

Original Article

Video Head Impulse Test (vHIT) and Vestibular Evoked Myogenic Potential (VEMP) Test for Assessment of Vertigo: Our Initial Experience

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Abstract:

Introduction: Loss of balance causes the sensation of vertigo. Balance is maintained by vestibular afferent from labyrinth, eyes and proprioceptors and their central integration. For diagnosis of vertigo, along with history different vestibulometric tests can be done to identify the specific anatomical part that is involved.

Material and methods: A cross sectional study was done among 82 patients who did video Head Impulse Test (vHIT) and among 75 patients who did Vestibular Evoked Myogenic Potential (VEMP) test at Audiovestibular Centre (AVC) at Bangladesh ENT Hospital Ltd. during the period from April 2018 to September 2019.

Results: Age range of the sample was 16 to 80 years. Among the 82 patients who did vHIT 62(75.6%) had abnormality in either Semi Circular Canal. Among 75 patients who did VEMP 27(36%) were detected to have abnormality in either in saccule or utricle.

Conclusion: For diagnosis of cause of vertigo the appropriate test for individual part of vestibule is essential. vHIT and VEMP are two tests which are complementary to each other in explaining common peripheral causes of vertigo.

Key words: Video head impulse test (vHIT), Vestibular evoked myogenic potentials (VEMP), vertigo, balance.

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Introduction:

According to 1995 guidelines by the American Academy of Otolaryngology-Head and Neck Surgery, vertigo is characterized as “the sensation of motion when no motion is occurring relative to earth’s gravity.”¹ Vertigo can disrupt a person’s daily activities and have a profoundly negative impact on his or her quality of life.^{2,3}

The balance system serves three primary functions namely i. maintenance of posture stability – for standing comfortably and prevention from falling, ii. Perception of subjective visual vertical and horizontal – for spatial orientation of an object with respect

to gravity, iii. Gaze stabilization or visual stability – so that objects in the visual field remain stable and do not appear to be moving when the head is moved, or when the visual surroundings move, or when both the head and the visual surroundings move.

Vestibular afferent from labyrinth, eyes and proprioceptors execute their function through efferent motor organs through vestibuloocular reflex (VOR), vestibulo-collicreflex(VCR) and vestibulospinal reflex (VSR). For diagnosis of patients presented with with dizziness, vertigo, taking history from the patient is of utmost importance and different vestibulometric tests are now also available to identify the specific anatomical part that is involved.

The **video head impulse test (vHIT)** incorporates a new technology that uses a pair of high-speed, light-weight video goggles to measure (left or right) eye velocity in response to head movement and record “catch-up” saccades (and other abnormalities) in patients with an impaired VOR.

vHIT provides a quick and objective measure of the VOR in response to head movements in the natural range of daily motions and thus evaluates the functional integrity of all the six Semi Circular Canals (SCC)s of bothsides (Fig.1,2,3).Hence, this test is much more relevant than the caloric ENG/ VNG tests.

Vestibular evoked myogenic potentials (VEMPs) are becoming widely used for detailed neurophysiological assessment of the vestibular system. A VEMP is basically a myogenic response from the muscles of the neck or eyes, in response to loud acoustic stimulation of the otolith organs(viz., the saccule and utricle).⁴ Ocular VEMPs (oVEMPs) (Fig. 4) measure the function of the vestibulo-ocular reflex arc (utricle, superior vestibular nerve, brainstem

vestibular nuclei, medial longitudinal fasciculus, inferior oblique muscle)⁵. Cervical VEMPs (cVEMPs) (Fig.5) measure the integrity of the vestibulo-collic reflex (saccular afferents, inferior vestibular nerve, the brainstem vestibular nuclei, the medial vestibulospinal tract, upper cervical motor neurons and the accessory nerve)⁵.

Materials and Methods:

A cross sectional study was done among 82 patients who were referred for video Head Impulse Test (vHIT) and among 75 patients who did Vestibular Evoked Myogenic Potential (VEMP) test during the period from April 2018 to September 2019. All the tests were done in Audiovestibular Centre(AVC) at Bangladesh ENT Hospital Ltd. vHIT is done by Eye See Cam of Interacoustics and VEMP tests are done by protocol of Eclipse by Interacoustics.

Results:

Age range of the sample was 16 to 80 years. Among the 82 patients who did vHIT 62(75.6%) had abnormality in either SCC. Among 75 patients who did VEMP 27(36%) were detected to have abnormality in either in saccule or utricle.

Table 1 :
Age distribution of patients

Age	vHIT	VEMP
11-20	4	4
21-30	9	6
31-40	14	15
41-50	24	23
51-60	18	17
61-70	11	8
71-80	2	2
Total	82	75

Table II:
Abnormality in vHIT test

Canal involved	Abnormal=62(75.6%) in 82			
	Frequency	Side of involvement		
		Bilateral	Right	Left
Lateral	27(43.5%)	20(75%)	5(18%)	2(7%)
Posterior	15(24%)	3(20%)	8(53%)	4(26%)
Anterior	20(32.2%)	5(25%)	10(50%)	5(25%)

Table III :
Abnormality in cVEMP and oVEMP

Abnormal=27(36%) in 75		
Both	oVEMP	cVEMP
11(14.7%)	7(9.3%)	9(12%)

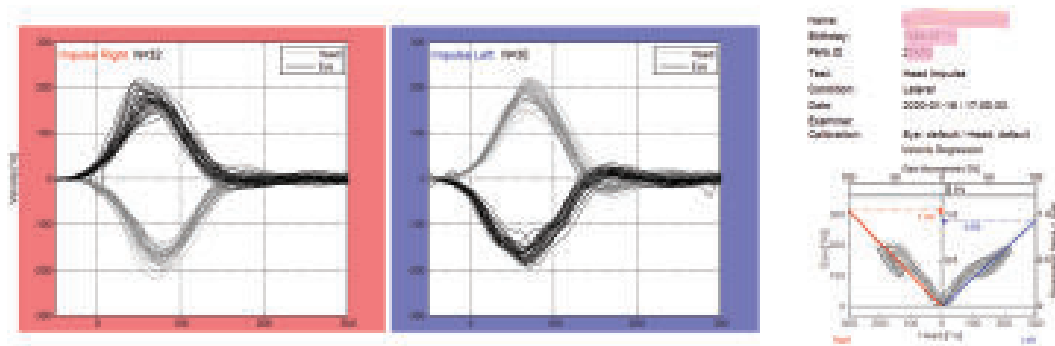


Fig 1: *Bilateral Lateral canal graph with Gain comparison*

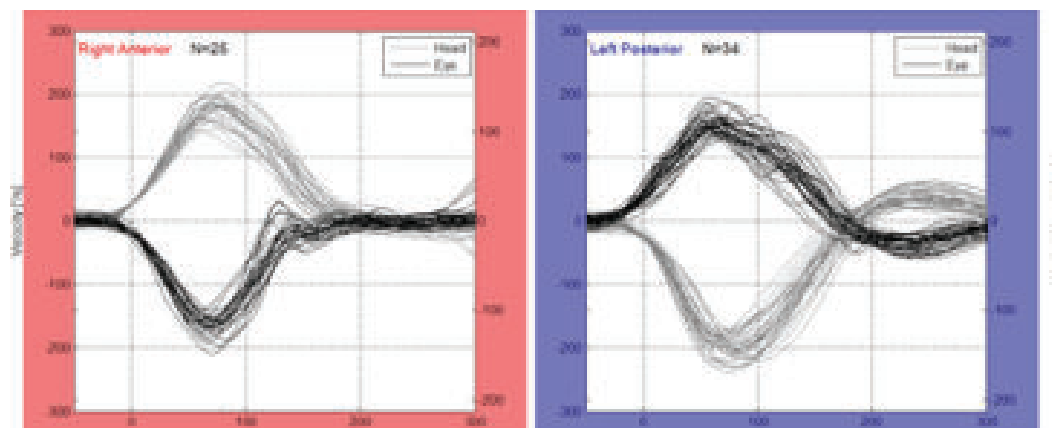


Fig 2: *Right Anterior-Left Posterior canal (RALP) graph*

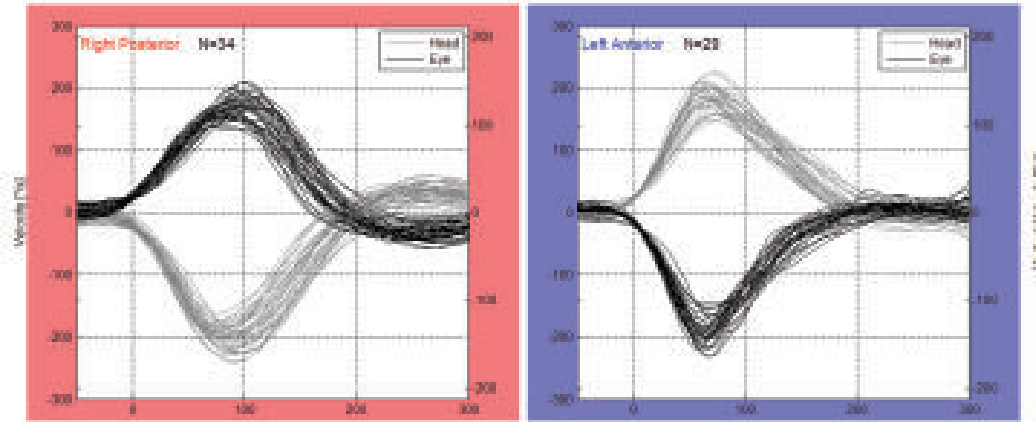


Fig. 3: Left Anterior-Right Posterior canal (LARP) graph

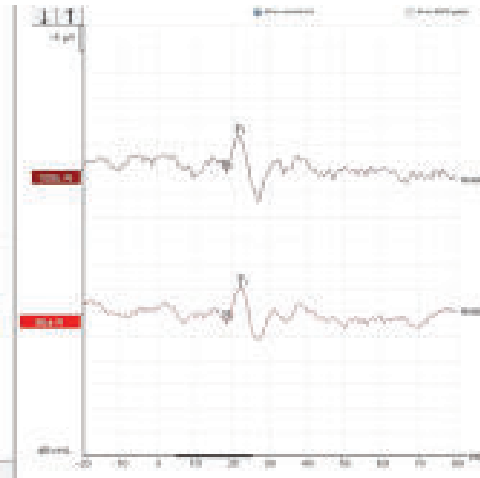


Fig. 4: oVEMP graph

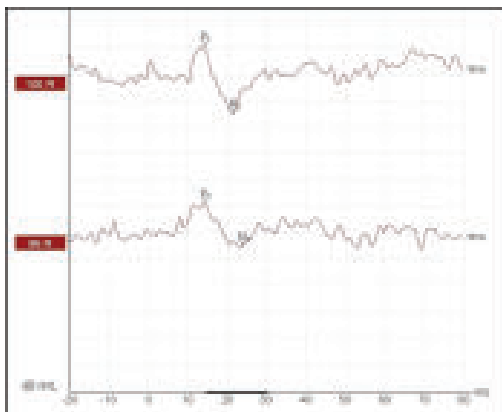


Fig. 5: cVEMP graph

Discussion:

The central and peripheral vestibular system, in conjunction with the ocular and somatosensory system, is responsible for equilibrium balance and orientation in the space. Of all the symptoms of otological/ neurotological diseases vertigo can be one of the most incapacitating of symptoms.

A detailed history, clinical examination, neurological examination is mandatory in assessment of a dizzy patient. With advancement of computer aided neurotological investigation we can locate the more accurately the site of lesion.

Table I shows among the referred patients about two-third (~64%) belonged to 41-70 years of age range. It represent the referral pattern in this series but Prevalence of dizziness increases significantly with age and among institutionalized patients⁶.

Table II shows distribution of result of video Head Impulse test (vHIT) according to the individual semicircular canal affected. In interpreting vHIT the following points are considered: i) the gain of VOR (normal range 0.7-1). ii) presence or absence of saccades (jerky corrective movement of eye). Lateral and Superior SCC are innervated by

Superior division of Vestibular nerve and the Inferior division innervating the Posterior SCC.

Table III shows the frequency of abnormality in Ocular and Cervical VEMP test. In interpreting the tracing of these tests following points are considered: i) particular pattern of graph at defined time interval ii) EMG scaling. Abnormality in oVEMP and cVEMP represent abnormality in Utricle and Saccule respectively. It assist in the diagnosis of disorders such as Superior Semicircular Canal Dehiscence (SSCD)⁷ and Meniere's disease⁸.

it is obvious that the combined use of VEMPs and vHIT we can analyze the peripheral vestibular function to far greater detail than by only using the caloric test⁹.

Conclusion:

Vertigo almost always arises from the vestibule and rarely from central or intracranial causes. Approximately 80% of vertigo cases result from peripheral causes, including Meniere's disease, vestibular neuritis, and benign paroxysmal positional vertigo. Central-type vertigo is caused by more severe diseases, including migrainous vertigo, brainstem ischemia, cerebellar infarction, and intracranial hemorrhage.¹⁰

So for identification of the part of the vestibule involved, the appropriate test for individual part is an essential key to diagnosis. vHIT and VEMP are two tests which are complementary to each other in explaining common peripheral causes of vertigo.

References:

1. American Academy of Otolaryngology —Head and Neck Surgery Foundation, Inc. Committee on Hearing and Equilibrium guidelines for the evaluation of results of treatment of conductive hearing loss. *Otolaryngol Head Neck Surg.* 1995; 113:186-187.
2. Lopez-Escamez JA, Gamiz MJ, Fernandez-Perez A, et al. Impact of treatment on health-related quality of life in patients with posterior canal benign paroxysmal positional vertigo. *OtolNeurotol.* 2003; 24:637-641.
3. Neuhauser HK, von Brevern M, Radtke A, et al. Epidemiology of vestibular vertigo: a neurotologic survey of the general population. *Neurology.* 2005; 65:898-904.
4. Colebatch JG, Halmagyi GM, Skuse NF. Myogenic potentials generated by a click-evoked vestibulocollic reflex. *J NeurolNeurosurg Psychiatry.* 1994 Feb; 57(2):190-7.
5. Rosengren SM, Kingma H. New perspectives on vestibular evoked myogenic potentials. *Curr Opin Neurol* 2013; 26:74–80.
6. Lai YT, Wang TC, Chuang LJ, Chen MH, Wang PC. Epidemiology of vertigo: a National Survey. *Otolaryngol Head Neck Surg.* 2011 Jul; 145(1):110-6.
7. Milojcic, R., Guinan, J.J., Rauch, S.D., & Herrmann, B.S. (2013). Vestibular evoked myogenic potentials in patients with superior semicircular canal dehiscence. *OtolNeurotol*, 34(2), 360-367.
8. Rauch, S. D., Zhou, G., Kujawa, S. G., Guinan, J. J., Herrmann, B. S. Vestibular evoked myogenic potentials show altered tuning in patients with Ménière's disease. *Otology & Neurotology* 2004, 25(3), 333-338.
9. Magliulo G, Gagliardi S, CiniglioAppiani M, et al. Vestibular neurolabyrinthitis: a follow-up study with cervical and ocular vestibular evoked myogenic potentials and the video head impulse test. *Ann OtolRhinolLaryngol* 2014; 123:162–73.
10. Kroenke K, Hoffman RM, Einstadter D. How common are various causes of dizziness? A critical review. *South Med J.* 2000; 93:160-167.