The Effect of Various Modes of Excitation of Sterno-Cleido Mastoid Muscle on Vestibular Evoked Myogenic Potentials (VEMP)

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Abstract

The Vestibular Evoked Myogenic Potential (VEMP) is an inhibitory potential recorded from the Sternocleidomastoid muscle (SCM) in response to loud sounds. VEMPs are short latency Electromyograms (EMG) that are evoked by higher-level acoustic stimuli and are recorded from surface electrodes over the tonically contracted SCM muscle. VEMP testing is considered to be easy, but there are a lot of technical pitfalls such as, operator pitfalls, assuring neck muscle activation, electrical artifact, mode of neck muscle activation, sound stimulus, electrode layout etc., Research in the area of VEMP have addressed the issues of subject variables and test parameters, but literature does not provide any suggestion to the clinicians about which method/mode of excitation of sternocleidomastoid muscle should be employed. So, as *patient comfort and reliability of mode of excitation of sternocliedo mastoid are also the factors to be considered while testing, there is a need to study the effect of mode of excitation of SCM muscle on VEMP response. 25 normal male and 25 normal female subjects were tested for VEMP in three different body positions namely; Subject's body rotated to one side for measurement of VEMP on the opposite side in sitting position, Subject's body rotated to one side for measurement of VEMP on the opposite side while lying in supine position, subject pressing the Forehead against a soft surface. VEMP measures amplitude of P13-N23, latencies of P13, N23, response rate and wave morphology were analyzed along with the subjective rating on patient comfort in the three positions for all the subjects. Irrespective of gender VEMP measures such as latencies of P13, N23, amplitude of p13-n23, response rate and wave morphology were not affected by body position that is used to excite the sternocleidomastoid muscle during VEMP testing. But, the rating of comfortness was more to second position in males and to third position in females.*

Introduction

The Vestibular Evoked Myogenic Potential (VEMP) is an inhibitory potential recorded from the Sternocleidomastoid muscle (SCM) in response to loud sounds.

VEMPs are short latency Electromyograms (EMG) that are evoked by higher-level acoustic stimuli and are recorded from surface electrodes over the tonically contracted SCM muscle. The neurophysiologic and clinical data indicate that the VEMPs are mediated by a pathway that includes the saccular macula, inferior vestibular nerve, the lateral vestibular nucleus, the lateral vestibulospinal tract, and the motor neurons of the ipsilateral SCM muscle (Halmagyi & Curthoys, 2000).

VEMP testing is a new diagnostic tool for professionals who are dealing with assessment of Vestibular and Auditory disorders. VEMPs were first described by Bickford, Jacobson, and Cody (1964), and recently have been proposed as a reliable clinical test of saccular or inferior vestibular nerve function (Colebatch, 2001).

Normal VEMP responses are characterized by biphasic (positive–negative) waves. In a majority of studies, the peaks and troughs are usually labeled with the mean latency

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in milliseconds preceded by the lowercase letters "p" (for positive) or "n" (for negative), as proposed by Yoshie and Okudaira (1969) to distinguish them from neutrally generated evoked potentials. The first positive–negative complex is often labeled as p13–n23 (Colebatch, Halmagyi & Skuse, 1994). Authors have also reported later serial peaks of VEMP labeled as n34 –p44. The VEMP amplitudes are large and vary from a few micro volts, depending on the muscle tension and the intensity of stimuli. (Cheng & Murofushi, 2001a, 2001b).

There are various tests that can be carried out in vestibular clinic, such as, Electronystagmography (ENG), Rotational chair test, tests for postural control Assessment that majorly focus on assessing vestibulo spinal pathways and VEMP test. Among all these tests, ENG is the most widely used test since long, ENG is not a single test but consists of various sub tests in its battery such as caloric test, Gaze test etc., All the tests mentioned above though address the issue of assessing the same problem i.e. vestibular disorder; each test has its own unique significance and hence cannot be replaced by other test. Thus, the information obtained from VEMP testing is different from the information obtained from the results of ENG tests. ENG assess the Semicircular canals, utricle and superior vestibular nerve where as VEMP assess saccule and inferior vestibular nerve.

Review of Literature

Vestibular evoked myogenic potentials (VEMP) are responses from the otolithic organs i.e. the saccule and the utricle to the high intensity acoustic stimulation. These responses can be acquired from the anterior neck muscles, specifically from the Sternocleidomastoid (SCM) muscles. There is initially biphasic positive-negative response (p13-n23) recorded from the averaged EMG which occurs at short latency and ipsilateral to the stimulated ear (Colebatch, Halmagyi & Skuse, 1994).

VEMP has been used as a clinical tool, which provides additional information about disturbances of vestibular function as a result of their dependence upon different vestibular receptors.

1. Neck muscles via the medial vestibulospinal tract (MVST).
2. The leg muscles via the lateral vestibulospinal tract (LVST). (Colebatch, Halmagyi & Skuse 1994; Murofushi, Halmagyi, Yavor, & Colebatch, 1996; Uchino et al., 1997; Kushiro et al., 2000).

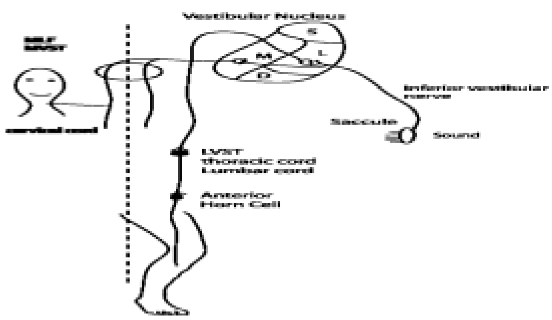


Figure 1. Pathway of Vestibular Evoked Myogenic Potential.

Methods for recording VEMP

VEMPs evoked by bone- conducted stimuli

A bone- conducted tone burst delivered over the mastoid process via a B71 clinical vibrator (radio ear corporation, Philadelphia, PA), routinely used in audiometric testing, evokes VEMPs despite conductive hearing losses. VEMPs are often bilateral as the stimulus is transmitted via bone and activate end organs on both sides. The ipsilateral VEMP is about 1.5 times larger and occurs approximately 1 millisecond earlier. Rarely larger responses have been recorded contra lateral to the stimulated ear (Sheykholeslami, Murofushi, Kermany & Kaga, 2001; Welgampola, Rosengren, Halmagyi & Colebatch, 2003).

VEMPs evoked by galvanic simulation

A short duration (2 millisecond) pulsed current delivered via electrodes attached to the mastoid processes evokes a p13-n23 response on the side ipsilateral to cathodal stimulation. Similar to that evoked by sound stimuli of 4mA/2msec as used for clinical testing are well tolerated by patients. Such a current in close proximately to the recording site causes a large stimulus artifact and specific subtraction techniques are required to recover the response of interest (Watson & Colebatch 1998*)*.

VEMP in Clinical Use

Superior canal dehiscence

Sven-Olrik., Cremer, Carey, Weg, and Minor (2001), have studied VEMP responses in subjects with Superior Canal Dehiscence and found lowered VEMP thresholds in these subjects and concluded that VEMP can be included in the test battery along with symptoms, signs and CT imaging in diagnosis of Superior Canal Dehiscence syndrome.

Vestibular neuritis

Halmagyi, Colebatch and Curthoys (1994) reported in their study that patients who did not have caloric responses on the affected sides indicated dysfunction of the lateral semicircular canal. Results showed VEMPs were normal in 6 patients, reduced in 5 patients and absent in 11 patients. Therefore, results not only suggested that VEMPs were not of lateral canal origin but also revealed different pathologies involved in vestibular neuritis.

Vestibular Schwannoma/Acoustic Neuroma

Itoh, A. (2001), concluded that VEMP test compromises a useful new diagnostic method for identifying lower Brainstem lesions in which ABR is present and VEMP is absent.

Diallo (2006), stated that VEMP can be included in the audio vestibular assessment in diagnosing all sizes of vestibular schwannomas. It was also reported that inter aural latency of VEMP can be a tool to diagnose vestibular schwannomas, (Yang, W., Han, D., & Wu, Z., 2002).

Meniere's disease (Endolymphatic hydrops)

Robertson and Ireland (1995) reported that VEMPs were absent in all 3 of their patients with Meniere's disease (MD). VEMPs in patients with MD showed that 54% of the patients had no VEMPs when clicks were used as stimuli (De waele, Hay, Diard, Freyss, & Vidal, 1999). Shojaku, Takemori, Kobayashi and Watanabe (2001), reported similar results in which 8 out of 15 patients with MD had abnormal VEMP amplitude.

Multiple sclerosis

The latencies of a vestibulo spinal reflex can be prolonged in multiple sclerosis (MS). The VEMP delay could be attributed to demyelination either of primary afferent axons at the root entry zone or secondary vestibulo spinal tract axons rather than to lesion involving vestibular nucleus. Measurement of VEMPs could be helpful in detecting sub clinical vestibulospinal lesions in suspected multiple sclerosis (Shimizu, Murofushi & Sakurai, 2000).

Conductive hearing loss

Interference of sound transmission due to some disorders such as chronic otitis media (COM) may lead to absent VEMPs (Young, Wu & Wu, 2002). Tone stimuli rarely elicit VEMP responses in patients with conductive hearing loss (Halmagyi, Colebatch & Curthoys, 1994).

Gentamycin therapy

DeWaele et al. (2002) found that the VEMPs can be used to monitor the effects of low close intra tympanic gentamycin injections used to achieve chemical labyrinthectomy, a procedure used to control debilitating vertigo in Meniere's disease and other peripheral vestibulopathies.

Auditory Neuropathy

Sheykholeslami, Kaga, Murofushi and Hughes (2000) studied 3 auditory neuropathy patients. These patients also complained of balance disorders. Tests of battery were administered, audiometric tests (pure-tone audiometry and speech discrimination tests), Otoacoustic emissions, auditory-evoked brainstem responses and vestibular function tests (clinical tests of balance, electronystagmography, damped rotation tests and VEMPs). VEMP responses were absent in the affected ear. They concluded that, in patients with isolated auditory neuropathy, the vestibular branch of the 8^{th} cranial nerve and its innervated structures may also be affected.

Reviewing the literature available on VEMP testing shows that a majority of the factors affecting the stimulus and response or parameters have been studied and reported. However, there is scanty literature on the variable of the subjects comfort with respect to the various body positions or postures used to excite the strenocleidomastoid muscle. Hence, present study aimed at fulfilling the above mentioned lacuna in literature related to VEMP testing.

Method

The present study aimed at investigating the effect of various modes of excitation of sternocleidomastoid muscle on vestibular evoked myogenic potentials.

Subjects

50 subjects in the age range of 18 to 25 years were selected for the study. This group consisted of 25 male and 25 female subjects. These were selected on the criteria that subject should be

- having bilateral hearing sensitivity within normal limits PTA<20dBHL
- having no history of conductive hearing loss
- having no history of tinnitus and vertigo
- having no history of neuromuscular problems in body & neck region
- having no history of intake of drugs that may lead to vestibulotoxicity

All the subjects underwent case history and basic hearing evaluation for the purpose of meeting subject selection criteria which included pure tone audiometry and impedance audiometry.

Research Design: ***"within subject design"***

Procedure

Puretone thresholds were obtained using modified Hughson - Westlake procedure (Carhart and Jerger, 1959), across octave frequencies (including interoctave frequencies) from 250 Hz to 8 kHz for air conduction stimuli and from 250 Hz to 4 kHz for bone conduction stimuli. Tympanometry was done to rule out middle ear pathology. 226 Hz was the probe frequency at the intensity level of 85 dBSPL.

All the Subjects selected based on the inclusion criteria were subjected to VEMP testing in left ear using three different modes of excitation of sternocleidomastoid muscle.

Instructions were given to subjects regarding the following body postures required in testing:

A. Subject's body rotated to one side for measurement of VEMP on the opposite side in sitting position
B. Subject's body rotated to one side for measurement of VEMP on the opposite side while lying in supine position
C. Instructing the subject to press the Forehead against a soft surface

VEMP Testing

- As mentioned in the test protocol, VEMPs were recorded for all the subjects by an averaging of the acoustically evoked electromyogram of the sternocleidomastoid muscle. The site of electrode placement was prepared with skin preparation gel. Silver chloride disc electrodes were used with a conducting gel. Absolute electrode impedances were less than 5kohms and inter-electrode impedances were less than 2 Kohms.

- Subjects were instructed about the three body positions and were asked to maintain the same during the test run. While testing VEMP for each subject in all the three positions subjects the tonic EMG level was maintained between 30 – 50 micro volts. A visual feed back was provided to the subject so as to monitor tonic EMG level of sternocleidomastoid muscle.

- A single-channel recording of the evoked potential was obtained with a non-inverting electrode placed at the mid point of sternocleidomastoid muscle, inverting electrode placed on the sternoclavicular junction, and the ground electrode on the forehead.

- VEMPs were obtained from each subjected evoked by 500 Hz tone bursts (rarefaction onset phase, blackman gating function, two cycle rise-fall time with no plateau) presented at 95 dBpeSPL. The stimuli were presented monaurally to the ear ipsilateral to the activated (excited) sternocleidomastoid muscle via ER3A (Etymotic Research) insert earphones at a rate of 3.1Hz.

- Each run of VEMP test consisted of 75 to 250 no. of sweeps, each run lasting for 45sec to 1min of duration. Minimum of required rest period was given to the subject between each run. VEMP test was done in all the three positions and a rest period was given after testing in each position

- Replicability of VEMP wave form was checked by performing VEMP on all clients in all modes by testing at least twice. It was also ensured that VEMP is absent at low intensity level i.e. 65 dBpeSPL by testing all subjects in all the three positions at that level. This indirectly confirmed that the VEMP wave form present at higher intensity levels were indeed reliable.

Test protocol for VEMP Testing

Table -1Stimulus parameters

Transducer	Insert ear phones
Type	Tone burst
Frequency	500 Hz
Duration	2-0-2 cycle Tone burst
Intensity	95 dBpeSPL
Polarity	Rarefaction
Repetition Rate	3.1/sec Tone burst

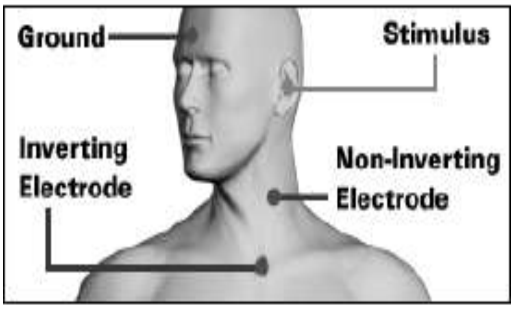


Figure 2. Electrode configuration required for VEMP test

Inverting (-) electrode	Sternoclavicular junction
Non-inverting (+) electrode	Midpoint of Sternocleidomastoid muscle
Ground electrode	Forehead
Stimulator	Side being tested

Table 2. Acquisition parameters for VEMP test

Analysis time	
Pre stimulus	10 to 20ms
Post stimulus	50 to 100ms
Filter Settings	
High pass	1 to 30Hz
Low pass	250 to 1500Hz
Notch	None
Amplification	5000
Sweeps	75 to 250

After VEMP testing each subject was evaluated for patient comfort during VEMP testing in all modes of SCM muscle excitation using 3 point rating scale. The subjects were asked to rate their level of comfort in all positions based on rating scale.

3 point rating scale was used to measure comfort

1 – Intolerable
2 – Tolerable
3 – Comfort

Results and Discussion

The present study aimed at investigating the effect of different body positions on the following parameters of VEMP assessment. Latency of p13, Latency of n13, Amplitude p13-n23, Wave Morphology, Response rate, and Comfort of the patient. The data was subjected to statistical analysis using SPSS software (version.15.0) to test the hypothesis of the study namely: there is no effect of mode of excitation of SCM on VEMP response. The statistical analysis included descriptive statistics, repeated measure analysis of variance and independent samples t-test.

1) The effect of body position on Latency of P_{13}

Repeated measure analysis of variance was carried out to investigate the relationship of body position on latency of p13 peak in VEMP response. Table-3 shows the descriptive statistics of latency of p_{13} of males and females for the three body positions namely

Table 3. Mean & S.D of latencies of p13 (in msec) in male and female subjects

Body position	Males		Females	
	Mean	**S.D**	**Mean**	**S.D**
A	14.1273	2.17566	13.7905	.85901
B	13.6400	2.32750	13.4800	1.09237
C	13.9053	2.44892	13.4111	.55507

Results revealed that there is no significant difference in p13 latency between any of the three body positions used in VEMP testing for both male[$F (2, 30) = 1.295, p > 0.05$] as well as female [$F (2, 32) = 1.462, p > 0.05$] subjects at 0.05 level of significance.

The mean and S.D values of p13 latency of VEMP response in present study are almost in agreement with the studies on VEMP by various authors such as Cheng & Murofushi (2001), Akin et al. (2003), Kaushal (2006), and Huei-Jun et al. (2007). The present study indicates that there is no significant difference in latency of p13 peak in VEMP response between the three body positions used. **Thus the null hypothesis that there is no effect of body position on VEMP measurement with respect to p13 latency is accepted.**

2) The effect of body position on Latency of n23

Repeated measure analysis of variance was carried out to investigate the effect of body position on latency of n23 in VEMP response. Table-4 shows the descriptive statistics of latency of n23 of males and females across the three body positions (A, B & C).

Table 4. Mean & S.D of latencies of n23 (in msec) in male and female subjects

Body position	Males		Females	
	Mean	S.D	Mean	S.D
A	21.7255	2.39769	21.3048	1.75911
B	21.4310	2.49932	20.6100	1.50714
C	19.7368	2.35613	21.8444	1.46256

Results revealed that there is significant difference in latency of n23 between position A and position C in males [$F (2, 30) = 4.415$, $p < 0.05$] and between position B and position C in female [$F (2, 32) = 4.881$, $p < 0.05$] subjects at 0.05 level of significance. In males C position yielded shorter latency of n23 than A position and in females B position yielded shorter latency of n23 than C position. Thus the null hypothesis that there is no effect of body position on VEMP measurement with respect to n23 latency is rejected.

Literature on response consistency of VEMP was reviewed by Ferber et al. (1999) based on the studies done by Cody and Bickford (1969), Townsend and Cody (1971), Colebatch et al. (1994) and Robertston and Ireland (1995). This review suggests that response consistency was not 100% in all the subjects for both the waves of VEMP. How ever, consistency is more for first wave p13 and less for second wave n23 of VEMP response. In the present study, the results suggest that there is significant difference between the latencies of n23 evoked by three different body positions. And this difference can be attributed to the possible poor response consistency of n23 as reported in the literature.

3) The effect of body position on Amplitude of p13-n23

Repeated measure analysis of variance was done to investigate the effect of body position on p13-n23 (peak to trough) amplitude. Table-5 shows the descriptive statistics of amplitude of p13-n23 of males and females across the three body positions (A, B & C)

Table 5. Mean & S.D of amplitudes of p13-n23 (in micro volts) in male and female subjects

Body position	Males		Females	
	Mean	S.D	Mean	S.D
A	48.3427	19.28879	52.9376	23.50879
B	46.4415	22.97675	54.1420	21.35789
C	50.8195	24.71197	51.5478	15.86674

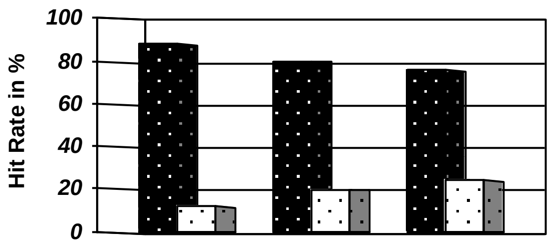
Results revealed that there is no significant difference in amplitude of VEMP between any of the three body positions in both males [$F (2, 30) = 0.254$, $p > 0.05$] as well as females [$F (2, 32) = 1.088$, $p > 0.05$] at 0.05 level of significance. **Hence, the null hypothesis that there is no effect of body position on VEMP measurement with respect to p13-n23 amplitude is accepted.**

The mean amplitude values of VEMP in the present study are not consistent with the amplitude values reported in other studies. The mean amplitudes of p13-n23 as reported by Kaushal (2006) were less in comparison to the amplitudes recorded in the present study even though the level of stimulus was 10dB lower in the present study than the level of the stimulus in Kaushal's (2006) study. The reason for this could be that the EMG level was controlled to be between 30-50 micro volts in the present study, where as it was not controlled in the Kaushal's study. It is possible that the EMG level greater than 50 micro volts would have raised the mean amplitude value of p13-n23. This further indicates that the effect of EMG level is more than that of the intensity of stimulus (short tone burst) on amplitude of VEMP response.

Huei-Jun et al. (2007) found mean amplitudes of VEMP to be 198.53 micro volts with S.D of 64.64. Mean amplitudes of present study are around 50 micro volts with S.D of around 25. Since the level of stimulus used was same in both the studies, the difference in amplitudes can be attributed to two reasons: (a) The S.D of amplitudes of Huei-Jun et al. study was higher than the S.D of the present study indicating that the group was heterogeneous thus affecting the mean, (b) The effect of EMG level was >50micro volts in Huei-Jun et al. study and this was lower than 50 micro volts in the present study (maintained between 30-50micro volts).

4) The effect of body position on Response Rate of VEMP

Graph-1 shows the descriptive statistics of response rate of VEMP for the different body positions (A, B & C) for male subjects. X-axis represents the body positions and Y-axis represents the percentage of subjects in whom VEMP could be recorded, i.e. response rate.



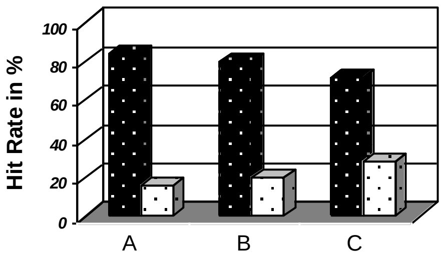
	A	B	C
■ Present(%)	88	80	76
□ Absent(%)	12	20	24

Graph-1. Effect of body position on response rate of VEMP in Males

Graph-1indicates that response rate of VEMP was highest (88%) in A position and minimum (76%) response rate was obtained in C position. The following are the details of male subjects in whom VEMP could not be recorded.

- Number of subjects in whom VEMP was absent in all three positions: 02 (08%)
- Number of subjects in whom VEMP was absent in only two positions: 01 (04%) (A and B positions)
- Number of subjects in whom VEMP was absent only in one position: 06 (24%) (8%in B position and 16% in C position).

Graph-2 shows the descriptive statistics of response rate of VEMP for the different body positions (A, B & C) for female subjects. X-axis represents the body positions and Y-axis represents the percentage of subjects in whom VEMP could be recorded, i.e. response rate.



	A	B	C
Present(%)	84	80	72
Absent(%)	16	20	28

Body Positions

Graph-2. Effect of body position on response rate of VEMP in Females

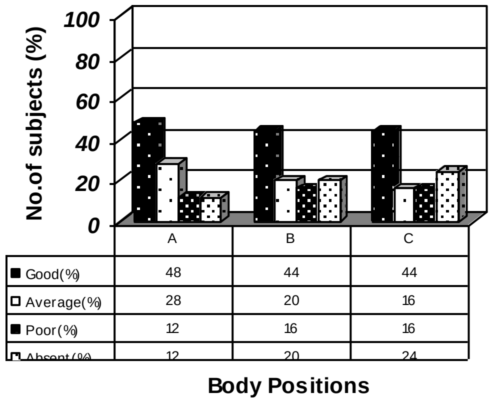
Graph-2 indicates that response rate of VEMP was highest (84%) in A position and minimum (72%) response rate was obtained in C position. The following are the details of female subjects in whom VEMP could not be recorded:

- Number of subjects in whom VEMP was absent in all three positions: 03 (12%)
- Number of subjects in whom VEMP was absent in only two positions: 02 (08%) (4% in A, C and the other 4%in B, C)
- Number of subjects in whom VEMP was absent only in one position: 03 (12%) (4% in B and 8% in C positions).

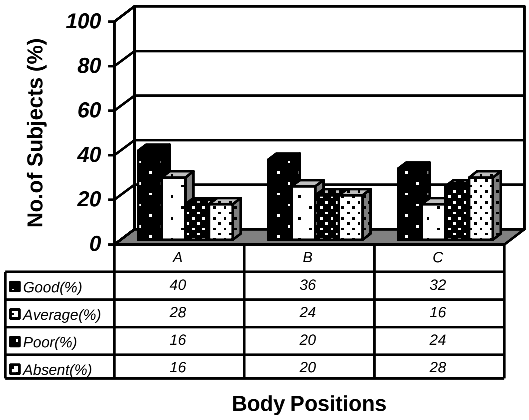
According to the present study there is not much difference in the Response rate of VEMP between the three positions and overall response rate is consistent with the response rate observed by Cody & Bickford (1969) and Townsend & Cody (1971). The number of subjects in whom VEMP could not be recorded was more for position C in both male and female subjects.

5) The effect of body position on Wave morphology of VEMP

Wave morphology of VEMP wave forms was rated using a 3 point rating scale (good, average and poor). Graph-3 & 4 shows the descriptive statistics of the rating on wave morphology of VEMP response in the different body positions (A, B & C) for male and female subjects. X-axis represents the body positions and Y-axis represents the number of subjects.



Graph-3. Effect of body position on wave morphology of VEMP in Males



Graph-4. Effect of body position on wave morphology of VEMP in Females

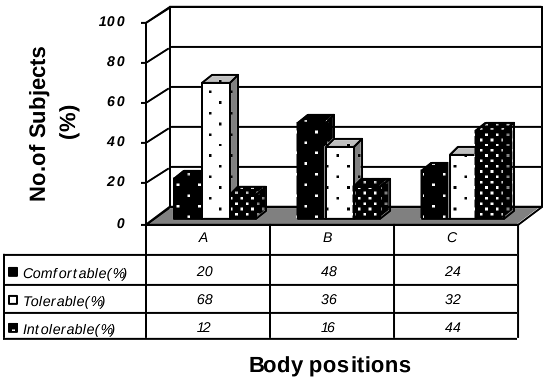
Graphs 3 & 4 show that position 'A' could evoke good wave morphology of VEMP in 48% of subjects compared to B (44%) & C (44%) positions in males. In female subjects also 'A' position has evoked good wave morphology of VEMP in 40% of subjects compared to B (36%) & C (32%) positions. But it should be noted that there was not much difference across 3 positions in number of subjects that had good wave morphology.

The present study indicates that there is difference in wave morphology of VEMP response evoked by different body positions and position ‘A’ evokes better wave morphology in males as well as in females.

6) Relation ship between body position and Subjects rating for comfort

All the subjects were asked to rate the body positions used in VEMP testing for the comfort level experienced on a 3 point rating scale (1-Intolerable, 2-Tolerable, 3-comfortable).

Graph-5 shows the descriptive statistics of subjective rating for comfort across different body positions (A, B & C) for male subjects. X-axis represents the body positions and Y-axis represents the number of subjects.

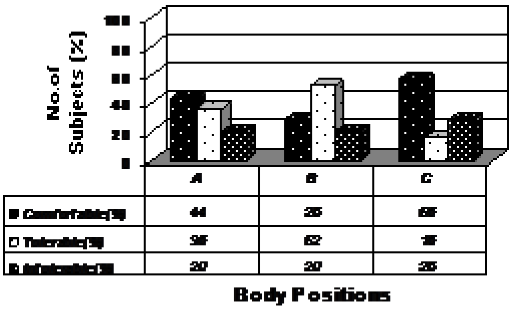


Graph-5. Relationship between body position and comfort in males

From the graph-5 with respect to male subjects it can be seen that:

- in position ‘A’ most of the subjects (68%) rated as tolerable, some (20%) rated as comfortable and least number of subjects (12%) rated it as intolerable
- in position ‘B’ most of the subjects (48%) rated as comfortable, some (36%) rated as tolerable and least number of subjects (16%) rated it as intolerable and
- in position ‘C’ most of the subjects (44%) rated as intolerable, some (32%) rated as tolerable and least number of subjects (24%) rated it as comfortable.

Graph-6 shows the descriptive statistics of subjective rating for comfort across different body positions (A, B & C) for female subjects. X-axis represents the body positions and Y-axis represents the number of subjects.



Graph-6. Relationship between body position and comfort in females

From the graph-6 with respect to female subjects it can be seen that:

- in position ‘A’ most of the subjects (44%) rated as comfortable, some (36%) rated as tolerable and least number of subjects (20%) rated it as intolerable
- in position ‘B’ most of the subjects (52%) rated as tolerable, some (28%) rated as comfortable and least number of subjects (20%) rated it as intolerable and
- in position ‘C’ most of the subjects (56%) rated as comfortable, some (28%) rated as intolerable and least number of subjects (20%) rated it as tolerable

Since this is the first study to investigate the comfortness of subjects for the different body positions used to evoke VEMP response, there is no literature to compare the results of the present study with that of the others. And the results of the present study indicate that not all positions are equally comfortable to all the subjects and the position preferred by males is different from the position preferred by females. Males have preferred ‘B’ position i.e. subject’s body rotated to one side for measurement of VEMP on the opposite side while lying in supine position and females have preferred ‘C’ position i.e. instructing the subject to press the Forehead against a soft surface to be comfortable for VEMP testing.

Independent samples t-test was administered to the data to investigate whether there is any significant difference between males and females for p13, n23 latencies and amplitudes of VEMP across the three positions (A, B & C). Table-6 shows the descriptive statistics of independent t-test. It shows t values for males and females with respect to p13, n23 latencies and amplitudes across the three positions.

The present study indicates that though the male and female subjects choose different body position for VEMP testing in terms of the comfort, there is no difference between them in terms of the response parameters of VEMP (p13, n23 latencies and amplitude) in any of the body position.

Summary and Conclusions

The present study was taken up to investigate the relationship between VEMP measures (latency of p13 & n23 and p13-n23 amplitude), response rate, wave morphology and subject comfort when tested in different body positions used to excite sternocleidomastoid muscle during testing. Further, it was also to see whether there is any relationship between different body positions performed by client in terms of comfort and the nature of VEMP response.

A. Subject's body rotated to one side for measurement of VEMP on the opposite side in sitting position.
B. Subject's body rotated to one side for measurement of VEMP on the opposite side while lying in supine position.
C. Instructing the subject to press the forehead against a soft surface.

From the results obtained the following conclusions are tenable:

1. Irrespective of gender VEMP measures such as latencies of P13, N23 and amplitude of p13-n23 are not affected by body position that is used to excite the sternocleidomastoid muscle during VEMP testing.
2. Response rates, wave morphology of VEMP are also not affected by the body position used to excite the sternocleidomastoid muscle during VEMP testing irrespective of gender.
3. Regarding the comfort of the patient during VEMP testing, position 'B' that is "Subject's body rotated to one side for measurement of VEMP on the opposite side while lying in supine position" was the most preferred position while testing male subjects. And position 'C' that is "subject pressing the forehead against a soft surface" was reported to be more comfortable position for females.

Limitation of the study

- Very small population was taken into the study

Implication of the study

- The study reveals that clinician while testing VEMP need not prefer any body position for better VEMP measures; one may rather consider the subject comfort in choosing the prescribed position.

Further Scope

- VEMP testing may be carried out on different age groups to explore the issue of subject comfort.
- VEMP testing may be carried out on disorder population to explore the issue of subject comfort.
- The same kind of study can be carried out with some other body positions that can excite Sternocleidomastoid muscle.

- VEMP testing may be carried out to study the effect of body positions for binaural VEMP.

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