



ORIGINAL RESEARCH ARTICLE- A CLINICAL STUDY OF VERTIGO USING  
ELECTRONYSTAGMOGRAPHY

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ABSTRACT

Dizziness is an extremely common symptom that may be consequent upon a diversity of pathologies. It is essential to obtain a detailed and accurate history, to perform a full medical examination with special reference to the ears, eyes and neurological assessment and to institute appropriate and specific special investigations like electronystagmography. The aim of this study is to document the electronystagmography findings used in the diagnosis of vertigo. Fifty patients with vertigo attending the ENT OPD of Dr. B.R. Ambedkar Medical College and Hospital are included in the study over a period of two years (November 2012 to December 2014). ENG results showed that 32% of the patients had normal findings, 6% had inconclusive findings, 46% had findings of peripheral vertigo and 16% had findings of central vertigo. ENG along with clinical examination adds valuable information in the diagnosis of vertigo and indicates a peripheral or central cause of vertigo.

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INTRODUCTION

Dizziness is a commonly used term which encompasses a number of symptoms of disequilibrium, including light headedness, faintness, giddiness, sensation of 'swimming' or 'floating', vertigo, imbalance, ataxia, minor episodes of mental confusion or loss of consciousness.

In the concise Oxford dictionary, it is defined as a 'feeling of being dazed' or 'in a whirl', or as if 'about to fall'. In medical terms, it is of little value in identifying a precise underlying pathological process. In contradistinction, vertigo is a specific symptom related directly to dysfunction of the vestibular system (Dix, 1973). By definition, vertigo is 'a hallucination of movement' (Caw Thorne, 1952) or 'disagreeable sensation of instability or disordered orientation in space (Agate, 1963) (Linda Luxon, 1988)

Aims and Objectives

1. To document the electronystagmography findings used in the diagnosis of vertigo
2. To determine various causes of vertigo- peripheral and central

MATERIALS AND METHODS

The proposed study is a hospital based prospective study. Patients presenting with vertigo in ENT OPD of Dr. B.R. Ambedkar Medical College and Hospital were studied over a

period of 2 years, from November 2012 to December 2014 after taking their consent.

Inclusion criteria

1. Patients with dizziness and vertigo
2. All age groups
3. Both males and females

Exclusion criteria

1. Congenital conditions
2. Patients who refuse to follow up

A detailed history was taken, a complete general physical examination and a thorough ENT examination was done. Patients were then subjected to:

Clinical tests

Spontaneous nystagmus  
Fistula test  
Rhomberg's test  
Gait  
Past pointing and falling  
Hallpike maneuver (Positional test)

Laboratory tests

Caloric test  
Electronystagmography

### Statistical Analysis

Continuous data were summarized as Mean +/- SD (standard deviation) while discrete (categorical) in number and percentage. The categorical groups were compared by chi-square ( $\chi^2$ ) test. Pearson correlation analysis was used to assess association between the variables. A two-tailed ( $\alpha=2$ ) p value less than 0.05 was considered statistically significant. All analyses were performed using SPSS software (Windows version 17.0)

## OBSERVATION AND RESULTS

### Age distribution

**Table 1** Age Distribution

AGE (years)	Number	Percentage (%)
25-35	12	24
35-45	19	38
45-55	9	18
55-65	10	20

The age of the patients were ranging from 25 to 65 years, the mean age being 40.9 years. Maximum number of patients were seen in the age group of 35 to 45 years. (Table 1)

### Sex distribution

**Table 2** Sex Distribution

SEX	Number	Percentage (%)
Male	21	42
Female	29	58

Out of the total 50 patients studied, 21 were males and 29 were females. A slight female predominance is observed in the ratio of 1.4:1 (Table 2)

### Presence of nystagmus in ENG test

**Table 3** Incidence of nystagmus in various ENG tests

TEST	NUMBER	PERCENTAGE (%)
Spontaneous nystagmus test	24	48
Gaze test	0	0
Optokinetic test	0	0
Positional test	6	12
Caloric test	27	54

Out of the 50 patients studied, 24 patients (48%) showed nystagmus in Spontaneous Nystagmus test. Out of these 24 patients, 8 showed right beating nystagmus and 8 showed left beating nystagmus, which is suggestive of left and right peripheral vestibular lesions respectively and remaining 8 showed clinically insignificant nystagmus. There were no positive results for Gaze test and Optokinetic test. Six patients (12%) had positional nystagmus and 27 patients (54%) showed nystagmus in Caloric test. (Table 3)

### ENG test results

**Table 4** ENG Diagnosis

ENG DIAGNOSIS	NUMBER	PERCENTAGE (%)
NORMAL	16	32
UNDETERMINED	3	6
PERIPHERAL	23	46
CENTRAL	8	16

Sixteen patients (32%) had normal ENG findings, 3 patients (6%) had inconclusive findings, 23 patients (46%) had findings of peripheral vertigo and 8 patients (16%) had findings of central vertigo. (Table 4)

## DISCUSSION

The term "Vertigo" comes from a Latin word "Vertere" which means "to turn". It is defined as a sensation of movement of self or environment. Usually, the perceived movement is rotatory- a spinning or wheeling sensation- but some patients simply feel pulled to one side. However they are described, dizziness and vertigo may be disturbing and even incapacitating, particularly when accompanied by nausea and vomiting. (Harrison WL *et al*, 2012) Vertigo may be classified into either Peripheral or Central depending on the location of the dysfunction along the vestibular pathway.

1. **Peripheral Vertigo** ("otologic" or "vestibular") is due to the dysfunction of the vestibular system (Dhingra PL, 2010). The common causes include Meniere's disease, Benign Paroxysmal Positional Vertigo (BPPV), Vestibular neuronitis, Labyrinthitis, Ototoxic drugs, Head trauma and Perilymphatic fistula
2. **Central Vertigo** is due to injury to the balance centers of the central nervous system. It is associated with less prominent movement illusion and nausea as compared to the peripheral type. It also has accompanying neurologic deficits (slurred speech and double vision) and pathological nystagmus (pure vertical/ torsional). The common causes include Vertebrobasilar insufficiency, Posterior inferior cerebellar artery syndrome, Basilar migraine, Cerebellar disease, Multiple Sclerosis, Cervical Vertigo, Tumors of brainstem and fourth ventricle and Epilepsy.<sup>3</sup>

The stimulation of the peripheral vestibular receptors initiates a vestibular reflex whose ocular manifestations are seen as *nystagmus*. Nystagmus is a condition of involuntary (Zahn Jr July 1978) eye movements and its direction is defined by the direction of its quick phase. (Pierrot- Deseillingny *et al*, 2005) It may be caused by congenital disorders, acquired or central nervous system disorders, drugs, alcohol or rotational movement. It is occasionally associated with vertigo. There are two key forms of nystagmus: pathological and physiological, with variations within each type. The resulting eye movements may be recorded and quantified by special devices like electronystagmography, a form of electrooculography or less invasive devices like videonystagmography. Special swinging chairs with electrical controls can be used to induce rotatory nystagmus. (Markley, BA 2007).

Electronystagmography (ENG) is a study used to clinically evaluate patients with dizziness, vertigo or balance dysfunction. It provides an objective assessment of the oculomotor and vestibular systems. Electrodes are placed around the patient's eyes to record the corneo-retinal potential differences. (Lightfoot GR, 2004) By placing electrodes on both horizontal and vertical axis around the eyes, tracings are produced for eye movements on both axes. A standard ENG test battery consists of oculomotor evaluation, positioning/positional testing, caloric stimulation of the vestibular system. Claussen's butterfly chart gives a pictorial representation of caloric testing. It is represented in four quadrants showing caloric response in each ear. The horizontal axis represents time and vertical axis represents the number of nystagmus beats. Readings are shown as normal (0) if there are 19 beats/

30 seconds, hypoactive (1) if <19 beats/ 30 seconds and hyperactive (2) if there are >19 beats/ 30 seconds.

Increasingly, clinicians are using infrared technology to record eye movements for ENG. These systems are commonly referred to as Videonystagmography (VNG). Here the tracings can be made in complete darkness, thereby eliminating any visual fixation points. The systems may use a camera for either one or both the eyes. The most important advantage of VNG is that all eye movements are captured on video and can be viewed by the clinician during and after the test.

In this study, a total of 50 patients were examined, out of which 29 (58%) were females and 21 (42%) were males, which indicates that sex is not a predisposing factor in the incidence of vertigo. The age of our patients ranged from 25 to 65 years with the mean age being 40.9 years, with almost 38% between 35 to 45 years. Twenty four percent of the patients showed nystagmus in spontaneous nystagmus test, no positive results were seen for gaze and optokinetic tests, 12% had positional nystagmus and 54% showed nystagmus in caloric test in which, 70.3% showed a hypoactive butterfly chart indicating a peripheral lesion and 30.7% showed a hyperactive butterfly chart indicating a central lesion. Thirty two per cent of the patients had normal ENG findings, 6% had inconclusive findings, 46% had findings of peripheral vertigo and 16% had findings of central vertigo.

In a study conducted by Sharma V, Shah R K, Department of Otorhinolaryngology, Manipal College of Medical Sciences & Teaching Hospital, Phulbari campus, Pokhara, Nepal titled "Conventional Vestibular Function Tests vs Butterfly Vestibulometry in peripheral vertigo", to perform conventional vestibular function tests and butterfly vestibulometry via ENG in patients diagnosed clinically as suffering from peripheral vertigo, to rule out the presence of a central lesion. (V Sharma *et al*, 2014) During ENG, among the pathological group 8.96% had normal response, 80.43% had a peripheral lesion, 7.97% had a central lesion and 2.89% had a non-localizing lesion. Among the control group, 96% had normal response and 4% had a peripheral lesion. Among the 11 central causes of vertigo diagnosed by ENG, four cases were diagnosed by MRI Brain but in seven cases (63.63%), no structural pathology was seen.

An analysis of the data obtained from the 600 ENG's performed over the last 5 years by Dr. M.V. Kirtane in his clinic shows the following results: Normal (31.26%), Peripheral lesions (28.23%), Mixed lesions (4.07%), Central lesions (26.93%), Undetermined (9.51%) which showed that the incidence of central lesions is almost as high as peripheral lesions in the causation of vertigo. (Kirtane MV, 2009)

In a study conducted over a period of three years titled "A study on peripheral vertigo in a Kolkata based hospital" by DebashishBurman, SaileswarGoswami, Pallab Kumar Majumdar, 95 cases of vertigo of peripheral origin were selected. Otoneurological examination and relevant audiovestibular studies were done. Audiological tests included pure tone audiometry with tone decay, speech discrimination and short increment sensitivity index (SISI) tests. Vestibular evaluation comprised of balance tests, examination of spontaneous nystagmus, positional tests, ENG with bithermal caloric tests, Craniocorpography (CCG) and Brainstem Evoked Response Audiometry (BERA). ENG studies consisted of spontaneous and positional nystagmus and caloric stimulation. Radiological tests like X-Ray of mastoids,

cervical spine and internal auditory meatus, CT scan and MRI of skull were done besides other routine and special biochemical examinations as and when required. Vertiginous disorders of peripheral origin were more commonly found in older age groups, i.e., in 3<sup>rd</sup> and 4<sup>th</sup> decade of life. The disease is less common above the age of 50 years and rare below the age of 20 years. (Debashish Burman *et al*, 2002)

This study corroborates with the findings of Deka (1985). According to Deka, the male and the female ratio of peripheral vertigo is 3:2, while Gopal G.S. (1991) showed the ratio as 4:1.<sup>12</sup> BPPV appears to be the commonest disorder (20%) (Montadon 1984, 28%; Deka *et al* 1985, 17%). Its frequency is probably greater than indicated, because the physicians tend to refer these cases less, being aware of its specificity and good prognosis. (Montadon PB *et al*, 1984) Post-operative vertigo was found in 7 cases of mastoid operations where hammer and gouge were used. Meniere's disease, which is supposed to be the commonest peripheral vestibular disorder (Mawson and Ludman, 1979) (Mawson SR *et al*, 1979), was less commonly seen in the set up (10.5%). This figure was almost the same as studied by Deka (1985). All the patients showed canal paresis on ENG and increased rotation and deviation on CCG. Labyrinthitis comprised of 7.4% of all patients and vertigo was the predominant complaint in all cases except in a dead labyrinth, which was found in one case. Five cases were due to the result of chronic ear disease and one case was of viral origin.

In a study titled "Electronystagmography findings in children with peripheral and central vestibular disorders" by Angelo Salami, Massimo Dellepiane, Renzo Mora, Giuseppe Taborelli, Barbara Jankowska from University of Genoa, Italy in February 2005; to determine whether the results of electronystagmography testing improve an emergency physician's diagnosis of dizziness in children. Patients selected were aged between 2 and 12 years and were affected with vertiginous symptoms. All patients underwent the following instrumental examinations: blood tests, audiological screening, ENG of spontaneous nystagmus or provoked by vestibular and optical stimulation and electroencephalogram. The result underlines a high incidence of central vertigo (83%). Fifty two percent children presented a prevailing unidirectional nystagmus on labyrinth stimulation and 48% of the children have an asymmetrical response on optokinetic stimulation with quality alteration of shocks. This study concluded that ENG can register and evaluate the qualitative and quantitative characteristics of the nystagmic response and allow to distinguish between central or peripheral vertigo. (Salami A *et al*, 2006)

## CONCLUSION

Dizziness accounts for an estimated 5 percent of primary care clinic visits. The patient history can generally classify dizziness into one of the four categories: vertigo, disequilibrium, presyncope or lightheadedness. The main causes of vertigo are Benign Paroxysmal Positional vertigo, Meniere's disease, Vestibular Neuritis and Labyrinthitis. Many medications can cause presyncope, and regimens should be assessed in patients with this type of dizziness. Parkinson's disease and diabetic neuropathy should be considered with the diagnosis of disequilibrium. Psychiatric disorders such as depression, anxiety and hyperventilation syndrome can cause vague lightheadedness.

The variety of causative agents producing vertigo stresses the importance of a thorough clinical history and examination, blood biochemistry, proper laboratory investigations, audiological and vestibular tests, radiography, etc. in the management of a case of vertigo. The approach to a patient with vertigo must be broad based and multidisciplinary and not narrow, as seen through the eyes of a specialist, who may concentrate solely on proving or ruling out a disorder located in his realm.

Most specialists tend to have a telescopic vision and cannot think of anything beyond their line of specialization, but diagnosis of vertigo essentially requires a holistic approach as different systems, viz. the visual system, the musculoskeletal system, the psychic system, the central and the peripheral nervous system and last but not the least, the vestibular system combine to maintain the body balance.

The objective record obtained by ENG facilitates proper documentation and measurement of the degree of abnormal eye movement and provides an accurate record, a documentary evidence for medicolegal cases, a more vivid picture for teaching and publication and also helps in easier patient follow up. ENG certainly does not eliminate the need for various other tests performed for patients suffering from vertigo. It however, adds valuable information which when considered along with the data obtained from the other tests, can facilitate the diagnosis.

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