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RESEARCH ARTICLE

Evaluation of Vestibular Evoked Myogenic Potentials Test in Vitamin B12 Deficiency

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Abstract

Objective: The aim of this study is to evaluate the possible cervical-vestibular-evoked myogenic potential (C-VEMP) abnormalities in patients with vitamin B12 deficiency.

Material and method: 35 people with vitamin B12 deficiency (16 female, 19 male), 35 people with a normal B12 level who has no hearing or balance problems (18 female, 17 men) participated in the study. Using the 500 Hz stimulus ToneBurst of the patients participated in the study, P1 and N1 wave latencies and amplitudes were evaluated.

Results: No statistically significant difference was found between P1 and N1 wave latencies and amplitudes at the 500 Hz and 100 dBnHL intensity level of the participants ($p < 0.05$).

Conclusion: Although Vitamin B12 deficiency affected the central nervous system, normal findings were obtained in C-VEMP testing. In vitamin B12 deficiency, the saccular, inferior vestibular nerve, lateral vestibular nucleus and medial vestibular pathway are not affected.

Keywords

Vitamin B12, C-VEMP, Vestibular system

Introduction

In vitamin B12 deficiency, the function of nerve cells can be disrupted. Vitamin B12 is responsible for balancing neural activity. B12 is an essential cofactor for the methylation of proteins of myelin and cells membrane. In vitamin B12 deficiency; related to demyelization, axonal degeneration and death of neurons, neurological problems emerge [1-4].

Lately, vitamin B12 deficiency triggered hyperhomocysteinemia has been shown to be significantly associated with neurodegenerative diseases, cognitive impairments, auditory dysfunction, and neuropsychiatric symptoms [5].

Vitamin B12 deficiency has been shown to affect the peripheral vestibular system in some studies [6,7]. The studies on which both peripheral and the central system are not be found in the literature.

One of the electrophysiological measurement method C-VEMP saccule is the short latency electromyogram record with electrodes of the sternocleidomastoid (SCM) contracted high intensity click and Tone Burst stimulus through medial vestibular, inferior vestibular nerve, lateral vestibular nuclei's [8,9]. The purpose of this study is to evaluate the functions of the medialvestibular, inferiorvestibular nerve, lateralvestibular nucleus path on adults with vitamin B12 deficiency.

Materials and Methods

This study was conducted in the Audiology and Speech Disorders clinic of Turgut Özal University Medical Faculty Hospital. Ethical approval was obtained with the decision of TurgutÖzal University Non-Pharmaceutical Clinical Research Ethics Committee dated 26/09/2014 and numbered 99950669/289. "Volunteer Consent Form" was signed to individuals who participated in the study. 35 people with vitamin

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B12 deficiency (16 female, 19 male), 35 people with a normal B12 level who has no hearing or balance problems (18 female, 17 men) participated in the study. The ages of the control group are between 18-42 and an average of 28 ± 9.8.

Using the 500 Hz stimulus Tone Burst of the patients participated in the study, P1 and N1 wave latencies and amplitudes were evaluated. In the audiological examination that was performed, all the participants had pure tone average (PTA) in the normal range and had ipsilateral and contralateral acoustic reflexes bilaterally with Type A tympanogram. Those with the Vitamin B12 level less than 220 pg/ml were included in the study. Vitamin B12 deficiency was defined as plasma vitamin B12 < 220 pg/ml (< 148 pmol/L). B12 vitamin plasma values of the patients participating in the study ranged between 155-204 pg/ml, with an average of 173.24 ± 18.66. Those with a vitamin B12 value of 220-940 pg/ml were included in the study normal group. In determining vitamin B12 deficiency, Cobas®c 501 devices were used.

C-VEMP (Interacoustics Eclipse EP25 Assens, Denmark) test was applied on the patients with normal audiological findings In C-VEMP test, Etymotic Research (ER-3A) insert headphones were used. Earth electrode was placed on the forehead while the patient is in a seated position, the reference electrode in the middle of sternocleidomastoid muscle both on right and left. ToneBurst 500 Hz stimuli was used. In C-VEMP test, with stimuli at 500 Hz Tone Burst and 100 dBnHL intensity level P1 and N1 wave latency and amplitude with dual trace level was checked C-VEMP parameters are shown in Table 1.

Statistical Analysis

For statistical analysis SPSS (IBM Corp; Armonk, New York, ABD) software package program for Windows 16.0 is used. In the assessment of the average of the groups Student t and Mann-Whitney U test were carried out. The relationship between age and values of latencies and amplitudes were evaluated by Pearson correlation analysis. P value being less than 0.05 was considered to be significant.

Table 1: C-VEMP parameters.

Analysis Time: 50 msn
Stimulus Intensity Level: 100 dBnHL
Filtering: 33-1500 Hz
Channel Number: 2
Average: 200 sweep
Stimulus Repeating Number (rate): 5.1 pps

Results

35 people with vitamin B12 deficiency (16 female, 19 male), 35 people with a normal B12 level who has no hearing or balance problems (18 female, 17 men) participated in the study. The ages of those with vitamin B12 deficiency ranged from 18-45, the average was 27 ± 8.6. The ages of the control group were between 18-42 and the average of the control group was 28 ± 9.8. In the study, 500 Hz Tone Burst through which C-VEMP threshold was obtained were used. In C-VEMP assessment, in the assessment of the P1 and N1 wave latency and amplitude values, there was no statistically significant difference between the groups ($p > 0.05$). No significant change was observed between both men and women in the control group as well as intra-group vitamin B12 deficiency and intergroup statistical ($p > 0.05$) (Table 2).

Discussion

Vitamin B12 deficiency is silent and under- diagnosed, as its onset and progression are slow and patients may get used to their symptoms. Nevertheless, the clinical consequences of undiagnosed vitamin B12 deficiency may be serious, including wide range of neurological and mood disorders [10]. Recently, nutritional status has become an increasingly popular research issue in the etiology of hearing loss. According to the National Health and Nutrition Examination Survey (NHANES) data, the prevalence of B12 vitamin deficiency is reported as 2.9%, 10.6%, or 25.7% based on B12 cutoff values of < 148, < 200, and < 256 pmol/L, respectively [11,12]. Vitamin B12 deficiency results in 3 main potential complications: These are hematological effects (macrocytosis, hyper-segmentation of neutrophils, anemia, leukopenia and thrombocytopenia, and megaloblastic changes in bone marrow), demyelinating disorder of the central nervous system and gastric neoplastic lesions. In addition, due to vitamin B12 deficiency, ataxia and Romberg test positive are also seen. This

Table 2: Latency and amplitude values of the groups.

	Control Group		**Vitamin B 12 Deficiency**		**P value**
	Right	Left	Right	Left	
P1 Latency	13.35 ± 2.5 msn	13.42 ± 1.8 msn	13.48 ± 2.2 msn	13.56 ± 2.7 msn	$p > 0.05$
N1 Latency	23.32 ± 2.1 msn	24.86 ± 2.7 msn	23.18 ± 1.6 msn	24.18 ± 1.7 msn	$P > 0.05$
P1 Amp	50.48 ± 25.01 µV	52.26 ± 26.04 µV	53.87 ± 23.58 µV	48.78 ± 27.36 µV	$p > 0.05$
N1 Amp	68.56 ± 44.65 µV	65.23 ± 42.06 µV	65.54 ± 41.25 µV	62.35 ± 48.01 µV	$p > 0.05$

Amp: Amplitude.

situation suggests the pathology of the vestibular system. In this case, pathological results can be observed in the VEMP test [10]. Symptoms and signs of vitamin B12 deficiency are vague and very often unrecognized. Prompt diagnosis and treatment are required before neuropsychological symptoms become irreversible or permanent. Vitamin B12 deficiency-induced hyperhomocysteinemia has been associated with impaired microarterial flow, demyelization, and neuronal damage, resulting in cochlear damage and auditory dysfunction. Vitamin B12 is an essential cofactor for the methylation of proteins of myelin and cells membrane and in balancing neuronal activity. In vitamin B12 deficiency; related to demyelization, axonal degeneration and death of neurons, neurological problems emerge [4,13,14]. In addition to the well-known hematological and neurological effects of Vitamin B12 deficiency, it is also considered to be the reason for such diseases like DNA damage, coronary artery disease, Alzheimer, Myelodysplastic syndromes (MDS), neural tube defects, spina bifida and hypertension [15,16].

There is one article published study available that evaluated the vestibular functions via VEMP method in patients with B12 deficiency. In this study, VEMP response could not be obtained in 12 cases with vitamin B12 deficiency. Whereas, Vestibular Evoked Myogenic Potentials (VEMPs) response was not observed in 6 people in the control group. In addition, normal latencies were obtained in the group with vitamin B12 deficiency, while a decrease in amplitudes was reported.In our study, no statistically significant difference was found between the VEMP responses (latency and amplitude) of the control group with vitamin B12 deficiency. There is a difference between the results of our study and the results of the study conducted by Özdemir, et al. (2019). This situation was attributed to the high average age of the individuals participating in the study of Özdemir, et al. The study of Özdemir, et al. (2019), the mean age of total participants was 46.75 ± 14.88 (range: 20-79) years [17]. VEMP is not stable in elderly patients due to weak muscle strength. In addition, higher severity levels of stimulus are required to receive VEMP responses with advancing age [18].

Schneck, et al. (1997) revealed that 24 patients with vitamin B12 deficiency had physical, mental and motor retardation; after the treatment 16 cases had a complete recovery, 6 cases had no neurological improvement physical development due to late diagnostic despite normal physical improvement [19]. In the study conducted in Şanlıurfa (city of Turkey) on the children between the ages 6-12 by Demir, et al. (2013) vitamin B12 deficiency caused retardation in mental and engine development and they reported that there is no full recovery with treatment if diagnosed late [16]. In these 2 studies, it was emphasized that neurological effects may occur. In our study, VEMP responses were obtained normally. The normal VEMP responses do not rule out other neurological problems. Therefore, comprehensive evaluations need to be made. Despite the damage caused in the nervous system by Vitamin B12 deficiency, the study on the vestibular system is very little in the literature. In order to assess the vestibular system, the test of Videonystagmography (VNG), caloric test, Video Head Impuls Test (vHIT), ocular, cervical VEMP and bedside testing are required to be conducted. With C-VEMP, asymmetry between latencies and amplitudes and ears are evaluated. Although the evaluation of latency is not as important as amplitudes, it is recommended to evaluate the latencies elongation pathologically [20].

In the central nervous diseases, abnormal VEMP may be obtained. It is more likely the latency prolongation. In multiple sclerosis, basilar migraine and vestibular migraine, abnormal VEMP responses were seen [21-23]. Different warning and recording system can help in determining the location of the lesion when evaluated together. For example; when it is used in conjunction with the VEMP and caloric test in cerebellopontine angle tumors, it may be useful in the differential diagnosis [24].

In our study, right and left ears with ear asymmetry between P1 and N1 wave latencies and amplitudes are evaluated. According to the findings in VEMP assessment, between latency and amplitude values, there wasn't a significant difference between the groups.

Aydın, et al. (2012) examined the homocysteine, vitamin B12 and folic acid levels of 31 females and 10 males with a complaint of vestibular. In this study, they showed that homocysteine, vitamin B12, folic acid levels of the patients with Meniere's, Benign Paroxysmal Positional Vertigo (BBPV) and vestibular neuronitis were in a normal range [6]. These findings are similar to the work we did. In the study performed by Kohl, et al. (1983), they showed that vitamin B12 levels of the patients with movement disorders at work (motionsickness) were in the normal range and stated that it was not related to the impairment of vitamin B12 disease [7]. In the studies performed by Dieterich and Hain, Vitamin B12 deficiency caused vertigo and indicated that Down Beat (DB) nystagmus, observed in central based pathologies can also be seen in vitamin B12 deficiency [25,26]. In the study conducted by Mayfrank and Thoden (1986), the presence of DB nystagmus could be seen in the vitamin B12 deficiency [27]. BPPV can be seen as a result of falling into the semicircular canals of calcium carbonate crystals where located in macula. Therefore, it may be necessary to test the peripheral vestibular system in vitamin B12 deficiency.

Conclusion

As a conclusion; in our study, it was seen that vitamin B12 deficiency doesn't affect the arc of C-VEMP. To reveal Vitamin B12 deficiency and its effects on the vestibular system, there is a need for studies through

which all vestibular system is evaluated. VEMP results of individuals with both vitamin B12 deficiency and hearing loss are a matter of curiosity. Conducting studies on this subject will contribute to the literature.

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Conflict of Interest

The authors have no conflicts of interest to disclose.

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