

Visual transmission in iron deficiency anemia

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Abstract

Background: Iron deficiency (ID) anemia is a worldwide health problem and is the most common nutritional deficiency. Impulse transmission in the visual pathway might be affected by ID.

Objective: To determine whether ID affects visual transmission in adults.

Materials and Methods: A total of 34 female subjects from low socioeconomic group were selected. All were aged between 20 and 35. Hematological parameters such as Hb, MCV, MCHC, and peripheral smear study, as well as biochemical analysis of serum ferritin were measured. Visual evoked potentials were performed by checker board-reversal stimuli system.

Result: Hematological parameters and ferritin levels were significantly lower in anemic group with a *P* value of <0.0001. P100-latency of (P100-L) ID anemic group was slightly prolonged, but it was statistically insignificant.

Conclusion: In the present study, visual transmission was slightly prolonged in ID adult females, but it was statistically insignificant. ID has discrete effects on visual system between children and adults. Further studies can also be carried out in ID of different age group, before and after treatment with fortified food.

KEY WORDS: Iron deficiency anemia, serum ferritin, visual evoked potential, P100-latency

Introduction

Iron deficiency (ID) is a worldwide health problem and is the most common nutritional deficiency.^[1,2] Iron plays a key role in the central nervous system (CNS) functions such as myelination; synaptogenesis; and synthesis of neurotransmitters such as dopamine, catecholamine, serotonin, and possibly GABA.^[2-4] Impulse transmission in the visual pathway might be affected by ID.^[5] Visual evoked potentials (VEPs) provide non-invasive measures of transmission in the visual system.^[6] It consists of a set of sequential waveforms designated according to their polarity and latency. P100 is the dominant wave and usually seen in all normal subjects.^[6] Evoked potential studies in ID anemia are limited to children. Therefore, to analyze whether ID in adults can also affect visual transmission,

this study was conducted to determine the effect of ID on sensory transmission in the visual pathway.

Materials and Methods

Thirty-four female subjects from low socioeconomic group were selected. All were aged between 20 and 35. The study was conducted at physiology research laboratory, Thanjavur Medical College, Thanjavur, from April 2014 to May 2015. A detailed history and thorough clinical and ophthalmic examination was done to rule out any other medical problem besides anemia. Subjects with a history of acute hemorrhage, malignancies, those on immunosuppressant drugs, chemotherapy, radiotherapy, women during menstruation, amblyopia, corneal opacity, squint and color blindness, history of ophthalmic surgery, ptosis, glaucoma, retinal pathology, those on myotic or mydriatics, neuromuscular disorder, or other diseases that might affect visual acuity were excluded. Informed written consent was obtained from all the participants and experimental protocol was approved by the college ethical committee.

Hematological parameters such as Hb, MCV, MCHC, and peripheral smear study as well as biochemical analysis of serum ferritin were done to evaluate the iron deficient anemic

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status of the subjects. Serum ferritin was done by chemiluminescent immuno assay (CLIA) method. On the basis of their Hb content, they were divided into control group ($n = 17$, Hb > 12 g%) and an anemic group ($n = 17$, Hb < 12 g%) for the case control study.

VEP was recorded with 4-channel Digital Polygraph (Digital color monitor 17-inch model-no: IT-173SB).

VEP—Experimental design and recording:

VEPs were performed by checkerboard pattern reversal displayed on a TV monitor at a viewing distance of 90 cm. The stimuli reversal rate was 2 per second. Electrode scalp placement and recording parameters were carried out according to the standard of the International Society for Clinical Electrophysiology of Vision (ISCEV).^[7]

The subjects were informed about the procedure and got informed consent. Pretest instructions such as avoidance of hair spray or oil after last hair wash and avoidance of miotic or mydriatics 12 h before the test were provided. The room parameters were maintained throughout the experiment.^[8] Standard disc EEG electrodes were placed at the Oz position (active electrode) and reference electrode was placed at Fpz position and ground electrode on the patient's vertex (Cz).^[7] The subject was instructed to fix his gaze at the center of the screen. The latency of P₁₀₀ was measured.

Statistical Analysis

Hematological parameters, serum ferritin and P100-L between control and anemia were analyzed by unpaired student's t-test. Graph pad statistical software was used for data analysis.

Results

The mean age for the control and anemic group was 25.65 and 24, respectively. There was no significant difference in age between control and anemia. Hematological parameters and ferritin levels were significantly lower in anemic group than the control with $P < 0.0001$ (Table-1). Peripheral smear study of anemia showed microcytes with central pallor greater than 50% (hypochromic). In control group, cells of normal size and Hb content were seen.

There was slight prolongation of P100-L in ID anemia, but no significant relation was found between P100-L of ID anemia as compared to control ($P = 0.2366$).

Discussion

Evidences suggest that neurodegeneration is associated with dysregulated CNS iron homeostasis.^[9] It requires proper regulatory mechanism to meet the demands of cells as well as prevent excess accumulation.^[9,10] Monga et al.^[11] studied the effect of ID anemia on flash VEP of growing children and found that in both eyes latencies of N1, P1, and N2 waves were prolonged in the anemic group compared with the control group. Alagrin et al.^[5] observed longer latency for P100 wave in ID anemia in children.

In this study, no significant difference was found in P100-L between anemia and control. The present study is consistent with Hamzei-Moghaddam et al. They found that there was no significant relationship in N75, P100, and N135 latency in anemia and ID when compared with control in women.^[12]

Sarici et al.^[13] studied the effect of iron supplementation on flash VEP in infants with ID anemia and found that after iron therapy VEP N2 latencies decreased significantly compared to pretreatment values. Singh et al.^[14] studied the effect of improvement in anemia on event-related potentials (ERPs)-P300; in chronic kidney disease after administration of recombinant human erythropoietin (rhuEPO). ERPs showed a significant reduction in P300-latency and increase in amplitude after administration of EPO.^[14]

Andersson et al. compared the iron status and VEP of women before and after iron therapy. They found that daily consumption of fortification iron improved the iron status and VEP wave form pattern and suggested correction of ID in young women may partially restore impaired myelination of the visual pathway.^[15]

In the present study, we sought to investigate the effect of ID on visual transmission and found that there was slight prolongation of P100-L in ID anemia, but no statistically significant relation between VEP-L of anemia in adult females as compared to control. ID has different effects on visual transmission between children and adults.^[11,13] Longer P100-L in anemic children could be because of incomplete myelination of visual system. This study has got limitations. Anemia of different age groups were not included. Further study can also be carried out in ID of different age groups after treatment with fortified food, so that with the help of these advances in electrophysiological techniques, VEP changes before and after nutritional rehabilitation can be evaluated.

Table1: Age, hematological parameters and serum ferritin of control and anemia

Parameters	Control (n = 17) Mean \pm SD	Anemia (n = 17) Mean \pm SD	P
Age (year)	25.65 \pm 4.97	24 \pm 7.29	0.4472
Hb (g/dL)	13.576 \pm 0.873	8.471 \pm 1.225	<0.0001
MCV (fL)	92.6941 \pm 2.5621	73.5376 \pm 8.2357	<0.0001
MCHC (%)	33.518 \pm 2.101	25.841 \pm 3.273	<0.0001
Serum ferritin (ng/mL)	82.529 \pm 48.270	8.388 \pm 6.930	<0.0001

Conclusion

In the present study visual transmission was slightly prolonged in ID adult females, but it was statistically insignificant. ID has discrete effects on visual system between children and adults. Further studies can also be carried out in ID of different age group, before and after treatment with fortified food.

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