Vestibular Evoked Myogenic Potentials (VEMP) in Conductive Hearing Loss

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Abstract

Background: Conductive hearing loss is one of the commonest diseases that result from a multitude of causes. VEMP is one of the tools used to test the vestibular system. Sound elicited VEMP require an intact conductive system. To overcome the conductive element, stimulation could be performed by bone conduction.

Aim: This study tries to clarify the effect of bone conduction stimulation on VEMP response.

Method: Twenty patients with chronic suppurative otitis media and conductive hearing loss were examined as well as 10 healthy individuals as a control group. All of them had pure tone audiometry for air conduction and bone conduction as well as VEMP by air conduction and bone conduction.

Results: It was found that 75% had VEMP to bone conduction stimulation while 25% had VEMP to air conduction stimulation.

Conclusion: VEMP can be used to test the presence of a conductive hearing loss as bone conduction VEMP can be elicited with higher degree of accuracy.

Key Words: Vestibular – VEMP – Conductive hearing loss.

Introduction

CONDUCTIVE hearing loss (CHL) is one of the commonest ear diseases. It can result from multiple causes in the external canal, in the tympanic membrane and in the middle ear. Chronic suppurrative otitis media (CSOM) with tympanic membrane perforation is the one of the commonest infective conditions. It accounts for almost 19.5% of ear conditions [1].

The general rule of thumb in hearing and VEMP is that conductive hearing loss obliterate VEMP. VEMP recording method clinical practice requires using loud sound stimulation. Sound transmitted VEMP require conduction of sound to the inner ear which means that an intact middle ear transmission system is needed [2].

Air conducted (AC) stimulating sounds, transmitted through the middle ear conduction system fail to elicit VEMP in those with conductive hearing loss [3].

To overcome this attenuation of stimulation, taping of the skull and bone conduction (BC) stimulation have been proposed as possible solutions to elicit VEMP in CHL. Bone conduction tone burst stimulation can evoke VEMP using frequencies around 500 Hertz (HZ). Clinical bone vibration generally requires additional amplification to produce strong enough stimuli for VEMP testing [4].

The aim of this study was to investigate the VEMP responses in conductive hearing loss using bone conduction stimulation.

Material and Methods

Twenty patients with CSOM and perforated tympanic membrane (twenty ears) were examined. The criteria for inclusion in the study included: Visualization of perforated tympanic membrane by otoscopy, age between twenty and forty years, consent of the patient to participate in the study and negative history of trauma to the ear and ototoxic drug intake.

All the patients had pure tone audiometry testing (PTA) to both AC and BC. VEMP, evaluation by AC and BC was performed in the same sitting.

Ten healthy subjects were chosen from those accompanying their relatives to the audiology clinic.
were used as control group after their consent and were subjected to the same testing protocol as the study group.

AC and BC were tested on an audiometer Quasar model Audi-master. AC and BC were tested by descending method for frequencies 250 to 8000Hz for AC and 500 to 4000Hz for BC. Air-bone gap (ABG) was noted for each frequency.

VEMP recording was done using Vivo sonic instrument model integrity v500. Surface electrodes were used to record the muscle activity. Active electrode was placed on the middle third of the sternocleidomastoid muscle with a reference electrode on the supra-sternal notch. The contra lateral sternocleidomastoid was used as ground. During recording, the subject was instructed to raise his head and tilt it throughout the test to ensure good muscle tone. The filter setting used was 30Hz and 3000Hz.

Short tone burst were uses as stimulus for both AC and BC recording. Intensity used was 95DB HL for AC and 75DB HL for BC (ramp 1 ms; plateau 2ms). AC stimulation was delivered an insertion type air phone while BC stimulation was done.

Through a bone vibrator radio ear B 71 placed on the mastoid tip. Stimulus repetition rate was 7Hz and analysis time was 30msec. The accepted number of responses was 250.

Results

The response percentage of present VEMP waves by AC stimulation was 20% (4 ears). For BC stimulation, the rate increased to 75% (15 ears). A significant difference existed in the response rate between AC and BC VEMP waves (p<0.05) the findings are presented in Table (1).

The difference in latency between the study group and the control group in AC VEMPs is shown in Table (2).

The difference in latency between the study group and the control group in BC VEMPs is shown in Table (3).

Comparing AC and BC VEMP waves versus PTA:

If comparing the presence of VEMP waves to threshold of both AC and BC, it was found that for average AC threshold less than 30 dBHL VEMP waves for both AC and BC were present.

In average AC threshold more than 30 dBHL and average BC threshold less than 30 dBHL, VEMP waves were absent for AC stimulation and BC.

In all cases in the study group, VEMP waves were present for both AC and BC stimulation.

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<tr>
<td>BC VEMP</td>
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<th>n23 mean &amp; SD</th>
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<td>Control group AC VEMPs</td>
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<td>NS = No Significant difference.</td>
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Discussion

VEMP waves recording has increasingly being used in evaluating the inner ear. By using conventional AC stimulation method, VEMP waves can easily be elicited in ears with normal hearing and sensorineural hearing loss, but fail to be elicited in ears with conductive hearing loss [5].

The present study slightly disagree with these findings as recording of VEMP waves was done in some patients with conductive hearing loss and average AC threshold less than 30 dBHL (25%).

The present study found good percentage of recordable VEMP waves (75%) by BC stimulation in conductive hearing loss with no significant difference in latency from healthy ears in the study group (Table 2).

This finding is in accordance with the study of Yang and Yong, who found no significant difference in their study on otosclerosis [8]. The explanation to these findings is that conductive hearing loss interfere with the transmission of sound through the inner ear for AC stimulation, while for BC stimulation, this attenuation is not present [6]. BC VEMP waves seem to have the same origin as AC VEMP waves, mainly the saccule, as they have similar wave character [7]. Thus if the attenuation element of the middle ear is removed, it is possible to record the waves.
Comparison of AC and BC VEMP waves with the hearing threshold for both AC and BC reveals that for patients with average AC threshold less than 30 dBHL, VEMP threshold to be around 85 dBHL.

For patients with average AC threshold more than 30 dBHL, AC VEMP waves recording was absent but BC VEMP waves recording can be evoked.

This denotes that threshold for BC VEMP waves is much lower than threshold for AC VEMP waves.

This finding is in agreement with the work of Welgampola et al., 2003, who found that their BC VEMP waves threshold was approximately 30 dBHL [7].

For patients with average BC threshold more than 30 dBHL, no VEMP waves were recorded.

The only explanation that the 40 dBHL remaining for BC stimulation, after removing the 30 dBHL for conductive hearing loss do not leave enough energy for eliciting VEMP waves.

This conclusion was deduced from the work of Akin and Munane, who stated that VEMP threshold, was around 85 dBHL [8].

Conclusion:

- VEMP can be used to test for the presence of conductive hearing loss in difficult to test patients.
- BC stimulation can be used to evoke VEMP waves with a high degree of accuracy when conductive hearing loss is present.
- All cases with absent VEMP waves for AC stimulation should have a trial to elicit VEMP waves by BC stimulation.

References