

Original Research Article

Role of electronystagmography as a definitive tool in evaluation of vertigo: a clinical study

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ABSTRACT

Background: Vertigo is one of the most distressing symptoms. It is difficult to identify, practically impossible to measure and not easy to treat. Electronystagmography (ENG) objectively records eye movements and thus tests the functional integrity of vestibulo-ocular reflex and its connections from inner ear to the brain. Hence, this present study was taken to evaluate the role of ENG in the diagnosis of vertigo, to know the peripheral, central and other causes of vertigo and to know the side of lesion. The aim of this study was to evaluate the role of ENG in the diagnosis of vertigo, to know the peripheral, central and other causes of vertigo and to know the side of lesion.

Methods: This study included 60 patients who presented with primary complaints of vertigo or dizziness. Patients were subjected to ENG under optimal conditions and the results were obtained in the form of a graphical recordings after analysis of the ENG data.

Results: Of the 60 patients subjected to ENG, a peripheral cause was seen in 33 patients. 21 patients were diagnosed with benign positional paroxysmal vertigo (BPPV), whereas 06 patients showed a central lesion of the vestibular system.

Conclusions: ENG acts as a useful screening tool to differentiate between peripheral cause of vertigo and central cause of vertigo. It has special significance in localizing the side of the lesion. Hence, ENG has proven to be a useful first line investigation in the diagnosis of vertigo.

Keywords: Electronystagmography, Peripheral vertigo, Central vertigo

INTRODUCTION

Dizziness and vertigo are common symptoms. Epidemiological studies have shown that vertigo and balance disorder affect 10-15% of the general population.¹

Dizziness was most effectively defined by Kerr as a subjective sense of imbalance which may or may not include sensation of rotation.² Dizziness can be classified into four types of dizziness. They are vertigo, disequilibrium, pre-syncope and light headedness.³

Vertigo is one of the most complicated morbid symptoms, which has immense psychological impact on patient's life. The symptom may result from a disease of lesion due to various causes affecting the peripheral, vestibular, optic and central balance systems and its co-ordinated activity in maintaining balance, differing in severity (from minor to very severe) and prevalence, while its early diagnosis can be of immense importance for further fate of the affected person.

Normal balance function relies on sensory information from the visual, peripheral vestibular and somatosensory systems. This sensory information is integrated,

modulated and interpreted within central nervous system to enable gaze fixation and postural stabilization and provide information regarding self and environment movement.

ENG based on the corneo-retinal potential measurement using electrodes, records and displays on-line the changing voltages resulting from eye movements occurring throughout various tests. ENG is one of the most important objective means for evaluation of vertigo.

Patients often visit multiple clinicians in different specialties (general practitioners, general physicians, neurologists and otolaryngologists). As a result, they undergo multiple consultations and investigations before a definitive diagnosis is made. This delay has a severe adverse impact on their work, family and hence quality of life. Half of the patients affected by dizziness feel that their efficiency at work has substantially dropped and one-quarter of patients even give up or change their work as a result of dizziness. ENG has also been used as a screening tool to help decide whether more expensive tests like CT, MRI are warranted in patients with neurological symptoms associated with vertigo.

The present study was thus centered on the evaluation of balance disorder using ENG and the ability of this innovation to differentiate between peripheral and central causes of vertigo.

METHODS

The present study was carried out on patients attending the ENT OPD at Basaveshwar teaching and general hospital Gulbarga from period of October 2016 to May 2018.

Source of data

Patients with primary complaints of vertigo attending the ENT outpatient department of Basaveshwara teaching and general hospital attached to Mahadevappa Rampure medical college, Kalaburagi were the source of data for this study.

Sample size

The sample size for this study was 60.

Method of selection

The method of selection of the subjects was by simple random sampling method.

Ethical clearance

Ethical clearance was obtained from the institutional ethical committee. An informed consent was obtained from all the patients before the start of study.

Inclusion criteria

All cases with primary complaints of vertigo with satisfactory vision, attending OPD were included in the study.

Exclusion criteria

Patients with defective vision and difficulty in understanding and obeying instructions, patients with otitis externa, patients with suppurative otitis media, patients with tympanic membrane perforation, patients with history of ear surgery, patients with cervical spondylosis, psychiatric illness, tremor and visual disturbances and patients not giving consent for procedure were excluded from the study.

Methodology

Patients were explained in detail about the duration and the nature of the investigation to be conducted on them and written and informed consent was taken. A complete history and otorhinolaryngology examination was carried out in all the patients. General examination, systemic examination, clinical cerebellar tests, tests to evaluate vestibulo-ocular and vestibulo spinal systems and provocative test like Dix-Hallpike were done. Patients were subjected to pure tone audiometry if they complained of any hearing loss. ENG was performed in a uniform manner on all the patients using RMS Nystagmorite 2+1 channel machine. ENG was done in quiet, lightproof room. Room was away from operation theatre and other heavy electrical equipments like X-ray machine, CT and MRI machine, lifts. A bed with head end raised to 30° above horizontal is used.

Patient preparation

All the patients are instructed to avoid alcohol and certain drugs (sedatives, hypnotics, antihistaminic, any anti-vertigo drugs) he may be taking for at least 48 hours before the test. Otoscopy examination was done for wax, discharge, infection, perforation of tympanic membrane or an operated mastoid cavity. If there is wax blocking external auditory canal was thoroughly cleaned prior to test. Patients with intact tympanic membrane were subjected to test. The areas where the electrodes are to be applied are cleaned with spirit or alcohol to remove grime so as to ensure good skin electrode contact. The cups of the electrodes are then filled with electrolyte paste and the electrodes are firmly applied to the respective sides with adhesive tape. For caloric testing, the polythene catheter was gently introduced into the external auditory canal and was gradually advanced along the posterior wall of external auditory canal till its tip lie close to the tympanic membrane. If the catheter touched the tympanic membrane patient would immediately complaint of pain and catheter was slightly withdrawn. A kidney tray was held near the ear, so that returning water was collected in tray without disturbing the patient. Patient was asked to

lie down on table raised 30° above horizontal. The electrodes were connected to junction box of the ENG machine and following tests were performed.

Calibration

The calibration of the horizontal eye movements was done by asking patient to transfer his gaze on red LED light to another on calibration bar. The calibration bar is held in front of the patient and patient was instructed to look alternately at 2 red LED lights for 30 secs separated by 20°. The equipment was calibrated to identify the normal voluntary movements of the patient’s eyes. Spontaneous nystagmus test, gaze test, pendulum tracking test, positional test, Dix-Hallpike test, Calorie test were performed on all the patients.

Statistical method

Statistical data was analyzed by SPSS 16.0 version software. Data was analyzed by non-parametric Chi square test for association between two variables. For comparison between the groups, ANOVA test was used. If p value was less than 0.05, it was considered as significant.

RESULTS

In our study out of 60 patients, most common presentation was spinning sensation seen in 30 patients, followed by imbalance among 27 patients. Rest 12 patients complained of swaying, 4 patients had unsteadiness, 2 patients complained of light headedness and 2 patients had blackouts. In our study no patient presented with syncope (Table 1).

Table 1: Presenting complaints.

Presenting complaints	Number of patients	Percentage (%)
Swaying	12	20
Unsteadiness	4	6.6
Light headedness	2	3.3
Spinning	30	50
Imbalance	27	45
Blackouts	2	3.3

Table 2: Associated symptoms.

Associated symptoms	Number of patients	Percentage (%)
Nausea	41	68.3
Vomiting	19	31.6
Headache	5	8.3
Earache	3	5
Hearing loss	6	10
Aural fullness	7	11.6
Tinnitus	21	35

Out of 60 patients evaluated, most common associated symptom was nausea in 41 patients followed by vomiting in 19 patients. Rest 5 patients complained of headache and 3 patients complained of earache, 6 patients had hearing loss, aural fullness among 7 patients and 21 patients complained of associated tinnitus. In our study, more than 50% of patient had associated ear symptoms suggestive of peripheral cause (Table 2).

Table 3: Other co-morbidities.

Other ailments	Number of patients	Percentage (%)
Hypertension	22	36.6
Diabetes mellitus	14	23.3
Neurological disorder	7	11.6
Head and neck trauma	9	15
Others	8	13.3

Out of 60 patients, associated co-morbidities include hypertension among 22 patients, 14 patients had diabetes mellitus, 7 patients neurological disorder and history of head and neck trauma among 9 patients and 4 patients had other causes like vitamin D3 deficiency, hypothyroidism, vitamin B12 deficiency and gastro esophageal reflux disease (GERD) (Table 3).

On clinical evaluation of 60 patients with vertigo, spontaneous nystagmus was positive in 11 patients, head impulse test positive in 8 patients, Unterberger test was positive in 14 patients all clinically suggestive of peripheral cause.

Dix-Hallpike test (posterior canal BPPV) showed nystagmus in 21 patients, clinically suggestive of BPPV. Supine roll test (lateral canal BPPV) showed no nystagmus. Fistula test was not positive ruling out superior semicircular canal dehiscence/fistula. Romberg’s test positive was positive in 3 patients, straight line walking test was positive in 2 patients and dysdiadochokinesia was seen in 01 patient all clinically suggestive of central cause (Table 4).

Table 4: Clinical findings.

Clinical test	Number of patients	Percentage (%)
Fistula test	0	0
Spontaneous nystagmus	11	18.3
Head-impulse test	08	13.3
Dix-Hallpike test	21	35
Supine-roll test	0	0
Unterberger test	14	23.3
Romberg’s test	3	5
Straight line walking test	2	3.3
Dysdiadochokinesia	1	1.6

In non-caloric ENG findings out of 60 patients, 11 patients had spontaneous nystagmus, positional test was

positive in 22 cases. Dix- Hallpike test positive in 21 patients suggestive of BPPV. Pendulum test was positive in 06 patients suggestive of central cause (Table 5).

Table 5: ENG findings.

Electronystagmography findings	Number of patients	Percentage (%)
Spontaneous nystagmus	11	18.3
Positional test	22	36.6
Dix-Hallpike test	21	35
Pendulum test	6	10

Among calorie ENG findings, showed hypoactive response in 44 patients, hyperactive response in 06 cases, normal response in 10 patients. Though calorie response was normal in 10 patients, other clinical findings and ENG results were suggestive of BPPV in 6 patients, cervicogenic vertigo in 2 patients, psychogenic vertigo and migranous vertigo in 1 patient each (Table 6).

Table 6: Caloric test findings.

Calorie test findings	Number of patients	Percentage (%)
Normal response	10	16.6
Hypoactive response	44	73.3
Hyperactive response	6	10

Table 7: Peripheral causes.

Peripheral causes	Number of cases	
Acute labyrinthitis	14	
Vestibular neuronitis	10	
Benign positional paroxysmal vertigo(BPPV)	21	
Meniere’s disease	2	
Labyrinthine dysfunction	Chronic labyrinthine dysfunction	2
	Traumatic labyrinthine concussion	1
Others	Migranous vertigo	1
	Psychogenic vertigo	1
	Cervicogenic vertigo	2

Out of 60 cases, a peripheral cause was seen in 54 patients. Of which acute labyrinthitis in 14 cases, vestibular neuronitis in 10 cases, BPPV in 21 cases, Meniere’s disease in 2 cases, labyrinthine dysfunction (chronic labyrinthine dysfunction and traumatic labyrinthine concussion) in 3 cases. Other causes include migranous vertigo, psychogenic vertigo in one each and cervicogenic vertigo among 2 cases (Table 7).

Among central causes included, cerebellar lesion among 2 cases, brainstem lesion in 2 cases and cerebrovascular events in 2 cases (Table 8).

Table 8: Central causes.

Central causes	Number of cases
Cerebellar lesion	2
Brain stem lesion	2
Vascular causes	2

Overall ENG findings showed BPPV in 21 patients, peripheral lesion in 33 patients and central lesion in 06 patients.

DISCUSSION

Clinical findings and ENG of 60 patients complaining of vertigo or dizziness were documented in this study and the causes were differentiated into peripheral and central causes of vertigo

Presenting complaints

Herr et al in 1989 in his study found spinning, imbalance, swaying, unsteadiness, light headedness as the main complaints.⁴ Complaints of patients in our study are comparable to above study.

In our study Romberg’s test came positive in 3 (5%) patients. Romberg’s test can also be positive in healthy subjects and this test cannot distinguish between vestibular deficit and other causes. Romberg’s test is less reliable in diagnosis of vertigo. Jacobson et al suggested that Romberg’s test is insensitive to consider it as a screening measure for vestibular impairment.⁵

In our study Unterberger test came positive in 14 (23.3%) patients of peripheral vestibulopathy. Bonanni and Newton in 1998 suggested that Unterberger stepping test is not a reliable screening tool for peripheral vestibular asymmetry as this test gives poor test-retest reliability and should be used in combination with other tests.⁶ Rudert in 1977 and Hickey et al in 1990 also stated that Unterberger test showed no significance in diagnosis of vestibular dysfunction.^{7,8}

In our study, 21 patients (35%) were positive for Dix-Hallpike maneuver which is comparable to other studies. Nystagmus on Dix-Hallpike maneuver in these patients were typically latent and fatigable. Positive Dix-Hallpike maneuver is diagnostic of BPPV.

Cerebellar test like dysdiadochokinesia was positive in 1 patient in our study which is a sign for cerebellar disease. These patients were eventually diagnosed with central lesion causing vertigo. In our study spontaneous nystagmus was seen in 11 patients, which were seen on eye examination, typically latent and fatigable; suggestive of peripheral vestibular disorder.

Smooth pursuit nystagmus abnormality on pendulum test indicates central pathology. In study done by Sharma and Shah, they found smooth pursuit abnormality in 1.45%.¹⁰ In study done by Gupta and Mundra abnormal nystagmus on positional test for three positions was seen in 44% of patients.¹² In our study abnormal smooth pursuit nystagmus on pendulum test was found in 6 patients (10%). All these cases were further evaluated by CT/MRI and referred to higher center. Though calorie response was normal, other findings were suggestive of BPPV in 6 patients, 2 patients had cervicogenic vertigo, psychogenic and migranous vertigo in 1 each.

Table 9: Dix-Hallpike test.

Study	Positive dix hallpike maneuver; percentage (%)
Cohen et al ⁹	40
Sharma et al ¹⁰	54.03
Kamath et al ¹¹	33
Our study	35

Almost all the cases evaluated in our department were cases with primary complaint of vertigo and also referred from other department and hence on evaluation had peripheral or central cause of vertigo. We didn't have a case presenting with pre-syncope. Peripheral disease localization was also comparable to other studies. In our study central disease localization was less than other studies. It might be due to inability of interpretation of vertical or torsional nystagmus produced by central disease by single channel ENG machine and less flow of patients having central pathology in our setup.

CONCLUSION

An attempt has been made in our study to document ENG findings of patients complaining of vertigo and to differentiate causes of vertigo into peripheral and central using ENG. ENG has proven to be very useful investigation in the diagnosis of vertigo along with detailed history and clinical examination. It can be used to differentiate the cause of vertigo into peripheral and central causes. ENG has special significance in localizing the side of the lesion in peripheral vestibular lesions. Single channel ENG machine identifies only horizontal nystagmus. Vertical nystagmus requires multi-channel ENG machine. It has less value in diagnosis of BPPV as only the posterior canal BPPV (most common type) can be evaluated by Dix-Hallpike test, horizontal and superior canal involvement cannot be evaluated smooth pursuit nystagmus abnormality on pendulum test in non-caloric ENG tests is suggestive of central vestibular lesion, though further radiological imaging is warranted in these cases. ENG acts as a useful screening tool to differentiate between peripheral cause of vertigo and central cause of vertigo. It has special significance in localizing the side

of the lesion. Hence, ENG has proven to be a useful first-line investigation in the diagnosis of vertigo.

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