Cranial MR in Spinal Cord MS: Diagnosing Patients with Isolated Spinal Cord Symptoms

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MR brain scans, spinal fluid electrophoresis, and evoked responses were obtained in 10 adult patients with isolated spinal cord symptoms diagnosed as possible multiple sclerosis (MS) according to the McAlpine criteria. Typical lesions of MS were found on T2-weighted MR images in six patients. Spinal fluid abnormalities were found in four. Visual-evoked responses or brainstem auditory-evoked responses were abnormal in three. MR in conjunction with spinal fluid analysis supported the diagnosis of MS in eight of 10 patients. Evoked responses appeared less sensitive than MR in identifying subclinical lesions in this population.

Patients with symptoms of adult-onset intermittent or progressive spinal cord disease and no symptoms of brainstem, visual, or higher cortical deficits present a special problem to the neurologist. Many are presumed to have spinal cord involvement with multiple sclerosis (MS), but to make a more definitive diagnosis, it is necessary to confirm a second site of involvement or to document characteristic spinal fluid changes [1]. Abnormalities in the evoked responses have traditionally been used to demonstrate subclinical demyelinating lesions [2]. MR imaging provides an additional tool that may be more helpful than evoked potentials in confirming MS in patients with symptoms and signs suggesting spinal cord disease.

MR of the spinal cord has the promise of demonstrating demyelinating lesions, which appear as areas of increased signal in the spinal cord on T2-weighted images [3]. The spinal MR findings are not specific for MS, however, and in a patient with isolated spinal cord symptoms, tumor, ischemia, or cord contusion could cause similar MR abnormalities. In our study, the MR examination was confined to the brain to look for additional, asymptomatic lesions not detected by the clinical examination in order to establish the multifocal nature of the disease.

Subjects and Methods

Ten patients with adult-onset progressive or intermittent spinal cord symptoms were examined in the Department of Neurology at Indiana University for suspected MS. All patients were determined by the McAlpine criteria to have possible MS [4]. None of these patients had symptoms suggestive of cerebral, brainstem, or visual pathway involvement. Isolated spinal cord symptoms in MS are fairly uncommon, occurring in only 10 of a larger series of 64 patients evaluated for suspected MS at Indiana University Medical Center between July 1984 and September 1985. The patients ranged in age from 29 to 65 years, with an age at initial presentation of 28–48 years. None of these patients had evidence of structural spinal column abnormality with plain films of the spine obtained in every case and myelograms obtained in most.

MR scanning of the brain was performed on each patient using a resistive scanner operating at a field strength of 0.15 T using two spin-echo pulse sequences. A pulse repetition rate (TR) of 2 sec was used with an echo-delay time (TE) of 120 msec producing a relatively T2-weighted image. A second sequence was performed with a TR of 0.5 sec and a TE of 30 msec, producing a relatively T1-weighted image. A multislice technique was used. All scans

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TABLE 1: **Findings in Patients with Suspected Spinal Cord MS**

Case No.	McAlpine Criteria [4]*	Symptoms	MR	Evoked Responses	CSF	Bartel Criteria [5][a]
1	Possible	Progressive paraparesis	–[b]	–	–	Not MS
2	Possible	Progressive paraparesis	–	–	–	Not MS
3	Possible	Progressive paraparesis	–	–	+	Possible
4	Possible	Progressive paraparesis	–	–	+	Possible
5	Possible	Progressive quadraparesis	+	+VER	–	Possible
6	Possible	Progressive paraparesis	+	–	–	Possible
7	Possible	Intermittent paraparesis	+	–	–	Probable
8	Possible	Intermittent paraparesis	+	–	–	Probable
9	Possible	Progressive paraparesis	+	+ VER	+	Probable
10	Possible	Intermittent paraparesis	+	+VER, +BAER	+	Definite

* Diagnosis of MS based on neurologic examination.
[a] Diagnosis of MS based on neurologic examination, MR, evoked responses, and CSF studies.
[b] Normal study (–); abnormal study suggestive of MS (+).

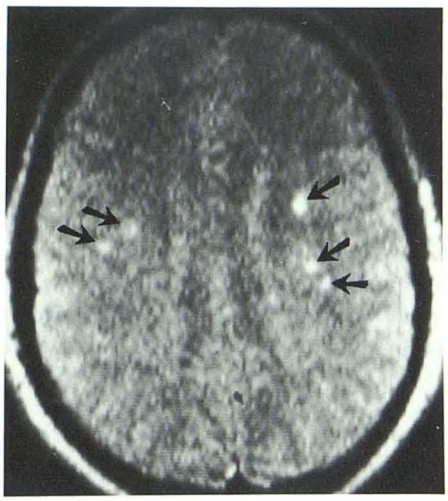

Fig. 1.—Multiple small bilateral plaques in white matter of corona radiata (*arrows*).

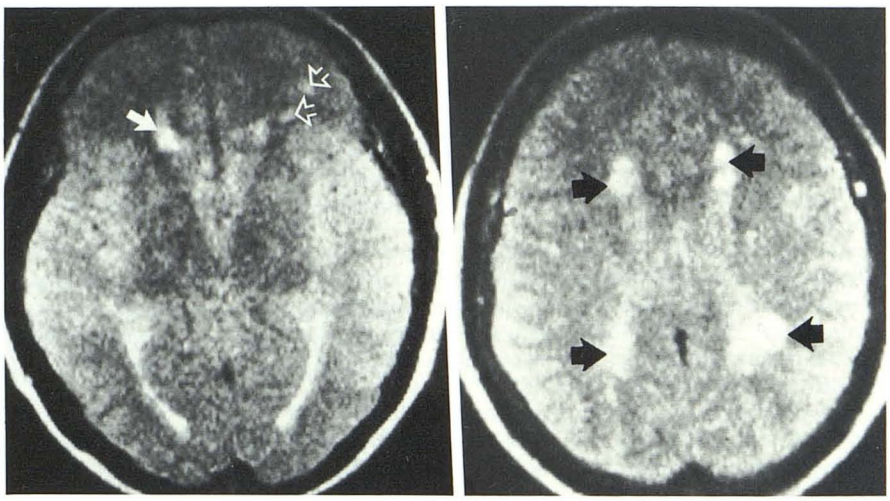

Fig. 2.—Lesions in deep frontal white matter (*open arrows*) and periventricular region (*solid arrows*). **A**, Level of frontal horns. **B**, Level of body of lateral ventricles.

were obtained in the axial projection.

Each patient had spinal fluid electrophoresis, and the presence or absence of oligoclonal bands was noted. A determination was also made of spinal fluid IgG levels. Visual-evoked responses (VERs) and brainstem auditory-evoked response (BAERs) were measured in each case.

Results

The results are summarized in Table 1. Three patients had relapsing and remitting symptoms of spastic paraparesis. In the other seven patients the symptoms were progressive. Six of 10 patients had MR findings suggestive of MS [6]. In these patients, multiple bilateral periventricular lesions with increased T2 signal were found (Figs. 1 and 2). In four of 10 patients the spinal fluid was abnormal with increased IgG or oligoclonal bands indicating an active immunologic response in the CSF suggestive of MS. VERs or BAERs were positive in three of 10 patients. Two patients with normal MR examinations had abnormal CSF studies, but no patient with normal MR studies had abnormal evoked responses.

Discussion

MS is the most common cause of progressive or intermittent spinal cord disease of adult onset in patients with no family history of similar symptoms and where structural lesions such as spinal stenosis have been ruled out [7]. Isolated spinal cord signs and symptoms are uncommon in MS, occurring in only 15% of patients in our series and in about 20% of patients in the experience of Helgason and Arnason [8]. The diagnosis of MS is made by confirming multiple lesions occurring at different times and in different locations within the neuraxis. It is recognized that many patients with apparent isolated spinal cord lesions may have subclinical lesions in other locations [9]. At autopsy, most MS patients with symptoms confined to the spinal cord are found to have extensive

disease, despite the clinical presentation [10, 11]. If these lesions in other locations can be demonstrated, the diagnosis of MS can be made with increased certainty.

Evoked responses, traditionally used to detect asymptomatic lesions, were positive for unsuspected disease in only three of 10 patients in our series. Other investigators have had similar results, with 29–40% of patients with suspected isolated spinal cord MS having an abnormal VER or BAER [5, 12]. VERs and BAERs detect lesions along the visual and auditory pathways, but cannot distinguish multiple lesions and have limited ability to localize abnormalities [13]. MR scanning would be expected to be more sensitive than evoked responses, since it images not only the pathways assessed by VERs and BAERs, but the entire brain as well. However, the results of MR in demonstrating optic neuritis have been disappointing, and a lesion in the optic nerve might be missed by MR and detected by the VER [14]. In our series no patient with normal MR was found to have an abnormal VER, possibly because patients with even transient visual symptoms were excluded from this study.

In six of 10 patients in our series MR was able to demonstrate bright lesions on T2-weighted images typical of MS in the periventricular region [6]. Spinal fluid abnormalities were found in four of 10 patients. Either MR abnormalities or CSF findings suggestive of MS were found in eight of 10 patients. All three patients with relapsing, remitting symptoms had abnormalities on MR imaging suggesting the diagnosis of MS.

The McAlpine criteria for diagnosing MS are based entirely on the clinical examination [4]. Several investigators have proposed that imaging techniques, evoked response studies, and laboratory tests should be used to improve the accuracy of the diagnostic criteria. Bartel et al. [5] suggested three criteria have to be met before the diagnosis of MS can be considered definite: (1) a history of neurologic symptoms with relapses and remissions; (2) evidence of two or more anatomically separate lesions documented by clinical examination, evoked responses, or imaging techniques; and (3) evidence of an immunologic disturbance in the central nervous system revealed by a demyelinative spinal fluid profile. The diagnosis of MS is considered probable in patients with two or more lesions if either of the other criteria is met. Possible MS is diagnosed if the patient has only one lesion and only one of the other criteria is fulfilled. Using these criteria in our series of 10 patients, one had definite MS, three had probable MS, and four had possible MS. Two patients no longer qualified for the diagnosis of MS, and the possibility that their progressive spastic paraparesis was caused by MS is considered doubtful.

In summary, MR of the brain is useful in helping to support or cast doubt on the diagnosis of MS in patients with isolated spinal cord symptoms. MR together with spinal fluid analysis may better define the risk of MS. VERs, especially in patients with normal MR scans, may provide additional support for the diagnosis of MS. In our experience, MR and spinal fluid analysis are the preferred initial tests to evaluate patients with suspected MS who have isolated signs or symptoms referable to the spinal cord. In this era of cost containment, the small amount of additional information derived from VERs and BAERs may not justify the cost of these expensive tests in patients with abnormal MR scans.

REFERENCES

1. McFarlin DE, McFarland HF. Multiple sclerosis. *N Engl J Med* **1982**;307:1183–1189
2. Markand ON, Garg BP, DeMeyer WE, Warren CH, Worth RM. Brainstem auditory, visual, and somatosensory evoked potentials in leukodystrophy. *Electroencephalogr Clin Neurophysiol* **1982**;54:39–48
3. Maravilla KR, Weinreb JC, Suss R, Nunnally RL. Magnetic resonance demonstration of multiple sclerosis plaques in the cervical cord. *AJNR* **1984**;5:685–689, *AJR* **1985**;144:381–385
4. McAlpine D, Lumsden CE, Acheson ED. *Multiple sclerosis: an appraisal*. Edinburgh: Churchill Livingston, **1972**:653
5. Bartel DR, Markand ON, Kolar OJ. The diagnosis and classification of MS: evoked potentials and spinal fluid electrophoresis. *Neurology* **1983**;33:611–617
6. Lukes SA, Crooks LE, Aminoff MJ, et al. Nuclear magnetic resonance imaging in multiple sclerosis. *Ann Neurol* **1983**;13:592–601
7. Blumhardt LD, Barrett G, Halliday AM. The pattern visual evoked potential in the clinical assessment of undiagnosed spinal cord disease. *Adv Neurol* **1982**;32:463–471
8. Helgason CM, Arnason BGW. Demyelinating diseases affecting the spinal cord. In: Davidoff RA, ed. *Spinal cord handbook*, vol 4. New York: Dekker, **1986** (in press)
9. Jorg J, Dullburg W, Koeppen S. Diagnostic value of segmental somatosensory evoked potentials in cases with chronic progressive para- or tetraspastic syndromes. *Adv Neurol* **1982**;32:347–358
10. Ikuta F, Zimmerman HM. Distribution of plaques in seventy autopsy cases of multiple sclerosis in the United States. *Neurology* **1976**;26[*suppl*]:28–26.
11. Adams RD, Kubik CS. The morbid anatomy of the demyelinative diseases. *Am J Med* **1952**;12:510–546
12. Bruden F, Mauquiere P. Diagnostic value of pattern reversal visual evoked potentials in progressive spastic paraparesis. *Presse Med* **1982**;11:3117–3120
13. Farlow MR, Markand ON, Edwards MK, Stevens JC, Kolar OJ. Multiple sclerosis: magnetic resonance imaging, evoked responses, and spinal fluid electrophoresis. *Neurology* **1986**; 36:828–831
14. Sheldon JJ, Siddharthan R, Tobias J, Sheremata WA, Soila K, Viamonte M Jr. MR imaging of multiple sclerosis: comparison with clinical and CT examination in 74 patients. *AJNR* **1985**;6:683–690, *AJR* **1985**;145:957–964