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AUDITORY BRAINSTEM RESPONSES IN SENILE PRESBYCUSIS PATIENTS OVER 90 YEARS

CHEN Aiting, LIANG Sichao, ZHANG Ruining, GUO Weiwei, ZHOU Qiyou, JI Fei

Abstract

Objective To analyze the characteristics of auditory brainstem response (ABR) in presbycusis patients elder than 90 years. **Methods** Fourteen presbycusis patients elder than 90 years (presbycusis group, 91.1.4±1.3 years, 26 ears) and 9 normal-hearing young adults (control group, 22.7±1.2 years, 18 ears) participated in the study. Alternative click-evoked ABRs were recorded in both groups. The peak latency (PL) of peak I, Ⅲ, and V, and the inter-peak latency (IPI) of I-Ⅲ, Ⅲ-V, and I-V were compared between groups. **Results** In elder presbycusis patients, the occurrence rate of peak I and Ⅲ were both 76.9%, and that of peak V was 84.6%. In presbycusis group, the peak latencies of I, Ⅲ, V were significantly longer than that of control group (P<0.001). There was no significant difference between groups in the IPI of peak I-I Ⅲ (P=0.298, peak Ⅲ-V (P=0.254) and peak I-V (P=0.364). **Conclusions** Auditory brainstem responses in presbycusis patients elder than 90 years showed worse wave differentiation

Key Words: Auditory brainstem response; Auditory electrophysiology; Presbycusis; Senile patients

Auditory brainstem response (ABR) is one of widely used neurophysiologic tests to evaluate auditory brainstem pathway function. It is applied in clinical in diagnosis of auditory nerve pathway or central lesions, evaluation of objective auditory threshold, screening and monitoring hearing loss, etc [1,2]. As China entered the aging society, the attention is higher and higher regarding the situation of the elderly and even centenarians hearing loss and rehabilitation [3].The influence of age on ABR has been a matter of controversy. While many authors have reported that the ABR waveforms in the elderly show a progressive latency shift of the principal components, others claim that there is not a delay in the central conduction time (CCT) with ageing [1,4]. This study investigates the characteristics of ABRs in a group of over 90 - year - old presbycusis patients.

Material and Methods

Participants

Data were obtained from 14 presbycusis patients elder than 90 years, average age of 91.1.4±1.3 years old. All ears in the study were excluded with sudden deafness, infection, drug deafness or conductive hearing loss. Eventually 2 ears in 2 patients were ruled out because of the existence of conductive hearing loss factor. A total of 26 ears were included in this study, including mild hearing loss in 3 ears, 9 ears moderate hearing loss, severe hearing loss in 12 ears, and 2 ears with profound hearing loss. For comparison, we also recruited normal hearing subjects 9 cases (18 ears) as the control group, mean age 22.7 ± 1.2 years old. The whole frequency thresholds of all ears were less than 25 dB HL.

Test Procedures

An otoscopic examination was performed before all the tests to ensure the external auditory canal and tympanic membrane intact and removal of cerumen in the external auditory meatus. Background noise in the shielding room is less than 30dB A.Pure-tone air-conduction thresholds were obtained in both ears of participants at the frequencies from 250 to 8,000 Hz using MADSEN Orbital 922,

Affiliation:
Department of Otolaryngology, Head & Neck Surgery
Chinese PLA General Hospital
Chinese PLA Institute of Otolaryngology
28 Fuxing Road, Beijing 100853, China

Corresponding authors:
JI Fei, Email: argfei301@163.com

Table 1 PLs and IPIs in different groups in unit ms.

Group	I PL	Ⅲ PL	V PL	I–Ⅲ IPI	Ⅲ–V IPI	I–V IPI
Presbycusis group	1.63±0.19	3.92±0.19	5.96±0.23	2.31±0.18	1.99±0.12	4.45±0.69
Control Group	1.32±0.05*	3.69±0.11*	5.63±0.16*	2.36±0.12	1.94±0.16	4.31±0.15
Liu et al	1.758±0.171	3.987±0.198	5.951±0.232	2.244±0.176*	2.258±0.192*	4.210±0.252*
Lv et al	1.94±0.13	4.10±0.19	5.94±0.29	2.16±0.16*	1.85±0.26*	4.00±0.28*

Note: * represents the group has a statistically significant difference with 90 years of age or older group ($P < 0.05$)

and excluded the presence of air bone conduction threshold gap exceeding 10 dB. The subjects were in the supine position, relaxed with eyes closed while ABR testing, using ICS auditory evoked potential system and CHARTR EP test software. The transducer is ER - 3A plug-in air conduction earphone and all electrodes are the button type electrodes. Recording electrodes were placed in the forehead hairline, reference electrodes are respectively arranged in the left and right side lobe (or mastoid), ground electrode was placed in nasion. Skim skin of electrodes position using 95% alcohol before the test until the electrode impedance no more than 3 kΩ. The intensity of stimulation signal, the maximum output of the system, is 95dB nHL of alternating polarity clicks (click), stimulus repetition rate at 11.1/s. The preamplifier is set to gain 100k, band pass filter of 100 ~ 3000 Hz, 1024 times. Repeat overlaid 3 times per ear at least.

Statistical Analysis

Identified and quantified the peak I, Ⅲ, V, extraction rate, peak latency (PL) and the I-Ⅲ, Ⅲ-V, I-V interpeak latency interval (IPI). Statistical analysis, using SPSS 17 statistical software, was as follows: (1) I, Ⅲ, V PL, IPI were presented as mean and standard deviation and evaluated with t-tests between presbycusis patients group and control group; (2) the PL, IPI of presbycusis patients group and the mean of other scholars of domestic reports [5,6] were evaluated with U test. The significant level was $\alpha=0.05$.

Results

ABR waves of presbycusis patients elder than 90 years group

In 26 tested ears, peak I, Ⅲ, V were all elicited in 20 ears(76.9%), 2 ears (from the same subject) had only V wave (7.7%), and 4 ears with no repetitive waveform (15.4%). The extraction rate of Peak I and Ⅲ were the same, 76.9% (20/26), peak V extraction rate was 84.6% (22/26). In all waveforms, the average I PL is 1.63 ± 0.19 ms, Ⅲ PL is 3.92 ± 0.19 ms, V PL is 5.96 ± 0.23 ms. IPI of I-Ⅲ is 2.31 ± 0.18 ms, Ⅲ-V is 1.99 ± 0.12 ms, I-V is 4.45 ± 0.69 ms. Relatively speaking, waveform differentiation of senile deafness patients is poor overall, and signal-to-noise ratio is low, especially poor differentiation of peak I, requiring repeated superposition.

Comparison between groups

The extraction rate of each wave of the normal young control group was 100%. The statistical research results of the comparison between presbycusis patients group and control group see table 1. Peak I PL ($P<0.001$), peak Ⅲ PL ($P<0.001$), and peak V PL ($P<0.001$) has a statistically significant difference between groups. ABR PLs increased in senile deafness group. I-Ⅲ IPL ($P=0.298$), Ⅲ-V IPL ($P=0.254$), I-V IPL ($P=0.364$) has no significant difference between groups (Table 1).

Comparison with two references results from domestic researches

Two domestic studies of higher age subjects' ABR results were selected, one is Liu [5] report of people above 60 years old and the other is Lv [6] in the 31-55 years old group. Compared with two references results, there is no significant difference in each PL between senile deafness group and two reports ($P>0.05$), the IPI has a significant difference (Table 1), especially the I-Ⅲ and I-V IPI were longer than those of Liu's and Lv's results.

Discussion

Clinical ABR measurements are concerned with seven peaks, and concentrated on peak I, Ⅲ and V, higher extraction rate, close to 100% in normal hearing population [2,7]. The name and origin were: the peak I, V, Ⅲ cranial nerve action potential, generated by afferent activities of the V, Ⅲ cranial nerve primary neurons in the internal auditory canal. The peak Ⅲ, originated near the cochlear nucleus. The peak V, the most easily induced in human ABR and the maximum amplitude of all peaks, is generally believed originated in hypothalamus [1,2]. There are many studies of the prevalence of the influence of age on evoked ABRs [4,5,8]. Martini's research [4] on 36 healthy subjects with an average age of 67.2, compared to standard data and the young subjects, confirm a latency shift of the principal components, but do not demonstrate a significant CCT impairment in the elderly. Konrad-Martin [8] identified and quantified the effects of aging on ABR from 131 predominately male Veteran participants aged 26 to 71 year. Results showed that, aging substantially reduced amplitudes of all principal ABR peaks, with significant latency shifts limited to peaks I and Ⅲ. Aging did not influence the I-V IPI even at high click rates. Compared with model predictions from the sample of better hearing subjects, mean ABR amplitudes were diminished in the group with poorer hearing, and peak V latencies were prolonged. They suggest that aging reduces the numbers and/or synchrony of contributing auditory nerve units. Liu [5] has been reported the ABR reference value in aged 60 years and above. It focuses on the characteristics of the ABRs of over 90 years old patients with presbycusis. Overall, ABR waveform differentiation of senile deafness patients is worse than normal control group, requiring more averaging to obtain repeatable waveforms, and the whole waveform of the signal to noise ratio is also worse than the control group. Compared with control group, the extraction rate of Peak I and Ⅲ are relatively low, and the latency was significantly prolonged in patients, which may be related to the number of patients with senile deafness associated spiral ganglion decrease. As the comparison with the reported results showed, there is no significant difference in each peak of PL, but the I-Ⅲ and I-V IPI were longer than those reported by Liu's 60 years old above average results. It may be caused by synapse potency of elderly presbycusis patients reduces further under the influence of various factors. Since ABR peaks were postsynaptic potential, the synaptic efficacy has significant impact to ABR duration. The synaptic efficacy regarding the recogtion and resolution is also of great importance. ABR changes in elderly patients with senile deafness, therefore, may have some implications for patients with speech recognition ability and the rehabilitation expected.

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