Original Article

Effect of Occupational Vibration on Visual Pathway Measured by Visual Evoked Potentials

Seyed Mohammad Masoud Shushtarian [1], PhD; Atoosa Shahriyari Kalantari [2], MD; Fatemeh Tajik [3], MD ; Farhad Adhami-Moghadam *[3], MD

1. Department of Biophysics and Biochemistry, Faculty of Advance Science and Technology, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran.
2. Department of Neurology, Faculty of Medicine, Tehran University of Medical Sciences, Islamic Azad University, Tehran, Iran.
3. Department of Ophthalmology, Faculty of Medicine, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran.

***Corresponding Author:** Farhad Adhami-Moghadam

E-mail: farhad.adhami@gmail.com

Article Notes:

Received: Jun. 29, 2017
Received in revised form: Jul. 26, 2017
Accepted: Aug. 26, 2017
Available Online: Sep. 27, 2017

Keywords:

Vibration
Visual pathways
Evoked potentials
Visual

Abstract

Purpose: To study the possible effects of vibration on visual pathway using visual evoked potentials.

Patients and Methods: Fifty workers from a textile factory segment with machinery creating high levels of vibration were selected. The workers had at least 6 years of experience in the factory segment where high vibrating machines were operating. The amplitude and latency of visual evoked potential, P100 peak was recorded for 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 and 27.28 ± 1.641 in the case and control groups respectively. There was a statistically significant higher latency of the visual evoked potential, P100 peak in the case group compared to the control group ($P < 0.001$). No significant difference regarding the amplitude of visual evoked potential, P100 peak was observed between the two groups ($P = 0.89$).

Conclusion: Occupational vibration might have adverse effects on visual system, mainly visual pathway, causing increased latency of P100 peak measured using visual evoked potentials.

How to cite this article: Shushtarian SM, Shahriyari Kalantari A, Adhami-Moghadam F. Effect of Occupational Vibration on Visual Pathway Measured by Visual Evoked Potentials. Journal of Ophthalmic and Optometric Sciences. 2017;1(5):7-11.

Introduction

Workers in different workplaces might be exposed to occupational hazards including very high ambient noise and vibration levels [1-6]. Visual system including the visual pathway might become affected by existing physical hazards in the workplace.

Different techniques are available to evaluate the function of visual pathway [9-10]. Electrophysiological studies have been used among certain professionals including musicians to determine the effect of occupational environment on visual pathway [11-13]. Visual evoked potential (VEP) is a suitable technique to look for demyelination in visual pathway. VEP can be recorded using two types of stimulations including pattern reversal checker board and flash stimulations; with pattern reversal resulting in more reliable results [14]. We observed that some referred patients with a medical history of working in textile factories had delayed VEP, P100 peaks, so the present study was conducted to evaluate the possible effects of excessive vibration on visual pathway in a textile factory setting using the VEP method.

Patients and Methods

This study was approved by our institutional ethics committee 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 25-30 years. The workers were selected from sections of factory where heavy noise and vibration were produced, 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] is 1.15 m/s [2,15]. 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. Along with these subjects fifty age and sex matched controls were selected from other sections of the factory with no heavy noise and vibration.

All participants in the study underwent VEP examination. Latency (msec) and amplitude (µv) of VEP, P100 peak were measured for each subject. Pantops - PC2 (Biophysic Medical, Clermont - Ferrand, France) was the instrument used to record the VEP. Conventional electrode attachments were used for attaching the electrodes to the subjects. Means and standard deviations of latency and amplitude of VEP, P100 peak in the case and control groups were calculated and compared. We performed the statistical analysis using SPSS software version 22 (IBM, Armonk, NY, USA). P values less than 0.05 were considered 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 VEP, P100 peak in the case and control groups. There was a statistically significant higher latency of the visual evoked potential, P100 peak in the case group compared to the control group ($P < 0.001$). No significant difference regarding the amplitude of VEP, P100 peak was observed between the two groups (P = 0.89).

Finally we observed that in the case group 27

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

Variable	Number of participants	Group		P*
		Case	Control	
Age	50	27.5 ± 1.741	27.28 ± 1.641	0.517
Visual Acuity (LogMAR)	50	0.003 ± 0.012	0.001 ± 0.009	0.404

*T-Test

participants complained from finger prickling, muscle weakness, or lack of balance.

Discussion

The excessive vibration was not avoided in the factory segment studied in the present manuscript by suitable protecting instruments and it was transmitted to laborers' body from skeletal system either via metatarsal bones in standing position or the pelvic bone in the sitting position.

We observed that the mean latency of VEP, P100 peak in participants exposed to excessive vibration was 112.52 ± 6.63 compared to 92.48±3.99 in the control group (P < 0.001). The origin of VEP, P100 peak latency is the visual pathway and a delay in latency might be due to demyelination of this pathway [16-18]. Whole-body vibration of more than 2.80 m/s^2 among the case group might have caused demyelination in their visual pathway resulting in increased latency of VEP, P100 peak. In our search of English language literature we found no previous study about the effect of occupational vibration on visual pathway, but there were some studies regarding the effect of occupational vibration on other parts of the body. In these studies vibration was found to induce demyelination in different parts of body in different working environments; which supports the findings of the present study. In a study including workers who were exposed to heavy hand-arm vibration, Strömberg et al., [19] reported demyelination and vibration induced neuropathy, which was associated with edema and incomplete regeneration and could finally cause neuro fibrosis.

Lopata et al., [20] studied the effect of long-term low frequency vibration on the sciatic and plantar nerves of Wistar rats. They found a reduction in the total number of nerve fibers, which was associated with altered distribution of myelinated fiber diameter, disturbances in axon structure and fiber demyelination [20]. The

Table 2: Measurements of mean latency and amplitude of VEP, P100 Peak in case and control groups

Variable	Number of participants	Group		P*
		Case	Control	
Latency (msec)	50	112.52 ± 6.637	92.48 ± 3.991	< 0.001
Amplitude (µv)	50	6.28 ± 1.525	6.12 ± 1.876	0.89

*T-Test

extent of the lesion depended on the duration of exposure and distance from the source of vibration [20]. Takeuchi et al., [21] observed pathological changes in finger biopsy of patients with vibration- induced white finger. They also noticed demyelinating neuropathy in peripheral nerves with marked loss of nerve fibers [21].

An important finding, which supports the results of the present study, was the complaints from some participants in the case group from finger prickling, muscle weakness and lack of balance, which might be the symptoms of demyelination in their other organs.

Conclusion

Occupational vibration might have adverse effect on visual system, mainly visual pathway, causing increased latency of P100 peak measured using visual evoked potentials.

References

1. Shevtsova VM. Physiological mechanisms of prevention of occupational hypoacusis. Gig Sanit. 2001;(6):44-7. (Article in Russian)
2. Gomes LM, Martinho Pimenta AJ, Castelo Branco NA. Effects of occupational exposure to low frequency noise on cognition. Aviat Space Environ Med. 1999;70(3 Pt 2):A115-8.
3. Martinho Pimenta AJ, Castelo Branco NA. Neurological aspects of vibroacoustic disease. Aviat Space Environ Med. 1999;70(3 Pt 2):A91-5.
4. Wu JZ, Welcome DE, Krajnak K, Dong RG. Finite element analysis of the penetrations of shear and normal vibrations into the soft tissues in a fingertip. Med Eng Phys. 2007;29(6):718-27.
5. Adamo DE, Martin BJ, Johnson PW. Vibration-induced muscle fatigue, a possible contribution to musculoskeletal injury. Eur J Appl Physiol. 2002; 88(1-2):134-40.
6. Griffin MJ, Bovenzi M. The diagnosis of disorders caused by hand-transmitted vibration: Southampton Workshop 2000. Int Arch Occup Environ Health. 2002; 75(1-2):1-5.
7. Ustinaviciene R, Obelenis V, Ereminas D. Occupational health problems in modern work environment. Medicina (Kaunas). 2004;40(9):897-904.
8. Heinrich SP, Andrés M, Bach M. Attention and visual texture segregation. J Vis. 2007;7(6):6.
9. Martínez A, Hillyard SA, Dias EC, Hagler DJ Jr, Butler PD, Guilfoyle DN, et al. Magnocellular pathway impairment in schizophrenia: evidence from functional magnetic resonance imaging. J Neurosci. 2008;28(30):7492-500.
10. Gunny R, Yousry TA. Imaging anatomy of the vestibular and visual systems. Curr Opin Neurol. 2007;20(1):3-11.
11. Shahin AJ, Roberts LE, Pantev C, Aziz M, Picton TW. Enhanced anterior-temporal processing for complex tones in musicians. Clin Neurophysiol. 2007;118(1):209-20.
12. Jongsma ML, Desain P, Honing H. Rhythmic context influences the auditory evoked potentials of musicians and non-musicians. Biol Psychol. 2004;66(2):129-52.
13. Cadden SW, Van Der Glas HW, Van Der Bilt A. Modulation of jaw reflexes by remote noxious stimulation and mental state: possible association with psychological measurements of mental stress and occupation. J Oral Rehabil. 1999;26(12):952-61.
14. Naser M, Shushtarian S, Abdulhusseinpour H, Davari T. Selection of suitable visual stimulator for recording of Visual Evoked Potential in photophobia patients. Indian journal of applied research. 2014(9);49:112-7.
15. Best Palmer KT, Bovenzi M. Pract Res Clin Rheumatol. Rheumatic effects of vibration at work. Best Pract Res Clin Rheumatol. 2015;29(3):424-39.
16. Walsh P, Kane N, Butler S. The clinical role of evoked potentials. J Neurol Neurosurg Psychiatry. 2005;76 Suppl 2:ii16-22.
17. Doulah A, Shushtarian SM. Probable Toxic Effect

of Methotrexate on visual pathway using visual Evoked potential. Indian Journal of Applied Research. 2016;6(2):499-500.
18. Dujmović I, Mesaros S, Pekmezović T, Lević Z, Drulović J. Primary progressive multiple sclerosis: clinical and paraclinical characteristics with application of the new diagnostic criteria. Eur J Neurol. 2004;11(7):439-44.
19. Strömberg T, Dahlin LB, Brun A, Lundborg G. Structural nerve changes at wrist level in workers exposed to vibration. Occup Environ Med. 1997;54(5):307-11.
20. Lopata P, Mikusek J, Karmańska W, Karmański A. Changes in the peripheral nerves in rats induced by vibration. Folia Morphol (Warsz). 1994;53(2):95-104.
21. Takeuchi T, Futatsuka M, Imanishi H, Yamada S. Pathological changes observed in the finger biopsy of patients with vibration-induced white finger. Scand J Work Environ Health. 1986;12(4 Spec No):280-3.

Footnotes and Financial Disclosures

Conflict of interest:

The authors have no conflict of interest with the subject matter of this manuscript.