions of the brain with normal T2-weighted MR appearance in patients with ADEM also had significantly lower NAA than healthy controls (p < 0.05). Only one ADEM lesion showed elevated lactate, while lactate was detected in lesions in 4 out of 7 X-ALD patients.

**Conclusion**

Our results demonstrate NAA reduction in ADEM. As opposed to demyelinating diseases such as X-ALD or multiple sclerosis, no choline elevation was detected in ADEM. T2 hyperintensity on MR imaging with normal levels of choline suggest that the underlying pathology is related more to edema and axonal injury rather than demyelination. Metabolite changes also were observed outside the ADEM lesions suggesting more diffuse pathology than observed by MR imaging. Proton MRS may be helpful in establishing an early diagnosis of ADEM in patients who will have a good clinical outcome.