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Original Article

Vestibular Assessment using Videonystagmography and Cervical Vestibular Evoked Myogenic Potentials in Normal Hearing Subjects with Tinnitus

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ABSTRACT

BACKGROUND: The internal perception of sound in the absence of external auditory stimulation is what is meant to describe the condition known as tinnitus. Tinnitus is one of three Otoneurologic manifestations, along with sensorineural hearing loss and dizziness, which are frequently the primary individuals' complaint. Tinnitus is the most common of these three symptoms.

AIM: Determination of relationship between vestibular function and tinnitus in normal hearing subjects

METHODS: Thirty subjects complained of tinnitus without hearing loss were included, and were divided into 2 groups, group 1: included 40 tinnitus ear, and group 2; included 20 non tinnitus ear.

RESULTS In terms of pure tone threshold, assessment SRT, WDS%, acoustic reflexes parameters, cervical vestibular evoked myogenic potential (cVEMPs) latencies, and peak amplitude, there was no statistically difference between the tinnitus and non-tinnitus groups. There was a statistically in-significant variation between the amplitude ratio of caloric response and sex, there was also statistically in-significant relation between tinnitus duration and vestibular function (P13 and N23 latency).

CONCLUSIONS: We concluded that; Tinnitus have a link with an aberrant caloric response.

KEYWORDS: Vestibular Function; Tinnitus; Normal Hearing.

INTRODUCTION

The perception of sound in the absence of an external source is one definition of the condition known as tinnitus. It is a pervasive problem that has the potential to interfere with people's life in many ways **[1]**, including their ability to concentrate, sleep, feel emotionally stable, and communicate with other people. Although hearing loss is a major risk factor, many people who have hearing loss do not report having tinnitus **[2]**. The same is true for those who report having unpleasant tinnitus but have audiometrically normal hearing.

There are three primary types of tinnitus: objective tinnitus (caused by external sources), subjective tinnitus (perception of sounds without any physical sound being present), and auditory hallucinations **[3]**, with the commonest one is objective tinnitus.

Tinnitus can be on occasion; the result of something audible occurring elsewhere in the body, such as throbbing blood vessels or tightening cranial muscles. However, this is an extremely rare. on the other hand, objective tinnitus in contrast to subjective tinnitus and auditory hallucinations can be heard by a listener who is not experiencing it. Although aberrant activity of hair cells in the ear may be responsible for some cases of tinnitus, the anatomic location of the physiologic abnormality that causes most cases of severe subjective tinnitus is in the central nervous system (CNS), including the central section of the auditory nerve **[4].**

Patients who have tinnitus may have aberrant vestibular test findings even if they do not have a balance deficit. This is because tinnitus affects the auditory system. Nearly forty percent (40%) of patients who were diagnosed with tinnitus were found to have an impairment in their caloric response, whereas all persons who were in the control group had normal results. An abnormal caloric response was seen in approximately 33.3% of patients who experienced tinnitus in both ears, 58.3% of patients who experienced tinnitus in the left ear, and approximately 20% of patients who experienced tinnitus in the right ear **[5]**.

Our aim was to determine if there was a connection between vestibular function and tinnitus or not.

METHODS

Thirty (30) subjects who reported having tinnitus but no hearing loss. The first group consists of 60 ears, including 40 ears with tinnitus and 20 ears without.

All subjects fulfilled the following criteria: Participants were of either gender, their age ranged from 18 to 50 years old, needed to have normal middle ear function, have no other systemic disorders (e.g., neurological diseases, uncontrolled hypertension, renal failure, and/or liver cell failure) that may impact the equilibrium, no history of brain damage or neurological sickness, no conductive hearing loss that would eliminate VEMPs, and no cervical abnormalities that would limit neck motion and prevent participants from participating in (cVEMPs) recording.

Investigation was carried out at the ORL Department of the Audiology Unit, Zagazig University.

Equipment: Two channel diagnostic audiometer, Madsen, model Orbiter 922, Sound treated room, Immittancemeter, Madsen model "Zodiak 902" and Cervical Vestibular evoked myogenic potential The use of video nystagmus

Methodology:

After a comprehensive history and physical examination, all participants underwent an otological examination, and a fundamental audiological evaluation (including standard pure tone audiometry, speech audiometry, and immittancemetry).

Cervical Vestibular evoked myogenic potential (VEMPs) was recorded as the following: After preparing the skin, the electrodes are inserted, testing the individuals, tweaking the stimulus parameters, evaluating the waveforms, and finding the asymmetry ratio.

Videonystagmography (VNG):

Results of caloric examination, supine posture, right ear down position, and left ear down position, and tests for spontaneous nystagmus, saccade, optokinetic, and gazing were collected.

Ethical approval

Written Informed Consent was obtained from all participants, the study was approved by the Research Ethical Committee of Faculty of Medicine, Zagazig University with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans .

Procedure

Preparation and Calibration (Spontaneous Nystagmus and Oculomotor Tests) Smooth Pursuit, the Saccade Test, Optokinetic Testing, the Positioning Test, Positional Tests, and Caloric Irrigations were used.

Statistical analysis of the data

The data were entered and analyzed with the assistance of the IBM SPSS software package, version 20.0, which was located at the Armonk, New York site of IBM Corporation. The characteristics of the quantitative data that were examined were their minimum and maximum values, as well as their mean, standard deviation, median, and interquartile range (IQR). The results that were obtained were deemed to be statistically significant at the 5% level of significance.

The Chi-square test, Fisher's exact or Monte Carlo correction test, Student t-test, and Mann Whitney test were utilized.

RESULTS

There was no age or gender disparity among those with tinnitus and those without, subjects with tinnitus had significant lower 25-hydroxyvitamin D levels than the controls (table 1). However, there was none statically significance differences as regard pure tone thresholds at different frequencies (table 2), Speech Reception Thresholds (table3) Word Discrimination scores (table 4), and Acoustic Reflexes at different frequencies (table 5) between those with tinnitus and those without.

Table (1): Vitamin D level distribution among study groups

	Group I (<12 ng/ml)	Group II (12-20 ng/ml)	Control (>20 ng/ml)	F	P
Vit D	8.91±1.68# 6-11.3	16.48±2.09 12.1-19.4	25.52±6.40* 20.1-44	113.715	0.00**

* Group significantly higher by LSD (least significant difference test), # Group significantly lower BY LSD

Table (2): Pure Tone Audiogram distribution among studied groups

		Group I	Group II	Control	F	P
250 HZ	**Rt**	11.78±3.65 5-20	13.86±5.96 5-20	13.60±4.21 10-20	1.566	0.216
	Lt	12.14±3.45 10-20	13.86±4.61 5-20	13.8±4.15 10-20	1.522	0.225
500 HZ	**Rt**	13.03±4.25 10-25	13.40±4.11 5-20	14.4±3.90 10-20	0.578	0.564
	Lt	12.67±3.96 5-20	15.0±5.0 5-20	13.6±3.39 10-20	1.843	0.166
1000 Hz	**Rt**	11.96±3.68 5-20	12.72±4.11 5-20	13.6±4.21 10-20	1.079	0.345
	Lt	11.42±3.87 5-20	12.95±4.22 5-20	13.7±3.53 10-20	2.765	0.095
2000 Hz	**Rt**	12.67±3.46 10-20	14.31±4.16 10-20	13.0±3.53 10-20	1.303	0.278
	Lt	12.32±4.11 5-25	15.45±5.09 5-25	14.80±4.44 10-20	3.091	0.052
4000 Hz	**Rt**	12.32±4.4 5-20	13.40±4.36 5-20	14.40±3.0 10-20	1.704	0.189
	Lt	12.17±3.25 5-25	14.31±4.55 5-25	13.60±4.21 5-25	2.199	0.125
8000 Hz	**Rt**	13.03±3.42 10-20	13.86±4.34 10-20	15.20±4.44 10-20	1.893	0.158
	Lt	12.50±4.25 5-30	15.22±5.66 5-30	15.0±3.53 10-20	2.333	0.104

Table (3): SRT distribution among studied groups

	Group I	Group II	Control	F	P
Rt SRT	11.60±3.54 5-20	13.86±4.34 10-20	13.0±3.53 10-20	1.963	0.148
Lt SRT	12.85±4.36 5-25	13.63±4.23 5-20	13.80±3.89 10-20	0.325	0.724

Table (4): WDS distribution among studied groups

	Group I	Group II	Control	F	P
Rt WDS	96.28±3.91 88-100	97.63±3.18 92-100	96.96±3.70 92-100	0.851	0.431
Lt WDS	95.71±4.47 88-100	97.45±2.63 92-100	96.64±2.98 92-100	1.508	0.228

Table (5): Acoustic Reflexes distribution among studied groups

		Group I	Group II	Control	F	P
500 Hz	**Rt**	88.57±3.56 85-95	88.63±3.83 85-95	88.60±3.68 85-95	0.002	0.998
	Lt	88.57±4.04 85-95	87.72±3.35 85-95	88.20±3.78 85-95	0.309	0.735
1000 Hz	**Rt**	88.74±5.21 85-95	87.98±4.56 85-95	88.36±4.21 85-95	0.444	0.643
	Lt	89.64±3.58 85-95	88.63±3.15 85-95	88.63±3.43 85-95	0.535	0.588
2000 Hz	**Rt**	90.17±3.46 85-95	88.86±3.42 85-95	89.60±3.51 85-95	0.885	0.417
	Lt	88.75±3.22 85-95	87.95±3.67 85-95	88.40±3.45 85-95	0.330	0.720
4000 Hz	**Rt**	90.35±3.31 85-95	89.54±3.05 85-95	90.0±3.22 85-95	0.394	0.676
	Lt	91.78±4.55 85-100	90.45±4.05 85-100	91.20±4.39 85-100	0.574	0.566

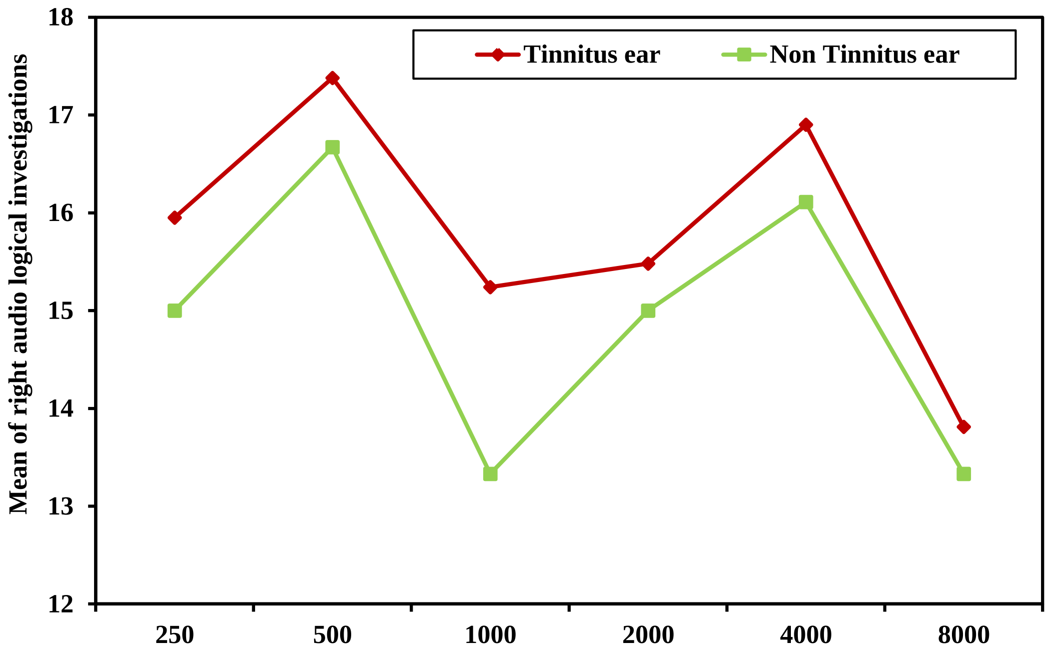

Figure (1): A comparison between the ear that has tinnitus and the ear that does not have tinnitus based on correct audiological studies.

DISCUSSION

Tinnitus is associated with a large morbidity and is known to disturb individuals' sleep, concentration, emotional control, and social life **[6].** Tinnitus has a high prevalence rate and is linked to severe morbidity.

Together with the vestibular system and the ocular system, the auditory vestibular system contributes to the maintenance of equilibrium in the body. Both the vestibular end organs and the cochlea rely on mechano-electric transduction to be carried out, which is something they have in common because of their evolutionary history **[7].**

A total of 30 patients, including 12 men and 18 women, ranging in age from 18 to 47 years old

The control group consisted of thirty adults who were found to be in good health. In patients diagnosed with bilateral tinnitus **[8],** symptoms occurred in both ears 46.7% of the time.

Electromyographic responses known as vestibular evoked myogenic potentials (VEMPs) are produced whenever the vestibular labyrinth is stimulated in any way; by sound, vibration, or electricity **[9].**

The current investigation found that there was no statistically significant difference between the P13 and the N23 in terms of cVEMP delay when comparing the ear with tinnitus to the ear without. Similar results founded by **Thirunavukkarasu and Ramsankar** who also divided their participants into two groups: one with normal hearing and experienced tinnitus, and the second group with normal hearing and no tinnitus.

We compared the responses of the cervical and ocular vestibular evoked myogenic potential (cVEMP) and the evoked myogenic potential (oVEMP) between group with tinnitus and the control group (without tinnitus), as well as between the right and left ear of the tinnitus group. Apart from the n23 latency of individuals with bilateral tinnitus; no statistically significant differences in cVEMP measures were found between the tinnitus group (normally hearing individuals with tinnitus) and the control group (normally hearing individuals without tinnitus) [**10].**

There was no difference in P1N1 amplitude between the ears that had tinnitus and those that did not have tinnitus when comparing the right and left ears.

Admis et al. [11] found no variations in P1-N1 amplitude between the patients and the control group. While **Weshahy et al.** conducted a study on fifty patients with unilateral tinnitus and twenty-five healthy volunteers and found a substantial differences between control ears and tinnitus ears **[12].**

We did not find any statistically significant gender differences in either the amplitude ratio or the caloric response. In addition, there was no association established between vestibular function (delay in P13 and N23) and the continued presence of tinnitus in the participants that was like that found by **Ila et al.,** who divided tinnitus sufferers into two groups: those whose symptoms had been present for less than six months and those whose had been there for longer. There were seventeen people (53.1% of the total) who suffered from acute tinnitus, and fifteen people (46.9%) suffered from chronic tinnitus, both patients suffering from acute as well as chronic tinnitus exhibited the same aberrant caloric response (p>.05), and there were no statistically significant differences between the acute and chronic tinnitus groups as regard: saccade accuracy and latency; smooth pursuit gains; asymmetry; and optokinetic gain (p>.05) **[13]**.

CONCLUSION

A significant connection among tinnitus and an aberrant caloric response was found.

Conflict of interest statement: The authors declared that there were no conflicts of interest.

Disclosure: The authors have no financial interest to declare in relation to the content of this article.

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