Binaural Interference in Multiple Sclerosis: Case Study

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Abstract

A case report of a young, adult male with multiple sclerosis who demonstrates binaural interference is presented. Binaural interference was demonstrated on behavioral and physiologic measures during the active stage. Binaural interference was present, although reduced, during the stage of remission. During remission, binaural interference occurred despite the absence of interaural asymmetry in the audiometric configuration or suprathreshold speech-recognition score. A trial period of left ear amplification was introduced. A possible explanation for the improvement in soundfield suprathreshold speech-recognition score with amplification is the reduction of the binaural-interference effect with monaural amplification of the affected ear when there is bilateral normal-hearing sensitivity.

Key Words: Amplification, auditory brainstem response (ABR), binaural, binaural interference, middle-latency response (MLR), monaural

J erger et al (1993) were the first to document the binaural-interference phenomenon whereby auditory performance for binaural stimulation is poorer than that for monaural (right or left ear) stimulation when asymmetric scores are obtained in the monaural condition. The poorer binaural than monaural performance is attributed to the interfering effect of the poorer ear. The Jerger et al report was based on four case studies performed on elderly adults and illustrated binaural-interference effects on soundfield W-22 suprathreshold speech-recognition scores, topographic brain maps of the middle-latency response (MLR), auditory brainstem response (ABR) amplitude, and laterality performance in the cued-listening task (Jerger and Jordan, 1992). To the author's knowledge, there are no other published reports of binaural interference.

The following case report illustrates, through physiologic studies, waning of a binaural-interference effect from a period of exacerbation to remission of multiple sclerosis in a young, adult male. The attempt to remediate binaural interference with monaural amplification of the affected ear is described.

CASE REPORT

T his 36-year-old male patient was seen at an audiologic and otolaryngologic center. His presenting complaints were sudden hearing impairment associated with high-pitched tinnitus in the left ear occurring approximately 1 week prior to the visit and weakness of the left knee for the last 2 months. The remainder of the audiologic and otologic history was unremarkable.

At the first visit, the patient was seen for audiologic and otolaryngologic evaluations. The results of the audiologic evaluation, shown in Table 1, revealed a unilateral, sloping sensorineural hearing impairment in the left ear with thresholds near normal at low frequencies and with severe to profound impairment in the high frequencies. The static-acoustic middle-ear admittance and tympanometric peak pressure were within normal limits bilaterally. The contralateral acoustic-reflex thresholds were elevated beyond the 90th percentiles (Silman and Gelfand, 1981) at 500, 1000, and 2000 Hz for the left ear (stimulus ear), consistent with the presence of left retrocochlear pathology; they did not exceed the 90th percentiles at any of these frequencies for the right ear, consistent with the
absence of right retrocochlear pathology. The contralateral acoustic-reflex decay results were negative for the right ear and positive for the left ear at 500 and 1000 Hz, consistent with left retrocochlear pathology. The patient was referred for (a) follow-up auditory electrophysiologic testing and audiologic re-evaluation and (b) magnetic resonance imaging (MRI) of the head.

First Retest at 1 Week Post Initial Evaluation

The patient reported improvement in his hearing but the knee weakness persisted. The results of the retest (retest 1) audiologic evaluation are shown in Table 1. Inspection of this table reveals substantial improvement in hearing threshold levels at all frequencies in the left ear. The improvement from initial test to retest averaged approximately 30 dB. The contralateral acoustic-reflex thresholds remained unchanged bilaterally. The contralateral acoustic-reflex decay results for the left ear reverted from positive to negative.

The ABRs were recorded for rarefaction clicks presented at a repetition rate of 11.4 clicks per second at 70 dB nHL. The results of ABR testing are shown in Figure 1. Inspection of Figure 1 reveals normal peak and interpeak latencies for the right ear. However, the waveforms for the left ear appear to be distorted, and if wave V is present, it is significantly delayed and its amplitude is remarkably reduced. The binaural ABR is abnormal, as can be seen by the absence of wave V and by the distorted waveforms.

The MLRs were recorded for 2000-Hz tone pips with a total duration of 6 msec (2-2-2 configuration) presented at the rate of 9.7/sec at 115 dB peSPL. The MLR results are illustrated in Figure 2. Inspection of Figure 2 reveals a robust Pa for right ear stimulation and an absent Pa for left ear stimulation. With binaural stimulation, Pa was absent or very markedly reduced.
The results of the MRI, received subsequent to the retest evaluation, indicated multiple nodular areas of abnormal signal intensity involving the periventricular white matter of the lateral ventricles, the bilateral centrum semiovale region, and the deep white matter of the bilateral frontal and parietal lobes, consistent with a demyelinating process from an entity such as multiple sclerosis. Neurologic follow-up confirmed the presence of multiple sclerosis.

Second Retest Audiologic Evaluation at 2 Months Post Initial Evaluation

At this evaluation, the patient was in remission, as documented by the neurologist. The patient reported decreased hearing difficulty and disappearance of tinnitus at this time. The results of the audiologic evaluation (retest 2) are shown in Table 1. Inspection of Table 1 shows complete recovery of the pure-tone and speech-recognition thresholds to within normal limits in the left ear at this retest. The suprathreshold speech-recognition score for the left ear significantly improved (Thornton and Raffin, 1978).

The retest MLR recordings are shown in Figure 3. Inspection of Figure 3 reveals a slight increase in the amplitude of Pa for the left ear and a robust, present Pa for binaural stimulation in the retest MLR recording. The amplitude of Pa for binaural stimulation, however, is less than that for monaural stimulation of the right ear. Because of patient fatigue, a retest ABR evaluation could not be performed and the patient declined any further follow-up ABR testing.

At this evaluation, unaided soundfield speech-recognition assessment was performed using the W-22 monosyllabic PB words (50-item list) presented at 50 dB HL. The unaided soundfield speech-recognition score was significantly poorer (Thornton and Raffin, 1978) than the speech-recognition score under phones for the monaural right and monaural left conditions. This finding was reliable, as shown by the retest unaided soundfield speech-recognition score obtained during the same session.

Because of the patient's complaint of hearing difficulty and reduced soundfield speech-recognition performance in the unaided condition, a trial period of amplification was provided with a slight-gain, linear amplification behind-the-ear hearing aid with maximum output below 100 dB SP to avoid overamplification. The aided (left ear) soundfield suprathreshold speech-recognition score for W-22 monosyllabic PB words (50-item list) presented at 50 dB HL was significantly higher than the unaided score.
Table 2  Test and Retest (Intrasession)
Soundfield Word-Recognition Scores* (SSRS)
in the Unaided and Aided Left Ear Conditions
during Remission

<table>
<thead>
<tr>
<th></th>
<th>Unaided SSRS (%)</th>
<th>Aided Left SSRS (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>72</td>
<td>96</td>
</tr>
<tr>
<td>Retest</td>
<td>80</td>
<td>96</td>
</tr>
</tbody>
</table>

*For W-22 monosyllabic words (50-word lists) at 50 dB HL.

This finding was reliable as shown by the retest score obtained during the same session.

At the time of this report, the patient has been successfully wearing amplification on a regular, daily basis for 4 months. The patient has requested an evaluation to obtain permanent amplification and the author will provide amplification with potentiometer settings that can be adjusted for the possible use of amplification during exacerbation as well as remission.

DISCUSSION

Binaural interference was demonstrated at the first re-evaluation on both the ABR and MLR tests during the active stage of multiple sclerosis. In one of the four cases in the seminal investigation on binaural interference (Jerger et al, 1993), both MLR and ABR tests were performed; binaural interference occurred on the MLR but not the ABR test. The findings suggest that the site of binaural interference can be brainstem and/or cortical.

Binaural interference was reduced, although still present, at the second re-evaluation (during remission), as evidenced by the MLR test and reduced soundfield speech-recognition score in the unaided soundfield condition as compared with the monaural condition under phones. Since ABR testing was not performed at the second re-evaluation, the question remains as to whether binaural interference was also present on the ABR test. In the Jerger et al (1993) investigation, binaural interference occurred in four subjects, all of whom had asymmetric suprathreshold speech-recognition scores. Interestingly, in this case, binaural interference occurred at the second retest despite essentially symmetric audiometric configuration and suprathreshold speech-recognition scores.

The reduced soundfield speech-recognition performance in the unaided condition substantiated the patient's complaint of hearing difficulty. A possible explanation for the better aided (left ear) than unaided soundfield suprathreshold speech-recognition performance is as follows: Binaural interference was demonstrated in the unaided soundfield condition at remission despite essentially symmetrical hearing-threshold levels, bilateral normal-hearing sensitivity, and excellent monaural suprathreshold speech-recognition performance under phones. At this time, there was reduced evidence of binaural interference on the MLR recordings. These findings suggest that for this individual, the binaural-interference phenomenon is associated with physiologic or functional asymmetry at the central rather than peripheral level, perhaps at levels associated with binaural processing. Perhaps this higher-level asymmetry is overcome with preferential stimulation of the weaker ear, provided that the stronger ear also can contribute to binaural processing (i.e., by dint of good hearing sensitivity). That is, perhaps left ear amplification, yielding preferential stimulation of the weaker ear when the hearing sensitivity is normal bilaterally, overcame higher-level asymmetry and reduced the binaural interference. No parallel can be drawn with the Jerger et al (1993) investigation as none of the patients had bilateral normal-hearing sensitivity.

The results of this study suggest the need for further investigations of amplification in the affected ear when binaural interference is documented and the hearing sensitivity is normal bilaterally.

REFERENCES


