Original Article

Zahedan Journal of Research in Medical Sciences

Journal homepage: www.zjrms.ir

Effects of Iron Deficiency and Iron Deficiency Anemia on Visual Evoked Potential in Women

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Article information

Article history:
Received: 9 Mar 2013
Accepted: 29 May 2013
Available online: 12 June 2013
ZJRMS 2014; 16 (6): 30-32

Keywords:
Visual evoked potential
Iron deficiency
Iron deficiency anemia

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Abstract

***Background*:** Visual evoked potential is one of the main methods to investigate visual pathway. Some studies in children show that iron deficiency anemia affects on visual evoked potential waves. In this study, we evaluated the effect of iron deficiency and iron deficiency anemia on visual evoked potential in adults.

***Materials and Methods*:** This cross sectional study was conducted on 99 non-pregnant women. Patients divided into three groups. Women whose ferritin and hemoglobin levels are less 15 ng/1 and 12 mg/dl placed in iron deficiency aimena group, women whose ferritin level is less than 15 ng/1 and hemoglobin level is more than 12 mg/dl, placed in iron deficiency puorg and women whose ferritin and hemoglobin levels are more than 50 ng/1 and 12 mg/dl, chosen as control group. Visual evoked potential was done from both eyes and the results evaluated by ANOVA test.

***Results*:** The average of N75 latency was 65.24±5.06 miliscecond in anemia group, 66.27±7.77 miliscecond in iron deficiency group and 67.19±6.79 miliscecond in control group. The average of P100 latency was 101.60±9.05 miliscecond in anemia group, 102.75±7.91 miliscecond in iron deficiency group and 100.67±7.34 miliscecond in control group. The average of N135 latency was 139.18±31.21 miliscecond in anemia group, 144.81±10.73 miliscecond in iron deficiency group and 141.81±10.73 miliscecond in control group. There is no significant difference between the average of waves' latency in iron deficiency and anemic groups with control group.

***Conclusion*:** Iron deficiency and iron deficiency anemia don't make any disruptions on visual evoked potential and are not considered as confounding factor of visual evoked potential in adults.

Introduction

Visual e potential (VEP) is a terminal response of a long optical pathway which starts from retinal light receptors passes retinal synapses and lateral geniculate body and finally terminated to primary visual cortex. In clinical works, tandem visual stimulations given to the patient's eye and average taken from the recorded data to record final form of VEP [1]. Since VEP is one of the important ways to evaluate patients with visual disorders such as optic neuritis, its confounding factors can lead to diagnostic error [2]. According to the key role of iron in many parts of central nervous system such as cellular respiration activity, production of myelin and neurotransmitters like dopamine, norepinephrine, serotonin and GABA [3, 4], it seems that iron deficiency may affect on functional tests such as VEP [5, 6]. Studies in this field are limited to children. The first study about this issue conducted in Turkey and its results showed that VEP indexes in children with iron deficiency anemia had abnormality that fix by treatment of anemia [7]. The two next studies in Chile and India also showed that VEP indexes in children with iron deficiency anemia had abnormality that may also relate to the level of anemia [8, 9]. It seems that iron deficiency has different effects on visual system between children and adults because; myelination of visual system is not complete until the age of 5-6 and may be, iron anemia in children is associated with perminant visual dysfunction [8]. Also, iron deficiency anemia considered as most common nutritional disorder in all over the world [10, 11]. In Iran, the prevalence of iron deficiency and iron deficiency anemia is 31.7 and 26.2%, respectively in children [12] and 23.7% and 12.2%, respectively in adults [13]. Unfortunately, no research has been conducted to determine that whether iron deficiency anemia in adults can also affect VEP indexes and be effective as a confounding factor. The purpose of this study was evaluating VEP findings in adults with iron deficiency and iron deficiency anemia.

Materials and Methods

The study has been conducted in cross sectional form, on 99 non-pregnant premenopausal women who had visited to obstetrics and gynecology clinic of Shahid Bahonar Medical School, Kerman. These women had come to clinic for abnormal vaginal bleeding. Complete blood cell (CBC) test accomplished for all the patients and they divided into three groups. Women whose ferritin and hemoglobin levels are less 15 ng/1 and 12 mg/dl

placed in iron deficiency anemia group, women whose ferritin level is less than 15 ng/1 and hemoglobin level is more than 12 mg/dl, placed in iron deficiency group and women whose ferritin and hemoglobin levels are more than 50 ng/1 and 12 mg/dl, chosen as control group [14]. Patients with hemoglobin level less than 8 mg/dl, or had abnormality in other CBC indexes excluded of the study. Past medical history were asked from all patients of three groups and patients who had history in eye strike, blurred vision, and systemic disease like hematologic and infectious disease, excluded of the study. Also, if one was under any drug treatment such as iron supplements, excluded of the study.

Afterwards, systemic, fundoscopy and pupil examination performed for all the patients and in case of abnormal examination, excluded and finally 33 patients in each group, intended for visual excited potential. The sample size in this study was calculated based on α=5% and β=10% with 90% potency. The reason for selecting target population from women visiting gynecology clinic was the fact that all three groups can be found by similarity moreover, distinct anemia factors (due to abnormal vaginal bleeding) and the possibility of confounding factor existence was minimum. The presence of these patients in the study was with consent and ethics committee of Kerman University approved this study.

VEP performed by Dantec, made in Denmark, using standard rout in method in neurology department of Shafa hospital in Kerman. To do this, patient sat in a dark side room in front of a monitor with 50 cm distance with one of her eyes covered. According to the international regulation 20-10, electrodes attached on fz, oz points and patient looked at the center of the monitor with the opened eye. Visual excited potential repeated twice for each eye separately to ensure of its reliability. Patients, whose wave latency difference in both eyes was more than 6 milliseconds, excluded of the study. Then, the values of N75, P100 and N135 waves delay determined and evaluated by ANOVA test. $p \leq 0.05$ in this study considered as significant.

Results

Mean age of control group, anemia group and iron deficiency group was 33.1±8.70, 32.1±9.88 and 31.5±9.21 years respectively. There is no significant difference between the age of anemia and iron deficiency groups with the age of control group. Also, no significant relationship was observed in N75, P100 and N135 latency in anemia and iron deficiency groups compared to control (Tables 1 and 2).

Table 1. Mean for VEP waves latency in patient with iron deficiency and control group

Wave	Control	Iron deficiency	*p*-Value
N75	67.19±6.79	66.27±7.77	0.842
P100	100.67±7.34	102.75±7.91	0.512
N135	141.51±11.09	144.81±10.73	0.460

Table 2. Mean for VEP waves latency in anemic patients and control group

Wave	Control	Anemia	*p*-Value
N75	67.19±6.79	65.24±5.06	0.385
P100	100.67±7.34	101.60±9.05	0.870
N135	141.51±11.09	139.18±31.21	0.976

Discussion

Our study evaluated the effect of iron deficiency anemia and iron deficiency on VEP. Our findings show that visual evoked potential waves in adults with iron deficiency and iron deficiency anemia had no difference with normal adults. We don't find any similar research on adults, in reliable medical sites such as Pubmed, to compare our results with them, but researches on children show inconsistent results, compared to our findings. In a study on 20 infants with iron deficiency anemia, Sarici et al. showed that such anemia accompanied by VEP variations and these variations may represent subclinical brain disorders and therefore, VEP variations can help to evaluate malnutrition problems in children [7]. It also observed that these variations disappeared after treatment of anemia that represents the fact that if anemia modify timely, at least part of brain abnormalities can be reversible. Algarin et al. in Chile showed that in anemic children under 4 years old, P100 latency abnormality is significantly frequent and this finding represents VEP disorders in anemic children [9]. Also, in a case control study on 25 anemic infants between 6 to 24 months, Monga et al. observed that latency of N75, P100 and N135 is significantly more than control group [8]. There are a variety of explanations for VEP abnormalities in anemic children which mainly associated with iron role in central nervous system [8].

Various studies show that many metabolic and neuronal functions such as neurotransmitters synthesis, reabsorption and function, mitochondrial function, protein production, oxidation-reduction and electron transfer depend on iron [4-15]. Also, the main cells in myelin production are oligodendrocytes which need sufficient iron to have normal function [15, 16]. Fetal and infancy are periods of rapid brain growth and development in most mammals, including humans [13]. Iron is a necessary nutrient for rapidly proliferating or differentiating tissues [17] and it seems that shortage of iron leads to disruption of the above brain activities and this disruption demonstrates with VEP abnormality in visual pathway [8, 18]. Considering the fact that myelination of visual system in human is not complete until the age of 5-6, it seems that defect of this process in iron deficiency flow is the main mechanism of VEP changes in children [6, 11, 19].

The process which completed in adults and may be one of the causes for the absence of VEP disruption observed in this study. Surely, it can't explain the different results between our study on adults and studies on children, because study on auditory excited potential in anemic children show completely inconsistent results [9, 20, 21].

Also, some articles point to the role of anemic hypoxia in detected neurophysiologic methods abnormality [8]. Lack of evaluating wave's amplitude in researched groups was one of our study limitations. However, waves latency are valuable in clinical works but, assessing the waves amplitude can also help to approve the results and should be considered in future studies. Sex factor may also affect the results which should evaluate by other researches. Generally, the results of this study show that iron deficiency and iron anemia don't make any disruptions in waves of VEP and are not considered as confounding factors of visual evoked potential performance in adults.

Acknowledgements

Authors thank the Neuroscience Research Center of Kerman for supporting this project.

Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

Funding/Support

Kerman University of Medical Sciences.

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Please cite this article as: Hamzei-Moghaddam A, Ebrahimi H, Heydari M, Iranmanesh F. Effects of iron deficiency and iron deficiency anemia on visual evoked potential in women. Zahedan J Res Med Sci (ZJRMS) 2014; 16(6): 30-32