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MAIN ARTICLE

Audiological evaluation in patients with Behçet's disease

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Abstract

Objective: This study aimed to determine the characteristics of hearing loss in patients with Behçet's disease.

Methods: Twenty-six consecutive patients with Behçet's disease and a control group consisting of 25 age-matched healthy subjects were prospectively included in this study. Pure tone and speech audiometry, tympanometry, distortion product otoacoustic emission testing, and auditory brainstem-evoked response assessment were performed in the patients and controls.

Results: The pure tone audiograms and the results of distortion product otoacoustic emission testing showed statistically significant hearing loss in the Behçet's disease patients ($p < 0.05$). Auditory brainstem-evoked response results were not significantly different between the patients and controls ($p > 0.05$).

Conclusion: The findings of the present study demonstrated that audiological involvement is more frequent in patients with Behçet's disease than in healthy controls. Therefore, all patients with Behçet's disease should be regularly monitored by an otolaryngologist and be given information about the possibility of inner-ear involvement.

Key words: Behçet Disease; Audiometry; Auditory Brainstem Responses; Hearing Loss

Introduction

Behçet's disease is a chronic, multisystem, inflammatory condition in which recurrent mouth ulcers are associated with genital ulcers, skin lesions and uveitis.[1–3] The prevalence of Behçet's disease indicates a marked geographical variation. There are thought to be about 2000 patients in the UK, but the prevalence is much higher in Japan (10 per 100 000 population) and Turkey (8–38 per 100 000 population).[3–5]

The cause of Behçet's disease remains unknown; however, viral agents, and immunological and bacterial factors have been cited as contributing to its development.[1,5] It is now recognised that many organs may be affected by a generalised vasculitis of small vessels.[2–4] This condition manifests as the infiltration of vessel walls by mononuclear cells, and later by polymorphonuclear cells, increased permeability of the vessel wall and abnormalities in platelet function.[1,2]

Dagli *et al*. reported that hearing is commonly impaired in Behçet's disease, and the rates of hearing loss vary between 12 and 80 per cent.[5] According to Kulahli *et al*., high-frequency sensorineural hearing loss (SNHL) is the major type of hearing loss encountered among these patients.[6] Inner-ear or vestibulocochlear system involvement has also been reported in the literature.[2,7]

This study aimed to determine the characteristics of hearing loss and cochlear status in patients with Behçet's disease.

Materials and methods

Study design

Twenty-six patients who met the diagnostic criteria of the International Study Group for Behçet's Disease,[8] and 25 age-matched healthy controls, were included in this study. The Behçet's disease patients were consecutive cases admitted to the department of dermatology. Patients with a history of cranial trauma, exposure to noise, ear infection, metabolic disease, systemic disease (such as diabetes mellitus), hearing loss before diagnosis of Behçet's disease, and ototoxic drug use were excluded from the study. The control group consisted of volunteers selected from the hospital staff. The medical history of control subjects was normal and there were no consistent audiological complaints. The pure tone average thresholds of all controls were normal. All patients underwent clinical

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otorhinolaryngological and systemic examination. Otoscopic examination findings were normal, with intact, mobile tympanic membranes in both groups.

Outcome parameters

The audiological evaluation of Behçet's disease patients and control subjects included pure tone audiometry, auditory brainstem-evoked response (ABR) assessment and distortion product otoacoustic emission (DPOAE) testing.

All audiological evaluations were performed at frequencies of 0.25, 0.5, 1, 2, 4 and 8 kHz, using an AC-40 diagnostic audiometer (Interacoustics, Assens, Denmark) in a standard sound-treated cabin. The first evaluation was performed with an impedance meter (AZ 26; Interacoustics). Normal middle-ear function and acoustic reflex results were recorded. Those patients and controls with normal peak compliance, peak pressure, gradient, ear canal volume and acoustic reflexes (obtained by immittance measures), as defined by the American Speech–Language–Hearing Association, were included in the study.[9] A threshold of more than 30 dB at two frequencies on the pure tone audiogram was accepted as SNHL.

The DPOAEs were measured using a GSI Audera™ evoked potentials system (on 'general diagnostic' mode). The amplitudes and growth functions of DPOAEs at 2f1-f2 were elicited by two primary tones f1 and f2, with a constant frequency ratio of f2/f1 = 1.22, and varying geometric mean values of 1, 1.5, 2, 4, 6 and 8 kHz. Stimulus intensities were L1 = 65 dB and L2 = 55 dB (L1-L2 10 dB).

The ABR testing was performed in a quiet room using the GSI Audera system. Abrasive paste was applied to clean the skin. Electrodes were then placed (using an electrolytic paste and adhesive tape) on the vertex, and on the right and left mastoids. Electrode impedance values were checked; these were required to be below 5 kohm. The tone-click stimulus was set at 80 dB HL to measure waves I and V and their latency times. The click stimulus was delivered at a frequency of 11.1 per second. Noise was applied to the opposite headphone at 40 dB. The test was repeated three times and the best overlapping responses were used for analysis.

Statistical analysis

Data were analysed using SPSS® software, version 11.5 for Windows. Statistical significance was accepted for p values less than 0.05. Normal distribution of the continuous variables was determined using the Shapiro–Wilk test. The mean values for patients and controls were compared using the Student's t-test. The median values for patients and controls were compared using the Mann–Whitney U test. Nominal variables were analysed with the use of the Pearson chi-square test. The results of left and right ears in the patient group were compared using a dependent t-test and the Wilcoxon signed rank test.

Results

Twenty-six patients with Behçet's disease (9 male and 17 female) and 25 age-matched healthy controls (12 male and 13 female) were included in the study. The mean age of the two groups was comparable (patients, 43.2 ± 10.4 years; controls, 42.5 ± 8.6 years). The comparison of left and right ears in the patient group revealed no significant difference ($p > 0.05$, Table I). The mean period of disease was 7.8 years. The duration of Behçet's disease was not significantly different between those patients with or without inner-ear involvement ($p > 0.05$).

Audiometric pure tone thresholds of the patients and controls were significantly different at all frequencies ($p < 0.05$, Table II). The assessment of pure tone thresholds revealed the presence of SNHL (more than 30 dB at a minimum of 2 frequencies) in 6 of the 26 Behçet's disease patients (23 per cent). Hearing loss in the patient group was bilateral in five cases and unilateral in one case. The most significant decreases were recorded at frequencies of 4 kHz and 8 kHz ($p < 0.05$, Figure 1). Three patients with Behçet's disease had SNHL at all frequencies, two had high-frequency

TABLE I
COMPARISON OF PATIENTS' RIGHT AND LEFT EAR RESULTS

Variable	Right ear (mean ± SD)	Left ear (mean ± SD)	p
Hearing threshold level (dB)	16.6 ± 11.9	17.0 ± 11.9	0.571*
Speech discrimination score (%)	97.1 ± 5.1	96.8 ± 5.7	0.157*
DPOAE (dB)	12.6 ± 5.6	13.6 ± 5.7	0.202†
ABR (ms)	3.9 ± 0.3	3.9 ± 0.3	0.472†

*Wilcoxon signed rank test; †dependent t-test. SD = standard deviation; DPOAE = distortion product otoacoustic emission; ABR = auditory brainstem-evoked response

TABLE II
COMPARISON OF PATIENT AND CONTROL GROUPS' HEARING THRESHOLD LEVELS AND DPOAE RESULTS

Variable	Controls (mean ± SD; dB)	Patients (mean ± SD; dB)	p
Hearing threshold level			
– 0.25 kHz	7.0 ± 4.4	14.2 ± 11.5	<0.001*
– 0.5 kHz	6.6 ± 4.6	13.7 ± 10.3	<0.001*
– 1 kHz	6.2 ± 3.8	14.3 ± 11.5	<0.001*
– 2 kHz	5.9 ± 5.7	12.3 ± 12.4	0.005*
– 4 kHz	8.7 ± 7.6	20.2 ± 18.0	<0.001*
– 8 kHz	13.5 ± 8.2	24.3 ± 20.0	<0.001*
DPOAE			
– 1 kHz	17.3 ± 7.2	13.2 ± 8.3	0.011†
– 2 kHz	23.2 ± 6.6	18.7 ± 7.8	0.002†
– 4 kHz	18.1 ± 7.1	14.3 ± 7.3	0.010†
– 8 kHz	9.7 ± 6.7	6.5 ± 6.3	0.015†

*Mann–Whitney U test; †Student's t-test. DPOAE = distortion product otoacoustic emission; SD = standard deviation

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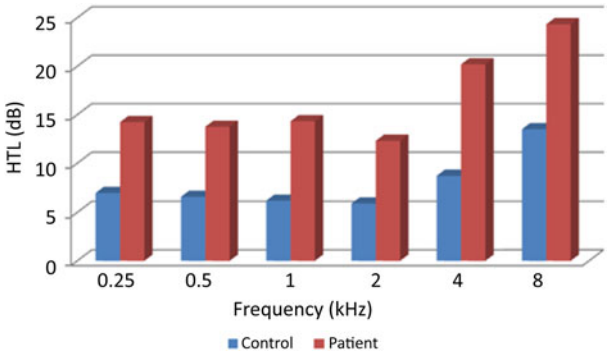

FIG. 1
Hearing threshold level (HTL) results for the patient and control groups.

SNHL (4 kHz and 8 kHz) and one showed SNHL at speech frequencies (0.5 kHz and 2 kHz). Compared with the control group, the distortion product otoacoustic emission (DPOAE) responses of the Behçet's disease patients with SNHL were significantly lower at all frequencies ($p < 0.05$), indicating weaker outer hair cell motility. The DPOAE findings of the patients are shown in Table III. The ABR findings did not disclose any inner-ear involvement. There were no significant differences between the two groups in terms of the I–V interpeak latencies at all frequencies ($p > 0.05$). Table IV shows the mean values of the ABR results, the speech discrimination scores and the p values.

Discussion

The findings of the present study indicate that audiological involvement is not uncommon in Behçet's disease patients, compared with healthy controls. It has been reported in previous studies that hearing can be affected in 12–80 per cent of patients with Behçet's disease.[10,11] Soylu *et al*. reported that 20 of 72 Behçet's disease patients showed some degree of hearing loss, although not all of them were aware of it. Significant hearing losses were recorded at frequencies of 0.25, 0.5, 2 and 4 kHz. Hearing loss was one-sided in 13 of the patients, while it occurred in both ears in the other 7 patients.[4] In our study, six patients (23 per cent) had SNHL. Hearing loss was bilateral in five cases and unilateral in one case. The most significant decreases were recorded at frequencies of 4 kHz and 8 kHz.

Behçet's disease can also involve lesions or inflammation of the inner ear, with vestibular and/or cochlear problems.[5,6,11–14] Gemignani *et al*. stated that sudden or temporary deafness can be a first sign of Behçet's disease.[10] Narváez *et al*. suggested that hearing impairment in patients with Behçet's disease should be treated quickly to prevent permanent hearing loss.[15] Brama and Fainaru reported that inner-ear involvement was observed more commonly in older patients with longer disease duration.[16] There was a statistically significant difference in hearing loss at high frequencies when compared with speech frequencies in that study. However, another study found no correlation

TABLE III
PATIENTS' DPOAE RESULTS

Patient no	1 kHz		2 kHz		4 kHz		8 kHz	
	L	R	L	R	L	R	L	R
1	11.3	23.5	12.7	23.2	10.0	14.5	12.7	11.3
2	5.6	5.4	10.6	10.8	14.7	15.0	10.6	10.3
3	0.0	10.7	17.0	14.6	13.8	15.6	0.0	0.0
4	22.2	14.9	23.5	25.2	20.4	20.2	0.0	0.0
5	17.3	9.4	22.8	21.5	20.7	20.2	15.3	11.4
6	21.2	24.0	28.0	32.4	24.9	28.4	19.6	12.8
7	10.3	5.8	25.2	17.0	12.2	10.8	11.4	11.9
8	14.9	13.1	11.7	10.6	11.9	12.5	8.5	0.0
9	0.0	10.4	13.1	11.6	0.0	9.5	8.7	0.0
10	0.0	0.0	11.6	2.9	12.0	10.1	16.9	0.0
11	10.0	0.0	10.6	14.0	11.3	10.1	2.8	0.0
12	28.1	17.2	27.4	22.7	5.8	11.5	0.0	0.0
13	9.0	0.0	15.8	17.4	0.0	8.3	0.0	0.0
14	2.0	19.5	25.4	20.3	14.1	10.4	11.4	13.2
15	20.9	20.7	16.8	21.1	5.6	10.1	10.7	7.0
16	27.6	28.4	27.6	31.7	19.7	17.2	2.4	12.4
17	14.3	11.3	21.4	20.1	27.6	28.0	0.0	8.0
18	7.0	16.4	13.8	17.5	12.4	21.2	0.0	10.4
19	18.6	17.6	23.0	26.5	12.6	13.7	13.4	10.5
20	27.0	24.9	29.0	26.9	12.3	17.2	19.1	15.2
21	18.1	15.2	1.6	0.0	6.6	0.0	0.0	0.0
22	11.5	11.4	28.6	21.2	22.9	12.2	5.0	0.2
23	17.8	12.4	16.1	19.7	15.7	17.7	0.0	0.0
24	7.9	10.8	19.4	6.8	12.0	12.7	0.0	0.0
25	0.0	10.5	11.1	16.0	7.2	10.0	0.0	9.9
26	10.4	26.4	20.9	34.8	29.6	32.9	11.5	12.7

Data represent means. DPOAE = distortion product otoacoustic emission; no = number; L = left ear decibels; R = right ear decibels

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TABLE IV
COMPARISON OF PATIENT AND CONTROL GROUPS' SPEECH DISCRIMINATION SCORES AND ABR RESULTS

Variable	Controls (mean ± SD)	Patients (mean ± SD)	*p*
Speech discrimination score (%)	100.0 ± 0.0	96.9 ± 5.3	<0.001*
ABR (ms)	3.9 ± 0.28	3.9 ± 0.30	0.930†

*Mann–Whitney U test; †Student's *t*-test. ABR = auditory brainstem-evoked response; SD = standard deviation

between duration of the disease and hearing loss (duration of the disease was over five years for all patients).[7] In our study, duration of Behçet's disease was not significantly different between those patients with or without inner-ear involvement ($p > 0.05$). This result may be associated with the stage at which the clinical findings of Behçet's disease were detected.

Although several studies have reported hearing loss in patients with Behçet's disease, there are relatively few studies on distortion product otoacoustic emissions (DPOAEs).[5] Measurements of DPOAEs correspond closely with the physiological state of the outer hair cells of the cochlea. Normal DPOAE results provide extremely strong evidence of normal cochlear function.[17] Dagli *et al*. showed a significant difference in DPOAE results between Behçet's disease patients and controls.[5] We also found significant differences in the DPOAE results between the patients and controls, at all frequencies ($p < 0.05$). These results are a strong indicator of cochlear involvement in patients with Behçet's disease.

- **This study aimed to determine the characteristics of hearing loss in Behçet's disease patients**
- **Pure tone and speech audiometry, tympanometry, distortion product otoacoustic emission testing, and auditory brainstem-evoked response (ABR) assessment were conducted in patients and controls**
- **The ABR results were not significantly different between the patients and controls**
- **Audiological involvement was more frequent in Behçet's disease patients than in healthy controls**

The ABR assessment is a simple, objective and non-invasive test of the neural pathway, which allows the prediction of the psychoacoustic threshold via the electrophysiological threshold. The ABR assessment was used to evaluate the presence of retrocochlear lesions.[6,11] There was no statistically significant difference between the ABR results of the patients and controls in our study ($p > 0.05$). We found no evidence of retrocochlear lesions in the six patients with SNHL; this finding is similar to that reported in another study.[11]

Conclusion

Most patients with Behçet's disease will exhibit other otolaryngological symptoms, hearing loss in particular. This article elucidates the level of hearing loss and cochlear involvement in Behçet's disease. We believe that audiological assessment and management may be helpful in the diagnosis and treatment of patients with Behçet's disease.

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