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CLINICAL CORRELATIONS BETWEEN AUDITORY BRAINSTEM RESPONSE AND MAGNETIC RESONANCE IMAGING IN PATIENTS WITH DEFINITE MULTIPLE SCLEROSIS

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ABSTRACT

In an attempt to assess objectively the integrity of the auditory pathways in 30 patients with definite multiple sclerosis (MS), an audiometric evaluation was performed and auditory brainstem responses (ABRs) were obtained.

Stressing the auditory system by increasing the stimulation rate showed some enhancement in the identification of MS. 24 (80%) patients had an abnormal ABR along with clinical signs of brainstem dysfunction at the time of assessment by magnetic resonance imaging (MRI), while those without such signs had no incidence of abnormalities. This is independent of the clinical classification of the patients.

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INTRODUCTION

The auditory behaviour of patients suffering from MS has been extensively studied during the past three decades.[1,7] Although auditory complaints are rarely the initial symptoms of the disease, appropriate functional tests may detect acoustic abnormalities, often subtle in the majority of the patients. Noffsinger et al.[8] found abnormal audiologic findings in the majority of cases, but only 7.0% of his 61 patients had auditory symptoms initially.

The development of electrical response audiometry and especially the application of the noninvasive technique of Sohmer and Feinmesser[5,9] opened new vistas in the study of MS. Although the diagnosis of MS depends primarily on clinical criteria, electrophysiological techniques have an important role in demonstrating lesions that are clinically silent, thereby helping to establish multiple lesions in patients with clinical evidence of an abnormality at only one site.

More recently, MRI has revealed multiple central nervous system abnormalities in patients with clinically definite MS.[2,3,12,13,14] By demonstrating lesions at several sites in the neuraxis, MRI may also be an important means of establishing the diagnosis of MS in patients presenting clinically with only a single lesion.

We have compared the diagnostic utility of MRI and ABR in patients with MS.

To accomplish this, we have only studied patients with clinically definite MS[6] which had been previously confirmed by MRI and who had brainstem involvement in the majority of cases.

MATERIAL AND METHODS

A total of 30 patients with MS confirmed by MRI were referred by neurologists for otolaryngeal and audiological evaluation. The ages of the patients ranged from 17 to 45 years (average 30.8 years). The study group consisted of 15 males and 15 females with disease durations of 1 month to 120 months from the onset of MS (with a mean of 35.6 months).

Each patient underwent a pertinent history, an ear and

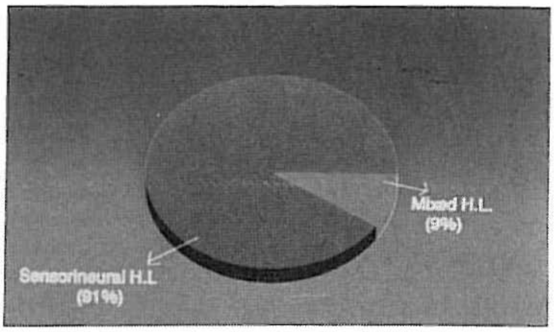

Fig. 1. Sensorineural and mixed hearing loss percentages.

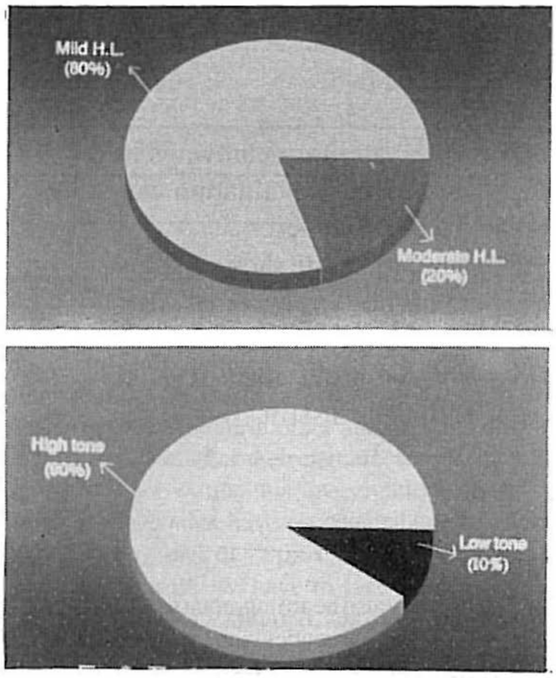

Fig. 2. The type and degree of hearing loss.

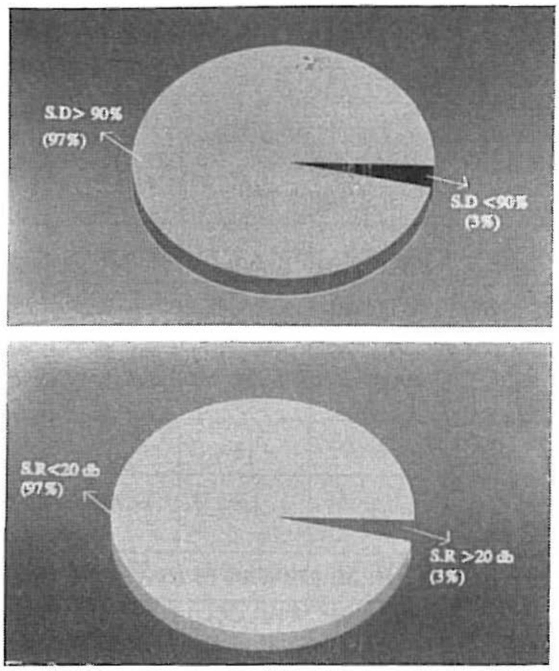

Fig. 3. Speech reception and discrimination percentages.

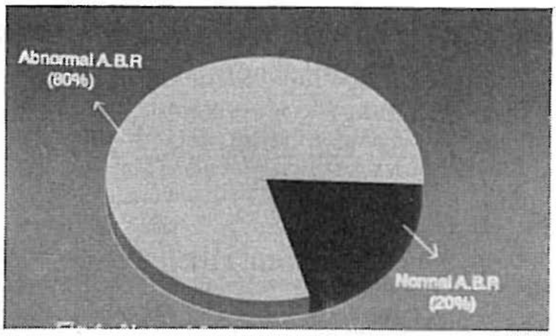

Fig. 4. Normal and abnormal ABR percentages.

neurologic examination, pure-tone and speech audiometry, and bilateral ABR testing.

ABR was performed with a Madsen 2250 in a sound-proof room. Clicks were used as stimuli. They were administered by shielded TDH-39 earphones. The clicks were presented at 85 dBHL and at rates of 10, 30, 50, and 70 stimuli/sec. Surface silver-silver chloride electrodes were used. The electrodes were placed on the vertex and on each mastoid. The potential between the vertex and mastoid ipsilateral to the stimulus was differentially amplified and band-passed at 125 to 2000 Hz with the contralateral mastoid serving as ground. One thousand twenty-four stimuli with condensation phase were presented monaurally and the potentials were averaged during a 10ms period. To ensure reproducibility for each trace the procedure was repeated. The averaged responses were recorded with an X-Y plotter and the responses of two identical stimulation rounds were superimposed on each graph. Vertex positive deflections were delineated upwards.

The latency period from the onset of the stimulus generating the click to the various positive peaks and the amplitudes of wave I and V were measured from the negative upward peak to the following positive trough on the monitor with a digital cursor. These measures were compared with normative data from 25 adult subjects (50 ears). Test data that exceeded 3 standard deviations from the normative mean for latencies and V/I ratios of less than one were considered abnormal.

RESULTS

Pure-tone audiometry results for the entire group of 30 patients with definite MS already confirmed by MRI scanning

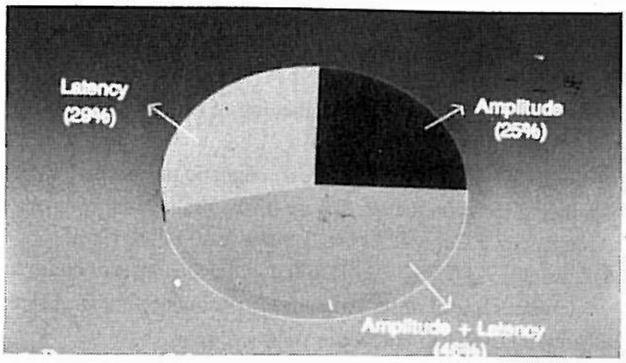

Fig. 5. Percentage of the abnormal latencies to abnormal V/I ratios.

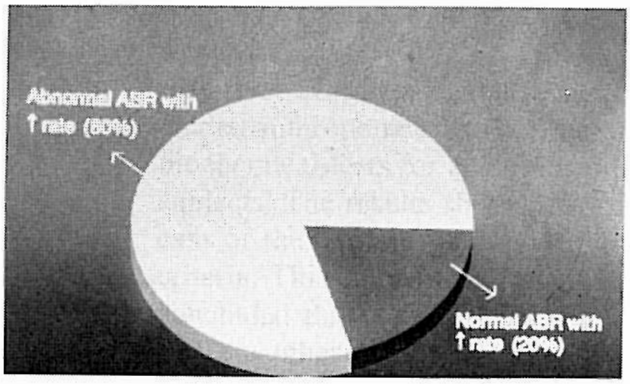

Fig. 6. The effect of an increase in the stimulus repetition rate on ABR.

were as follows: There were 91% sensorineural and 9.0% mixed hearing loss for 10 (33.3%) patients (Fig. 1). The percentage of the type and degree of hearing loss is demonstrated in Fig. 2. Speech audiometry revealed a speech reception threshold greater than 20 dB in 3.0% and less than 20 dB in 97% whilst the speech discrimination score was less than 90% in 3.0% and greater than 90% in 97% of the patients (Fig. 3).

ABRs were performed in all patients and were found to be normal in 6 (20%) and abnormal in 24 (80%) of the patients (Fig. 4). From these 24 patients, 10 patients were affected unilaterally and 14 bilaterally.

From the latency data, it was found that interpeak latency differences I-III and III-V in the low and high brainstem areas were both symmetrically affected; hence I-V intervals were calculated to include both areas. From the amplitude measurements, only waves I and V were found to be affected and their amplitude, ratios were calculated. The percentage contributions of the abnormal latencies to abnormal V/I ratios are shown in Fig. 5.

A significant abnormal response was noted in three patients unilaterally and in 21 bilaterally after increasing the stimulus repetition rate to 30, 50 and 70/ sec (Fig. 6).

DISCUSSION

Patients with definite MS were investigated by MRI and ABR to establish the diagnosis with greater confidence and to exclude other possible causes for symptoms. ABR techniques have an important role in demonstrating clinically silent lesions in the brainstem area,[4,16] and MRI has proved to be of similar value. Recent reports have compared the sensitivity of the two techniques. In one of these,[15] MRI was found superior to other investigative procedures, including ABR, whereas Tramo et al. found ABR studies to be more sensitive than MRI.[11] MRI was also reported to be more sensitive than ABR studies by Runge et al.[10]

We undertook this study to compare the sensitivity of the two techniques in patients in whom the diagnosis was clinically definite. We found that MRI had the same sensitivity as ABR techniques. In 6 of our patients MRI revealed multiple lesions not involving the brainstem. Therefore, ABR studies were normal in this group. Moreover, we anticipate that advances in MRI techniques will increase its sensitivity. Among our 24 (80%) patients with definite MS that involved the brainstem, the two techniques yielded similar results and in the rest of the patients (20%) the lesion was located somewhere else other than the brainstem.

Our data suggest that positive results from the two investigations are often complementary, and that one is not a substitute for the other. Whether ABR techniques still have a role in the diagnosis of MS when MRI is available is perhaps an economic issue. In 24 of our 30 patients, MRI provided no further information than was obtained by ABR studies, although the cost of MRI is much greater than the cost of ABR. Therefore, it may be appropriate to restrict MRI evaluation to those patients suspected of having MS whose ABR studies are normal.

In this study, ABR abnormalities were common (80%) and showed an excellent correlation with MRI.

Any further studies of MS should first include ABR as it costs less than MRI and is a sensitive predictor of CNS degeneration in MS, but if ABR studies are normal despite a suspicion of having MS, MRI scans should be performed. Moreover, ABRs are routinely used today in the diagnosis of retrocochlear and brainstem lesions. This study also showed that ABR plays an important role in the diagnosis of MS, while the definite diagnosis can be made consequently by the aid of MRI techniques.

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