

Vestibular Evoked Myogenic Potential (VEMP) Testing



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**Srinivasamurthy Ravi Prakash, Harvard
University--MIT Division of Health
Sciences and Technology**

Vestibular Evoked Myogenic Potential Vestibular Evoked Myogenic Potential:

Vestibular Evoked Myogenic Potential Toshihisa Murofushi, Kimitaka Kaga, 2009-03-28 The vestibular labyrinth consists of two compartments the lateral anterior and posterior semicircular canals the utricle and the saccule At the beginning of the twentieth century Robert Brannan proposed the caloric test as a clinical test of the lateral semicircular canal This test enabled clinicians to assess the individual lateral semicircular canal function easily by using the simple method of irrigating the external ear canal with cold or warm water and observing the induced nystagmus We believe that the caloric test was a breakthrough in the field of vestibular research However as far as the other compartments were concerned there was no simple clinical test equal to the caloric test for the lateral semicircular canal function At the end of the twentieth century the vestibular evoked myogenic potential VEMP test was proposed as a new method for assessing the individual saccule function This test has some unique attributes First it uses sound stimulation even though it is a test of the vestibular system This appears to be a contradiction neurophysiologically As a result in its early stages there were controversies concerning the origin of the responses However such controversies have been overcome by basic neurophysiological studies and clinical studies Above all sound sensitivity of the saccular afferents shown in cats and guinea pigs with single unit recording methods became the main supporting evidence Nowadays VEMP is one of the routine clinical tests for balance disorder

Fundamentals of Vestibular Evoked Myogenic Potentials Sujeet Kumar Sinha, Niraj Kumar Singh (Audiologist), Animesh Barman, 2022 Vestibular evoked myogenic potentials VEMPs are essential in assessing the otolith function in individuals with various vestibular disorders There are three types of vestibular evoked myogenic potentials cervical vestibular evoked myogenic potentials ocular vestibular evoked myogenic potentials and masseter vestibular evoked myogenic potentials are recorded in various clinical settings The book Fundamentals of Vestibular Evoked Myogenic Potentials covers all the information related to all three types of VEMPs The book has eighteen chapters containing information on recording factors affecting and applications of VEMPs in various vestibular pathologies such as Meniere's disease Labyrinthitis BPPV NIHL vestibular neuritis third window syndrome congenital sensorineural hearing loss ototoxicity vestibular Schwannoma and diseases of the central nervous system *Objective Detection of Vestibular Evoked Myogenic Potentials*, 2021 Cervical and ocular vestibular evoked myogenic potentials cVEMPs and oVEMPs respectively are considered objective tests of vestibular function measured using surface electromyography EMG In addition VEMPs are visually detected by an examiner often requiring a high level of stimulation to the ear to easily visualize a waveform plotted across time However a high level of stimulation like those used during routine VEMP testing is problematic since it has been shown to be unsafe in children when compared to adults Visual interpretation can also vary between examiners in cases of reduced vestibular function or when the level of required muscle contraction is low One method to alleviate the burden of visual detection is to use objective detection algorithms introduced as an alternative to visual detection of the auditory brainstem

response ABR An algorithm known as fixed single point Fsp estimates the signal to noise ratio SNR and statistically determines if a response is present Fsp has multiple clinical applications including a profound impact on the identification of hearing loss yet our understanding of how this algorithm behaves in VEMPs remains limited The purpose of this investigation was to characterize the behavior of Fsp in cVEMPs and oVEMPs and compare Fsp to visual detection in a group of young healthy participants Air conducted cVEMPs and oVEMPs were elicited using 500 Hz tonebursts For both responses the effect of stimulus level on Fsp was assessed For cVEMPs the additional effect of EMG activation was assessed by varying EMG targets between 10 150 V When applied to VEMP detection Fsp values increased as stimulus level increased in cVEMPs and oVEMPs however Fsp values remained significant at lower stimulus levels In cVEMPs Fsp values were comparable across different levels of EMG activation and maximum EMG activation did not yield larger Fsp values Finally Fsp was comparable to visual detection when detecting VEMP threshold These results showed the feasibility of Fsp when applied to VEMPs and have the potential to shift conventional thinking about the role of stimulus level and muscle contraction during routine VEMP testing

A Normative Study on the Click Vestibular Evoked Myogenic Potential Sasha T. Phillips, 2013 *Clinical Utility of the Vestibular Evoked Myogenic Potential* Rhonda R. Ward, 2006 *Evaluation of Vestibular Evoked Myogenic Potentials (VEMP) and Ocular Torsion* Jessica A. Godovin, Bloomsburg University of Pennsylvania. Department of Audiology and Speech Pathology, 2012 *Vestibular Evoked Myogenic Potential Measures in Adolescents* Reagan Albert, 2014 **The Effect of Increased Stimulus Repetition Rate on Vestibular-evoked Myogenic Potential (VEMP) Threshold** Chizuko Tamaki, 2006 Normative Data Study on Vestibular Evoked Myogenic Potential Tin Duc Truong, 2015 Vestibular evoked myogenic potential is a specialized test within the vestibular test battery that specifically examines the integrity of the otolithic organs within the inner ear The way in which the test is executed varies between individual clinics Therefore it is important for each individual clinic to establish its own set of normative data that are unique to their chosen recording and stimulus parameters The goal of this current study is to establish normative data for cervical and ocular vestibular myogenic evoked potential tests at the Towson University Hearing and Balance clinic

Normative Study on 500 Hz Tone Burst Vestibular Evoked Myogenic Potential (VEMP) Assessment Lauren Gene McGrath, 2013 The goal of the current study was to establish normative data on the various response indices of the VEMP assessment when the response was elicited to 500 Hz tone burst stimuli Eighteen adults with normally functioning vestibular systems participated in the current study Responses were recorded on the sternocleidomastoid SCM muscles on each side of the necks of these subjects Ipsilateral and contralateral recordings occurred for both sides of the neck with the ipsilateral channel recording from the contracted SCM muscle on the same side of the monaural stimulation of 500 Hz tone burst stimuli and the contralateral channel recording from the non contracted SCM muscle on the opposite side to stimulation The tonic EMG levels of the SCM muscle contraction were recorded during VEMP recordings for the ipsilaterally contracted SCM

muscles Two supra threshold i e 95 and 90 dB nHL stimulus intensities were utilized to explore the characteristics of the robust VEMP response Several response indices were measured from these supra threshold VEMP responses These included 1 the absolute latency value of waves p13 and n23 2 the peak to peak amplitude values of p13 n23 3 interaural asymmetry ratio values for amplitude 4 laterality of the VEMP response and 5 tonic EMG levels recorded during the supra threshold VEMP recordings The VEMP response was evaluated at lower stimulus intensities i e 70 85 dB nHL to determine each subject s VEMP threshold The findings from the current study were for the most part found to be consistent with the VEMP literature Latency values were stable across subjects for each of the VEMP components Peak to peak amplitude values of p13 n23 were highly variable across our subjects Interaural asymmetry ratio values were largely less than 30% but in some cases were elevated and or differed across stimulus intensities in the same subject VEMP thresholds were consistent with the documented literature The VEMP response was found to be largely dominant in the ipsilateral recording channel Tonic EMG levels were found to be extremely variable across subjects with the natural contraction of SCM muscles However these tonic EMG levels were found to be very consistent across VEMP recordings in a single subject

Vestibular Evoked Myogenic Potentials Srinivasamurthy Ravi Prakash, Harvard University--MIT Division of Health Sciences and Technology, 2009 cont In the second part of the thesis we develop a computational model of VEMP physiology and use the model to separate external sources of variability from internal noise The model outputs are also used to define a statistical measure the inverse coefficient of variation iCOV which correlates with altered vestibular sensitivity but is relatively robust to other changes When applied to the experimental data the iCOV is found to yield estimates of vestibular sensitivity that are more stable than the conventional VEMP amplitude This measure also reveals a diversity of response threshold and growth characteristics within the clinically normal population These findings suggest that the proposed approach could lead to the development of an improved clinical tool but could also yield new insights into the physiological mechanisms of vestibular pathology

Vestibular Evoked Myogenic Potentials in Clinical Applications Aleksandra Ostrovska, 2004 It is uncertain whether clinically useful information of otolith function can be well characterized by vestibular evoked myogenic potentials VEMPs i e electromyogenic activity recorded from sternomastoid muscles in response to brief loud auditory clicks We aimed to assess the utility of VEMP testing in the differential diagnosis of dizziness 81 dizzy patients 12 normals We found that 1 VEMP was reliably elicited from all controls and from 96% of patients without loss of vestibular function 2 in patients with documented unilateral peripheral vestibular disorders VEMP could reveal loss of otolith function that usefully facilitated diagnoses and 3 such otolith function loss was independent of canal function loss revealed by caloric testing We conclude that the VEMP test is clinically useful to assess vestibular otolith and or inferior vestibular nerve function providing information complementary to that obtained from caloric testing horizontal semicircular canal and or superior vestibular nerve function

The Acquisition of Vestibular Evoked Myogenic Potentials Steven Hagiannis, 1997 **The Vestibular Evoked Myogenic**

Potential Profile of Adults Post Vestibular Neurectomy as Compared to Adults with and Without Menière's Disease

Tamar Mehl Henen, 2016 **BACKGROUND** The recent development of the ocular vestibular evoked myogenic potential oVEMP test protocol in addition to the cervical vestibular myogenic potential cVEMP can provide clinicians information about the functioning of the otolith end organs and their enervating pathways The utilization of cVEMPs and oVEMPs together may also provide feedback on the success of the surgical attempt to preserve the cochlear fibres during vestibular neurectomy VN highlighting the need for including both oVEMPs and cVEMPs in Menière's Disease MD subjects post VN **OBJECTIVES** To describe the impact of VN via the retro sigmoid approach on cVEMPs and oVEMPs in subjects with MD **METHODS** This study compared cVEMP and oVEMP responses of 15 subjects with and without MD and 14 subjects with MD who received a VN The AAO HNS 1995 classification was used as diagnostic criteria for MD **RESULTS** cVEMP and oVEMP responses were absent on the side of the surgery in all subjects with MD who had undergone VN **CONCLUSION** Following VN cVEMPs and oVEMPs were found to be absent

Cervical Vestibular-evoked Myogenic Potentials (cVEMPs), 2019 A cervical Vestibular Evoked Myogenic Potential cVEMP is one of the few objective vestibular diagnostic tests available for pediatric populations This test evaluates the functionality of the saccule end organ through an inhibitory reflex on the sternocleidomastoid SCM muscle that inhibits the level of electromyographic EMG activity Wiener Vacher 2013 Because the saccule response is measured as an inhibition of EMG in the SCM it is imperative that the SCM have a tonic contraction prior to eliciting the response and that the contraction of the SCM is equal on the right and left sides It is generally accepted that young healthy adults can generate equal amounts of EMG on both their right and left sides but these results have not been replicated in young children There is very little cVEMP data for children under five years of age and EMG monitoring and amplitude normalization has not been studied in this age group As a result this study sought to compare generated EMG levels between pediatric and adult populations to determine if EMG monitoring and amplitude normalization would significantly reduce interaural amplitude asymmetry IAA in either group and to assess any developmental effects on cVEMP parameters During testing participants were placed in a seated head turned position An iPad was used to incentivize children to turn their head for a better SCM muscle contraction adults were simply asked to turn their heads Our findings showed that children were able to produce similar EMG values as adults in the same position and that they were able to generate equal amounts of EMG on both their right and left sides While we did not find statistical evidence for the use of EMG monitoring and amplitude normalization when performing a cVEMP there were individual cases within our data that showed using these techniques could have clinical relevance

Vestibular Evoked Myogenic Potentials: The Influence of Head Position for Click and Toneburst Stimuli Rebecca J. Price, 2007 Although the Vestibular Evoked Myogenic Potential VEMP was discovered nearly fifty years ago clinical interest in the vestibular evoked potential has only recently resurfaced Since the VEMP is a relaxation potential it is important to investigate stimulus and parameter characteristics in order to

minimize variability among the recordings and maximize clinical benefit The present study aims to determine what effect head position bandwidth and ear stimulated have on the VEMP recordings The present study will also correlate the relationship between test and re test reliability for VEMP amplitude and latency measures Twenty normal hearing defined as 15 dB HL for frequencies 250 8000 Hz females with no current or previous history of otologic and or vestibular dysfunction were enrolled in the study Participants underwent serial VEMP testing utilizing four different head positions Head Rotation Head Rotation with Forward Tilt Head Rotation with Backward Tilt and Head on Chin A 95 dB nHL 100 musc click and 500 Hz toneburst stimuli were utilized to elicit a VEMP for each head position For each test condition a VEMP response was recorded twice Intensity was decreased in 10 dB steps until threshold was reached Threshold was defined as the lowest intensity level where a VEMP recording was repeated Both the right and left ears were stimulated monaurally for all participants Condition order was randomized for head position bandwidth and ear to counterbalance order effect For all VEMP recordings absolute amplitude and latency measures for P1 N1 and P2 recorded Absolute threshold was also documented Interaural threshold measures were also calculated for analysis Results demonstrated high test re test reliability between VEMP recordings There was no significant ear effect for amplitude or latency measures A significant bandwidth effect was found with the 500 Hz toneburst stimuli producing larger amplitude and unanticipated longer latencies than the 100 musc click stimuli for P1 N1 and P2 measurements Lower absolute thresholds were also noted when utilizing the 500 Hz toneburst stimulus Head position was also shown to have a significant effect on VEMP recording with the Head Rotation and Head on Chin conditions producing larger amplitudes for P1 N1 and P2 than the other two head positions P1 latency did not demonstrate a significant head position effect However slightly longer N1 latencies were found for the Head Rotation and Head on Chin conditions Slightly longer P2 latencies were documented for the Head Rotation with Forward Tilt and Backward Tilt respectively The Head Rotation and Head on Chin conditions produced lower thresholds than the remaining two conditions

The Use of 64-channel Electroencephalography and Positron Emission Tomography to Study Vestibular Evoked Myogenic Potentials Kathleen Szalda McNERney, 2007 The vestibular evoked myogenic potential VEMP is a response that can be recorded from the sternocleidomastoid SCM muscle in response to either clicks or low frequency tonebursts that are presented at a high stimulus level The VEMP is most likely generated by the saccule The saccule is part of our vestibular system and normally contributes to our sense of balance However recent studies have shown that it is also responsive to sound The exact neural pathway of the VEMP is not yet fully understood limiting its clinical application The present study has identified the areas of the brain that are activated by stimuli used clinically to evoke the VEMP by utilizing both EEG brain electrical activity recordings as well as functional imaging which were collected separately Stimuli consisted of 500 Hz tonebursts Analysis of event related potentials ERPs derived from EEG recordings revealed that the responses to the 90 dB pSPL stimuli were absent or smaller than the responses that were recorded in response to the 120 dB pSPL stimuli We

recorded an initial negative going peak which occurred at 13.5 ms with the frontal electrodes producing the largest response amplitude as well as a later positive going peak which occurred at 20.5 ms with the occipital electrodes and the electrodes which were placed over the right temporal lobe producing the largest amplitude. Source localization techniques CURRY were used to analyze the EEG data while both PET and EEG data were analyzed using SPM5. When we compared the areas activated by the high vs low level stimuli we found that the VEMP stimuli activated vestibular regions of the brain specifically the premotor cortex the inferior and medial temporal gyri and Brodmann area 40 in addition to the auditory areas typically activated by sound such as the primary auditory cortex. In addition the brain activity for the initial negative going peak was localized in the primary visual cortex as well as the precuneus. In conclusion several brain regions were activated in response to stimuli that are used clinically to evoke the VEMP. We believe that these areas are representative of the neural correlates of the VEMP. Ocular Vestibular Evoked Myogenic Potentials in Children Kayla R. Ashland, 2012 **Cervical Vestibular**

Evoked Myogenic Potentials Nathalie Meyer, 2014 *Comprehensive Management of Vestibular Schwannoma* Matthew L. Carlson, Michael J. Link, Colin L.W. Driscoll, 2019-06-13. The definitive resource on clinical management of vestibular schwannoma from world renowned experts. Although a histologically benign and relatively uncommon tumor otolaryngologists and neurosurgeons have maintained a lasting and deep rooted fascination with vestibular schwannoma also known as acoustic neuroma. Advancements in microsurgical technique radiosurgery and radiotherapy coupled with an increased understanding of the natural history of the disease have made modern management of this tumor considerably more complex. Concurrently new controversies have added to the original debates among pioneering surgeons with the pendulum swinging between conservatism and definitive cure. *Comprehensive Management of Vestibular Schwannoma* by distinguished Mayo Clinic clinicians and renowned international contributors is a comprehensive textbook covering all the clinical aspects of vestibular schwannoma management. Eighty four chapters written by multidisciplinary experts including otolaryngologists neurosurgeons radiation oncologists neurologists neuroradiologists and audiologists ensure a balanced view of all treatment modalities for sporadic and neurofibromatosis type 2 associated vestibular schwannoma. Key Features: Evaluation surgical and nonsurgical approaches rehabilitation controversies and long term clinical outcomes. Detailed illustrations by Robert Morreale senior medical illustrator at the Mayo Clinic highlight relevant anatomy and surgical approaches. Chapter summary tables provide readers with a rapid clinical reference derived from the published world literature. The chapter *Anatomy of Vestibular Schwannoma Surgery* by the late internationally renowned neurosurgeon Albert L. Rhoton Jr reflects his major contributions on this subject. With inclusion of fundamental principles to advanced concepts this is a robust resource for residents fellows and early attending physicians as well as mid to later career physicians who care for patients with vestibular schwannoma.

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