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EVALUATION OF BRAINSTEM AUDITORY EVOKED POTENTIAL IN NOISE-INDUCED DEAFNESS

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Abstract: Noise-induced hearing loss is an increasingly prevalent but preventable hearing disorder. The hearing deficit is of sensorineural type and its prevalence is next only to age-related hearing loss.1 Occupational health hazards have not received significant attention yet. The rail engine drivers who operate trains in an environment with extreme noise and temperature, is an example. The present study was done to determine whether BAEP is valuable in the early detection of change in the hearing capability of the subjects due to continuous noise exposure. This present study is a cross-sectional study that compares the hearing status of rail engine drivers, exposed to heavy noise for a duration of 10 years or more, and subjects working in quiet environment, matched for age, sex and work routine. The technique used in this study is Brainstem Auditory Evoked Potentials (BAEPs) along with personal interview, tuning fork tests. Of the 60 subjects that we studied, 36 (60%) reported to be having sensorineural deafness. BAEP is a simple, non-invasive technique to detect the change in the hearing capability even in the absence of specific symptoms, when the person himself is not aware of it.

Key Words: BAEP; NIHL; hearing capability; Loco pilot

INTRODUCTION

Noise-induced hearing loss is an increasingly prevalent disorder resulting from prolonged exposure to high intensity sound. It is a preventable disorder if efforts are made to detect it earlier. It is a major health hazard in both industrialized and developing countries.[2] The hearing loss may be temporary, known as Temporary Threshold Shift (TTS), which is a transient elevation of the hearing threshold that returns to normal when the ear is allowed time to recover. It may be permanent, known as Permanent Threshold Shift (PTS). PTS may occur following repeated TTS, or following a single episode of very high level of noise exposure.[3] The US Department of Labors' Occupational Safety and Health Administration (OSHA) states that exposure to 85dB(A) of noise, for more than 8 hours per day can result in permanent hearing loss. This value is known as exposure action value.[4] Occupational health hazards have not received significant attention yet. The rail engine drivers who operate trains in an environment with extreme noise and temperature for 7-8 hours daily for more than 20 years, is an example. The noise level at which they work has been found out to be 100dB for 8-12 hours, 6 days a week.[1] In addition, Indian trains do not have adequate noise and vibration attenuating design features. The Auditory Evoked Potentials are a simple and non-invasive tool to assess noise induced changes in auditory function especially retrocochlear conduction. The present study aimed to evaluate the effect of high intensity background noise on BAEP (Brainstem Auditory Evoked Potentials), and to asses it's utility as a tool for early detection of hearing impairment.

MATERIALS AND METHODS

The study group comprised of 60 subjects exposed to continuous loud noise. The inclusion criteria included loco-pilots (rail engine drivers) of age group 40-50yrs, employed in Western-Central Railway, Jabalpur, and exposed to continuous loud noise (>85dB) for more than 10yrs. A detailed history, physical examination including otological examination was done. Each of them underwent Rinnie's test, Weber's test and endotoscopic examination before subjecting them to BAEP studies. Informed consent was taken. Before recording BAEP, all the subjects were asked to shampoo their hair and avoid oil or gel or hair spray. Skin was further cleaned with spirit. Electrodes were placed as follows: Ground electrode on the vertex, Reference electrode on the forehead, Two active electrodes on each mastoid. Two tracings were obtained and superimposed in order to check replicability of waveforms. The criteria for abnormal BAEP included absence of response, prolonged latencies (mean ±2.5SD) and prolonged inter-peak latencies (mean ±2.5SD). Normative data were gathered separately in 20 subjects matched in age and sex as a group to compare results.

Statistical Analysis

The data of the present study were recorded into the computers and after its proper validation, check for error, coding & decoding were compiled and analysed using the software SPSS 18 for windows. Appropriate univariate and bivariate analysis were carried out using the Student t test for the continuous variable and two-tailed Fisher exact test or chi-square (χ^2) test for categorical variables. All means are expressed as mean ± standard deviation. The critical

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levels of significance of the results were considered at 0.05 levels i.e. $p < 0.05$ was considered significant.

RESULT

Of the 60 subjects that we studied, 36(60%) reported to be having sensorineural deafness, near to previous studies.[5,6]

The physical characteristics of the subjects are given in Table I. The age, weight and height of the subjects in both the groups were comparable and there was no significant difference between exposed and unexposed group. The exposed group was interrogated for their chief complaints related to prolonged noise exposure (Table II).

TABLE I: Physical characteristics of the subjects

	CASE	CONTROL
AGE(Yrs)	44.17±2.87	44.05±2.74
WEIGHT(Kg)	66.8±2.37	64.4±3.08
HEIGHT(cm)	162.5±4.1	161.8±4.4

TABLE II: Chief complaints of exposed group

Complaint	Case	Percentage
Headache	30	50.0%
Irritation	22	36.7%
Insomnia	10	16.7%
Ringing	9	15.0%
Decreased hearing	8	13.3%
Lack of concentration	7	11.7%

Most of the subjects had vague complaints like headache (50.0%), irritation (36.7%), lack of concentration (11.7%) and insomnia (16.7%). Only 8/60 (13.3%) of the subjects had complain of decreased hearing and 9/60 (15.0%) complained of ringing in the ear. The peak latencies of wave I, III, V and the inter-peak latencies of I–III, III–V and I–V of both right and left ear BAER are given in Tables III and IV.

TABLE III: Right ear brainstem auditory evoked responses (BAER) in noise exposed and control subjects

	Peak Latencies(ms)			Intrerpeak Latencies		
	I	III	V	I-III	III-V	I-V
Case (n=60)	1.761±0.368*	3.733±0.404*	5.770±0.475*	1.972±0.307	2.036±0.221*	4.008±0.304*
Control (n=20)	1.637±0.107	3.592±0.151	5.437±0.198	1.956±0.165	1.744±0.283	3.800±0.217

Values are Mean ± SD; *P<0.05; n = No. of Subjects

TABLE IV: Left ear brainstem auditory evoked responses (BAER) in noise exposed and control subjects

	Peak Latencies (ms)			Intrerpeak Latencies		
	I	III	V	I-III	III-V	I-V
Case (n=60)	1.752±0.370*	3.738±0.369*	5.775±0.477*	1.985±0.299	2.037±0.232*	4.023±0.313*
Control (n=20)	1.639±0.114	3.582±0.166	5.443±0.183	1.984±0.201	1.751±0.310	3.803±0.211

Values are Mean ± SD; *P<0.05; n = No. of Subjects

The peak latencies of wave I, III, V and the interpeak latencies of III–V and I–V of both right and left ear BAER showed an increase in the exposed group as compared to unexposed group (P<0.05). This proves that there is delay in signal transmission through central conduction pathway resulting in prolongation of peak as well as interpeak latencies.[5,7,8,9]

DISCUSSION

Noise-induced hearing loss is an increasingly prevalent but preventable hearing disorder. In the present study, the hearing ability of 60 subjects exposed to heavy occupational noise for long duration were studied by using BAEP technique in an attempt to find out whether BAEP is valuable in the early detection of change in the hearing capability of the subjects due to continuous noise exposure. This study revealed that most of the subjects were not aware of their hearing disability and majority of them had just vague complains of headache, irritation, insomnia, etc. Moreover Rinnie's test as well as Weber's test did not reveal any abnormality. But BAEP recordings showed prolonged peak latencies and inter-peak latencies.[5,8,9]

Because peak amplitudes vary with a number of factors, e.g. electrode impedance, its location and the intensity of the stimulus applied, BAEP latencies are considered as more sensitive indicators for the early detection of hearing impairement.[2,10] The unexposed group recorded the BAEPs within the normal limit.[2,11,12,13] This suggests that BAEP can be used for early detection of hearing loss. The benefit will be several folds if BAEP recordings are done time to time in people exposed to occupational noise. With early detection, early intervention would be possible and prevention of disability would be achieved. It must therefore be taken into consideration that BAEP facility is made available to all employees who are working in high noise environment and who are at risk of Noise-induced Hearing Loss.

BAEP is especially useful to detect hearing losses due to high intensity occupational exposures as is found in case of loco-pilots.[14] Brainstem evoked response audiometry is a purely subjective audiological test and can also be used as a valuable tool to detect malingering in cases of noise-induced hearing loss.[15]

CONCLUSION

BAEP is a simple, non-invasive technique to detect the change in the hearing capability even in the absence of specific symptoms, when the person himself is not aware of it.

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