Original Article

Effect of Occupational Vibration on Human Retina Measured by Electroretinography

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Abstract

Purpose: To study the possible effects of occupational vibration on human retina using electroretinogram.
Patients and Methods: Fifty workers from a segment of a textile factory with machinery creating high levels of vibration were selected. The workers had at least 6 years history of working in the factory segment where high vibrating machines were operating. The amplitude and latency of electroretinogram b-wave peak and amplitude was compared between these selected workers and 50 age and sex matched controls from other sections of the factory.
Results: The mean age was 27.5 + 1.741 years and 27.28 + 1.641 years in the case and control groups respectively. There was statistically significant lower mean amplitude of electroretinogram b-wave peak in the case group compared to the control group ($P < 0.001$). Also higher mean latency of the electroretinogram b-wave in the case group compared to the control group was observed ($P < 0.001$)
Conclusion: Occupational vibration might have adverse effects on visual system, mainly retina, causing a decrease in amplitude and increase in latency of electroretinogram b-wave peak measured using electroretinography.

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Introduction

Workers in different work places might be exposed to occupational hazards including very high ambient noise and vibration levels [1]. Visual system including the retina might become affected by existing physical hazards in the workplace.

Different techniques are available to evaluate the retinal function. Electrophysiological methods have been used among certain professionals including turners, welders and different other industrial professionals to determine the effect of occupational hazards on visual system mainly retina [2-4]. Electroretinography (ERG) is a suitable technique to look for disturbances in retinal layers [5]. ERG can be recorded using two types of stimulation including pattern reversal check board and flash stimulations [6]. We observed in our practice that some referred patients with medical history of working in textile factories had lower amplitude and higher latency of ERG b-wave peaks, so the present study was conducted to evaluate the possible effects of excessive vibration on human retina in a textile factory using ERG .

Patients and Methods

This study was approved by Basir Eye Health Research Center ethics committee, Tehran, Iran, and all subjects gave written consent before entering the study. Fifty male workers from a big textile factory in Iran were selected randomly as the case group. Subjects were in the age range of 25 to 30 years. The workers were selected from sections of the factory where heavy noise and vibration were present, including the weaving and spinning sections. The noise levels in these sections were more than 90 dB and the workers were exposed to whole-body vibration of more than 2.80 m/s^2 in their eight hours working day. The recommended daily occupational whole-body exposure limit value [ELV] for vibration is 1.15 m/s [7]. The workers had at least a 6 year history of continuous work in above mentioned sections of the factory. The visual system of workers was examined using E-chart, ophthalmoscope and retinoscope. Medical history of all participants was also recorded. Fifty age and sex matched controls were selected from other sections of the factory with no heavy noise and vibration as the control group.

All participants in the study underwent ERG examination. Latency (msec) and amplitude (µv) of ERG, b-wave peak were measured for each subject. Pantops- PC2 (Biophysic Medical, Clermont-Ferrand, France) was the instrument used to record the (ERG). Conventional electrode attachments were used for attaching the electrodes to the subjects. Means and standard deviations of latency and amplitude of ERG b-wave peak in the case and control groups were compared. We performed the statistical analysis using SPSS software version 22 (IBM, Armonk, NY, USA). P values less than 0.05 were considered statistically significant.

Results

Table 1 shows the demographic findings in the case and control groups. There was no statistically significant difference between the two groups regarding the age ($P = 0.517$) and visual acuity ($P = 0.404$).

Table 2 shows the measurement results for latency and amplitude of ERG b-wave peak in the case and control groups. There was a statistically significant higher mean latency ($P < 0.001$) and lower mean amplitude ($P < 0.001$) of the electroretinogram b-wave peak in the case group compared to the control group.

Table 1: Demographic findings of participants in the case and control groups

Variable	Group		P value*
	Case	Control	
Age	27.5 ± 1.741	27.28 ± 1.641	0.517
Visual Acuity (LogMAR)	0.003 ± 0.012	0.001 ± 0.009	0.404

*T-Test

Table 2: Measurements of the mean latency and amplitude of ERG, b-wave peak in the case and control groups

Variable	Group		P value*
	Case	Control	
Latency (msec)	51.08 ± 9.2	44.30 ± 2.77	< 0.001
Amplitude (μv)	68.46 ± 23.51	116.28 ± 18.2	< 0.001

*T-Test

Finally we observed that in the case group 27 participants complained from floaters and shadows is their visual system.

Discussion

The excessive vibration of the machinery was not avoided by workers in the factory segment studied in the present study using suitable protecting instruments.

We observed that the mean amplitude of ERG, b-wave peak in participants exposed to excessive vibration was 116.28 ± 18.2 μv compared to 68.46 ± 23.51 μv in the control group ($P < 0.001$). The origin of ERG b-wave peak amplitude is the bipolar and Müller cells of retina and a fall in amplitude might be due to degeneration of these cells [8]. In fact whole body vibration of more than 2.80 m/s^2 among the case group might have caused degeneration in their retinal bipolar and Müller cells resulting in a decrease in amplitude of ERG b-wave peak.

On the other hand our results indicated an increase in the mean latency of ERG b-wave peaks, (51.08 ± 2.90 msec in the case group, versus 44.30 ± 2.77 msec in the control group). The increase of the mean ERG b-wave peak latency might be an indication of early deep retinal changes among workers exposed to high vibration.

Symilar to our findings previous reports have indicated the possible effects of excessive vibration on visual system. Bertschinger et al., [9] in 2008 reported a 43 year old man who presented 2 weeks after starting whole body vibration training with a spontaneous vitreous hemorrhage. Also Gillan et al., [10] have reported a 52 year old man with spontaneous vitreous hemorrhage after a session of whole body vibration training. Shushtarian et al., [11] studied fifty workers from a textile factory segment with machinery creating high levels of vibration. They recorded the visual evoked potential (VEP) in subjects exposed to whole body vibration and reported a delay in latency of VEP, Peak 100 wave suggesting visual pathway disturbances among these subjects.

Conclusion

Occupational vibration might have adverse effects on visual system, mainly retina, causing a decrease in amplitude and increase in latency of electroretinogram b-wave peak measured using electroretinography.

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Footnotes and Financial Disclosures

Conflict of interest:

The authors have no conflict of interest with the subject matter of the present study.