AJNR

Auditory dysfunction caused by multiple sclerosis: detection with MR imaging.

J K Curé, L D Cromwell, J L Case, G D Johnson and F E Musiek

AJNR Am J Neuroradiol 1990, 11 (4) 817-820
http://www.ajnr.org/content/11/4/817

Auditory Dysfunction Caused by Multiple Sclerosis: Detection with MR Imaging

Joel K. Curé[1,2]
Laurence D. Cromwell[1]
James L. Case[3,4]
Glenn D. Johnson[5]
Frank E. Musiek[3,5]

We reviewed the MR examinations of 167 patients who presented over a 3-year period with a chief symptom of hearing loss and/or tinnitus. In 14 of these patients the only MR abnormality was the presence of multiple parenchymal high-signal foci on T2-weighted images. Nine of the 14 had clinical evidence of multiple sclerosis; the remaining five had no clinical evidence of multiple sclerosis. Lesions in the auditory pathways, potentially responsible for the patients' symptoms, were identified in only five cases.

We recommend T2-weighted images of the whole brain in addition to T1-weighted images of the internal auditory canals and cerebellopontine angles in patients with hearing loss. In some patients, lesions found at higher levels in the periventricular white matter may provide the only clue to the origin of auditory abnormalities.

***AJNR* 11:817–820, July/August 1990**

MR imaging has limited sensitivity in detecting lesions responsible for sensorineural hearing loss. Of the 176 patients with sensorineural hearing loss studied by Armington et al. [1], intracranial abnormalities definitely or probably responsible for the symptoms were detected in only 50 (28%). Neoplasms, especially acoustic neuromas, accounted for a majority of the lesions believed to be definitely responsible for patients' symptoms.

Demyelinating disease is an unusual cause of hearing loss, accounting for not more than 2–3% of cases in several recent series [1–3]. Conversely, auditory complaints are rarely presenting symptoms in patients with multiple sclerosis (MS) (approximately 7%) [4]. While hearing loss of mild proportions is not rare among MS patients, it is said to be noted only infrequently [5].

Our goals were to estimate the frequency with which auditory complaints could be attributed to demyelinating disease and to estimate the sensitivity of MR in detecting demyelinating lesions in the auditory pathways.

Materials and Methods

During the period of this study (December 1986–January 1989) 167 patients presented for MR evaluation with a chief symptom of hearing loss and/or tinnitus. We reviewed the MR examinations and clinical records of 14 of these patients in whom MR detected multifocal white matter disease as the only positive finding. The patients included 12 women, ages 30–59 (mean, 44; median, 45), and two men, ages 32 and 44.

Clinical information concerning each patient was obtained by chart review and/or telephone consultation with the referring physician. The results of audiometry and/or auditory brainstem responses (ABR) were available in nine patients.

All the patients studied radiologically at our institution ($n = 12$) were examined on a Siemens Magnetom superconducting MR scanner operating at 1.0 T. Two additional patients were studied at other institutions on a 0.15-T resistive scanner and a 1.5-T superconducting scanner, respectively. A 30-cm head coil was used in all cases. The scanning protocol included proton-density-weighted, 2000–3000/30–40 (TR range/TE range), and T2-weighted,

Received November 8, 1989; revision requested December 9, 1989; revision received January 19, 1990; accepted January 19, 1990.

[1] Department of Radiology, Dartmouth-Hitchcock Medical Center, Hanover, NH 03756.

[2] Present address: Department of Radiology, Section of Neuroradiology, University of Rochester Medical Center, Rochester, NY 14642. Address reprint requests to J. K. Curé.

[3] Department of Medicine, Section of Neurology, Dartmouth-Hitchcock Medical Center, Hanover, NH 03756.

[4] Present address: 1200 28th St., Sioux City, IA 51104.

[5] Department of Surgery, Section of Otolaryngology and Audiology, Dartmouth-Hitchcock Medical Center, Hanover, NH 03756.

0195–6108/90/1104–0817

2000–3000/70–90, spin-echo axial images of the whole brain. These were obtained with one or two excitations, a field of view of 23–30 cm, and a slice thickness of 8 or 9 mm. A 256 × 256 or 256 × 512 acquisition matrix was used. Scans were obtained from the skull base to the vertex. Five patients had additional thin (4–6 mm) proton-density- and T2-weighted slices through the posterior fossa.

Results

The 14 patients were divided into four groups according to clinical history and the classification scheme for MS patients proposed by Poser [6]. Group I (n = 2) consisted of two women with clinically definite MS. The first patient had an abnormal audiometric examination indicating bilateral sensorineural hearing loss, more severe on her symptomatic side. MR detected a lesion in her auditory pathways, possibly responsible for her symptoms. The second patient had a normal ABR examination with a previous episode of transient hearing loss. The examination was not repeated during the recurrence that led to her MR examination, which revealed no lesions in her auditory pathways.

Group II (n = 3) consisted of three women with recognized, clinically probable MS. Two of the three patients had abnormal ABR examinations on their symptomatic sides. MR demonstrated lesions in the auditory pathways possibly responsible for the symptoms in each of these two patients. The remaining patient did not have an ABR examination. MR detected no abnormalities in her auditory pathways.

Group III (n = 4) consisted of one man and three women who had "unrecognized" clinically probable MS. In these patients MS was not a clinically suspected diagnosis, but a review of the clinical records revealed sufficient history, clinical findings, and paraclinical data to support a diagnosis of clinically probable MS. Two patients had ABR abnormalities on their symptomatic sides. MR examinations of each of these two (Figs. 1 and 2) also revealed auditory pathway lesions potentially responsible for their symptoms. Neither of the other two patients had ABR examinations and neither had positive MR findings in the auditory pathways.

Group IV (n = 5) consisted of one man and four women. None fulfilled Poser's diagnostic criteria for MS: none were hypertensive or diabetic; none had a history of prior ischemic cerebrovascular symptoms; and none have developed symptoms in other white matter distributions. The cause of their white matter lesions remains undetermined. Two patients had abnormal ABR examinations ipsilateral to their symptomatic sides. A third had a normal ABR examination. None of the patients had lesions in their auditory pathways on MR examinations.

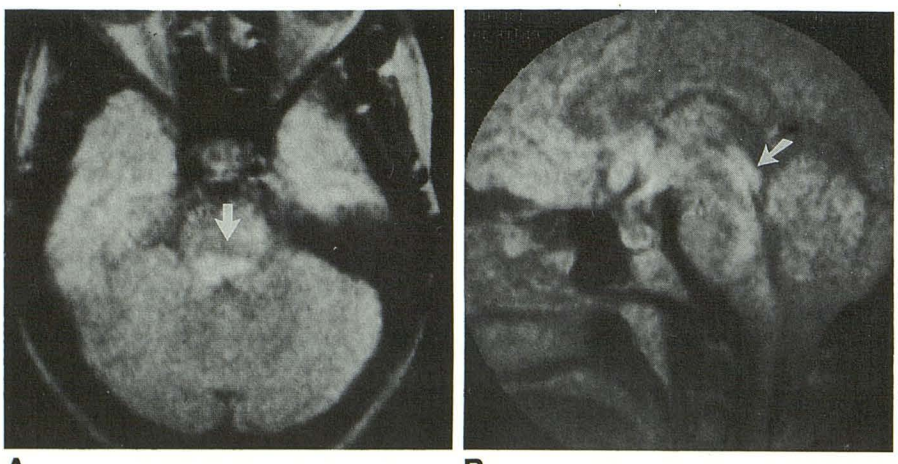
Table 1 summarizes the radiologic and clinical data from all 14 patients.

Discussion

Demyelinating disease was suggested as the probable cause of hearing loss in 5% (9/167) of the patients in whom we performed an MR examination to evaluate this complaint. Perhaps most important, the MR findings in the patients in group III were integral in raising MS as a diagnostic possibility, although in retrospect the diagnosis might have been made on the basis of available clinical and paraclinical information.

Lesions in the auditory pathways, possibly responsible for the presenting symptoms, were detectable by MR in only five of these nine patients. While postmortem examinations of MS patients reveal demyelinating plaques at various levels in the CNS, the primary site of involvement in the auditory pathways is the brainstem [4]. Here the lesions are often small to microscopic, and may therefore be below the limits of MR resolution [7]. Others have noted relative insensitivity of MR for lesions in this region. Sheldon et al. [7] were able to demonstrate only 43% of MS lesions clinically localized to the brainstem or cerebellum.

It is not possible to attribute auditory complaints to demyelinating disease with certainty, even in the presence of demonstrable lesions in the auditory pathways. Supporting the



A B

Fig. 1.—Patient III-2.
***A*, Axial MR image at 0.15 T (2200/60) through region of trapezoid body shows area of increased signal intensity (*arrow*).**
***B*, Sagittal MR image at 0.15 T (1600/60) in same patient shows area of increased signal intensity in collicular plate (*arrow*). Also note high signal intensity in dorsal pons, corresponding to abnormality seen in *A*.**

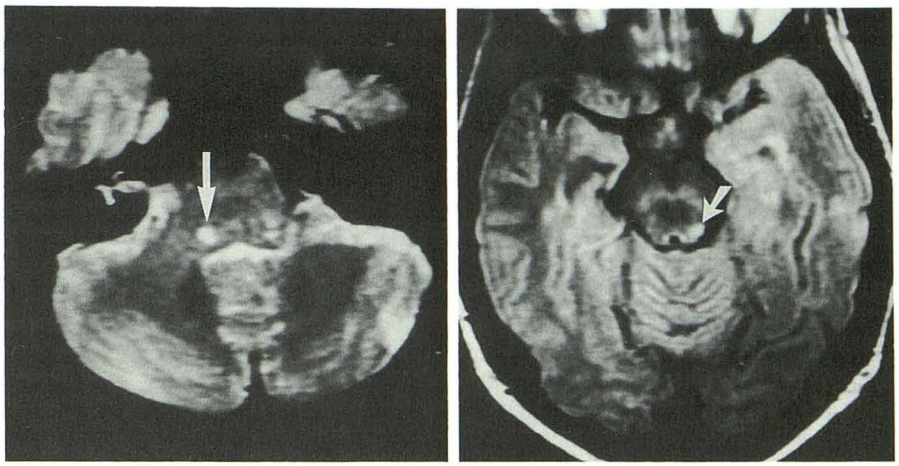


Fig. 2.—Patient III-3.
***A*, Axial MR image at 1.5 T (2500/80) through level of internal auditory canals shows areas of increased signal intensity in both cochlear nuclei, right (*arrow*) greater than left.**
***B*, Axial MR image at 1.5 T (2500/40) through inferior colliculus shows area of increased signal intensity in left collicular region (*arrow*).**

TABLE 1: Clinical and Radiologic Data

Patient No.	Age (years)	Sex	MS Status	Presenting Symptoms	Audiogram/ABR	MR Findings in Auditory Pathways	Clinical Findings
Group I							
1	36	F	Definite	BHL L > R	SNHL L > R	L cochlear nucleus	MS diagnosed late teens
2	53	F	Definite	RHL, ear pain	Not performed	None	MS diagnosed age 49
Group II							
1	46	F	Probable	Tinnitus, vertigo	Normal audiogram, B abnormal ABR	L cochlear nucleus, L inferior colliculus	Abnormal VER + OCB in CSF
2	37	F	Probable	BHL, tinnitus	Not performed	None	B + VERs, spastic R lower extremity
3	47	F	Probable	RHL, tinnitus	B abnormal audiogram, B abnormal ABR	B cochlear nuclei	Ataxia
Group III							
1	31	F	Probable	RHL, tinnitus, R facial numbness	Not performed	None	Developed gait disturbance on follow-up
2	30	F	Probable	LHL, tinnitus	L abnormal audiogram, L abnormal ABR	Trapezoid body, L inferior colliculus	History of visual blurring
3	42	F	Probable	LHL, facial numbness	L abnormal ABR	B cochlear nuclei, L inferior colliculus	Optic neuritis '78, '84, B + VERs, ataxia
4	32	M	Probable	BHL	Not performed	None	Diplopia, L hand paraesthesias
Group IV							
1	52	F	Not applicable	RHL, tinnitus, vertigo	Not performed	Normal	Normal neurologic exam
2	59	F	Not applicable	BHL, tinnitus, vertigo	B abnormal audiogram, L abnormal ABR	Normal	Oscillopsia
3	44	M	Not applicable	RHL, tinnitus, vertigo	Not performed	Normal	No clinical follow-up
4	44	F	Not applicable	RHL, tinnitus	R abnormal ABR	Normal	Stable on follow-up
5	52	F	Not applicable	BHL, tinnitus	Normal ABR	Normal	History of vertigo, diplopia, arm paraesthesias

Note.—MS = multiple sclerosis, ABR = auditory brainstem responses, HL = hearing loss, B = bilateral, R = right, SN = sensorineural, VER = visual evoked responses, OCB = oligoclonal bands.

significance of the MR findings in the five patients in groups I–III who had MR abnormalities in the auditory pathways were audiometric or ABR abnormalities ipsilateral to the lesion(s).

It is doubtful that any of the patients in group IV have MS. As a group they represent an older population, mean age 50.2 years, compared with a mean age for patients in groups I–III of 39.3 years. Despite the lack of obvious risk factors for small vessel disease, their white matter disease is probably more likely due to a vascular cause, or to the white matter changes of aging.

The MR evaluation of sensorineural hearing loss should include T1-weighted images of the internal auditory canals

and cerebellopontine angle cisterns, obtained both before and after administration of gadopentetate dimeglumine to exclude acoustic neuroma. Armington et al. [1] recommend including T2-weighted images of the whole brain. Our small series confirms the value of T2-weighted imaging of the whole brain in the evaluation of hearing loss. In cases of MS, patients' studies may only detect abnormalities above the uppermost levels of the auditory pathways (superior temporal gyrus) as noted in 4/167, or 2% of our patients with hearing loss. Demyelinating disease, while an unusual cause of hearing loss, merits consideration, particularly in young patients. The relative insensitivity of MR in the detection of lesions in the auditory pathways should be borne in mind when planning the evaluation of a patient with hearing loss.

REFERENCES

1. Armington WG, Harnsberger HR, Smoker WRK, Osborne AG. Normal and diseased acoustic pathway: evaluation with MR imaging. *Radiology* **1988**;167:509–515
2. Kumar A, Maudelonde C, Mafee M. Unilateral sensory neural hearing loss: analysis of 200 consecutive cases. *Laryngoscope* **1986**;96:14–32
3. Morrison AW. Acute deafness. *Br J Hosp Med* **1978**;19:237–249
4. Mustillo P. Auditory deficits in multiple sclerosis: a review. *Audiology* **1984**;23:145–164
5. Smith CR, Scheinberg LC. Clinical features of multiple sclerosis. *Semin Neurol* **1985**;5:85–93
6. Poser CM. New diagnostic criteria for multiple sclerosis: guidelines for research protocols. *Ann Neurol* **1983**;13:227–231
7. Sheldon JJ, Siddharthan R, Tobias J, et al. MR imaging of multiple sclerosis: comparison with clinical and CT examinations in 74 patients. *AJNR* **1985**;6:683–690