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Study of electronystagmography in the diagnosis and efficacy of follow-up after treatment, in patients with vertigo of peripheral origin

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ABSTRACT

Background: Vertigo is a symptom of multisystemic disorders of various etiological factors with different clinical manifestations. The disorders causing the symptom may be of peripheral or central origin, and accurate diagnosis of the underlying pathology is warranted for effective treatment. Balance is a complex sensorimotor task involving accurate and redundant sensory input from the visual, vestibular and proprioceptive systems, central nervous system integration of the sensory signals and the generation of the appropriate motor commands and adequate musculoskeletal capabilities to perform the motor tasks involved in occulomotor and posture control.
Methods: The study was conducted in the Department of Otorhinolaryngology, Regional Institute of Medical Sciences, Imphal, Manipur. 50 cases presenting with symptoms of vertigo were studied irrespective of age, sex and duration of illness in order to find out the cause of peripheral vertigo by using different diagnostic parameters with main emphasis on electronystagmography. All patients underwent pure tone audiometry for audiology assessment. The cases were treated and followed-up to a minimum period of 3 months, electronystagmography repeated during each visit to evaluate the efficacy and response to treatment.
Results: Vertigo of peripheral origin comprised of 64%. Meniere's disease was the largest group (28%) amongst the causes of peripheral vertigo. Subjective improvement of vertigo and electronystagmography was observed in all patients after treatment.
Conclusions: Vertigo was most common in fourth decade of life and males have a slight predominance. Medical management was the mainstay of treatment. Patients with peripheral vertigo responded well to symptomatic and supportive treatment. Electronystagmography facilitates diagnosis of vertigo.

Keywords: Peripheral vertigo, Electronystagmography, Audiometry, Nystagmus

INTRODUCTION

Vertigo is derived from the Latin word "Vertere", it means to turn; implies a sensation of turning. It may be defined as a hallucination of movement or subjective sense of imbalance.[1,2] It is the sense of rotational movement of the self or the surroundings and is usually due to disturbances in the vestibular system. Vertigo may be of central, peripheral or mixed. According to Hood, an important feature of any neurotological investigation of vertigo is the examination of the eyes for spontaneous nystagmus or for some derangement of induced nystagmus.[3] The vestibular system is one of the three sensory systems sub-serving spatial orientation and posture; the other two are the visual system (retina to occipital cortex) and the somato-sensory system that conveys peripheral information from skin, joint and muscle receptors. Vertigo may represent either

physiologic stimulation or pathologic dysfunction in any of the three systems. The presence of nystagmus with eye open and its behavior changes with eye closure or in darkness is of special value in differentiating end organ lesion of inner ear from the central lesion. Thus helpful to evaluate the side of lesion and whether it's peripheral or a central lesion, also gives a clue whether lesion is recovering, static or progressive.

Electronystagmography (ENG) is a study used to clinically evaluate patients with dizziness, vertigo, or balance dysfunction. ENG provides an objective assessment of the occulomotor and vestibular systems. The vestibular system monitors the position and movements of the head to stabilize retinal images. It is now accepted as a routine investigation in the diagnosis and management of patients suffering from vertigo and equilibrium disorders. The technique of electronystagmography depends on the potential difference between the cornea and retina, created by the retinal pigmentary epithelium. The pigmented layer of the retina maintains a negative potential with respect to the rest of the eye by means of active ion transport. The eyeball behaves as a dipole with its axis coinciding with the optical axis of the eye. An electrode placed lateral to the eye becomes more positive when the eye rotates towards it and more negative when it rotates away, with reference to an electrode at a more remote location. The voltage change represent the change in eye position as only small angular movements are involved in nystagmus and the relationship between voltage change and the eye movement is virtually linear at these small degrees of arc.[4] The electric potentials are greatly amplified and recorded directly on a running strip of paper by an apparatus called electronystagmogram.[5] Even electric potential of 2 mv can be recorded and a nystagmus beat of 2 mm of or more is significant. The technique of Electronystagmography has the advantage of supplying a graphic record of the nystagmus for immediate, delayed and repeated examination and also allows comparison and contrasting of the nystagmus with the eyes open and with the eyes closed. By ENG eye ball movement is recorded by recording the changes in corneo retinal potential during nystagmus. This method gives a documented record of spontaneous nystagmus with eyes close, gaze nystagmus, eye pursuit movement, position nystagmus and bithermal caloric nystagmus.[6,7]

Aim of the study

The aims of the study were to establish the diagnosis and causes of peripheral vertigo by ENG and to find out any change (improvement) in the ENG after treatment.

METHODS

This prospective interventional study was carried out in the Department of Otorhinolaryngology in Regional Institute of Medical Sciences, Imphal, Manipur. Ethical committee approval was taken before carrying out the study. The study was conducted between October 2002 to October 2004. A total of 50 cases presenting with symptoms of vertigo attending outpatient department of otorhinolaryngology and those admitted in the wards were studied irrespective of age, sex and duration of illness. Thorough clinical examination and relevant investigations were performed in all the cases. Ophthalmologist and other specialists were also consulted and their opinions were sought, whenever necessary.

Inclusion criteria were 50 patients with symptoms of vertigo.

Exclusion criteria were alcoholics, smokers, patients on antihistaminic, antiemetic drugs, sedatives and hypnotics.

All the cases underwent pure tone audiometry for audiological evaluation to assess conductive loss, sensorineural loss and mixed loss of hearing.

ENG test was done on all cases. The patients subjected to undergo this test were informed to abstain from alcohol, sedatives, hypnotics, antihistaminics, any anti-vertigo medications 48 hours prior to evaluation. The test was performed with eyes opened in a dark room. A series of subtests: pendulum tracking test, positional test, Dix-Hallpike test, bithermal caloric test were performed with the help of an electronystagmorite. Placing of electrodes: the electrodes used were made of silver, coated with non-polarizing silver chloride. The electrodes were firmly applied with the help of leadfree adhesive tapes and electrolyte paste were used to ensure proper conduction and to keep the electrodes-skin resistance to a minimum. The electrodes were applied to the skin over the forehead, 1.5 to 2 cm lateral to outer canthi, and above and below the left eye.

Depending on the lesion, for the peripheral vertigo causes like Meniere's disease, vestibular neuronitis, acute labyrinthitis and benign paroxysmal positional vertigo, the treatment plan was rehabilitative, medical or surgical. Most vertiginous patients were successfully treated by medical line of treatment. Vertigo was managed by a team involving neurotologist, neurologist, neurosurgeon, physician and sometimes physiotherapist and psychologist. Symptomatic and supportive treatment was the mainstay in our study.

Patients were followed up for a minimum period of 3 months. Electronystagmography was repeated in each patient during the follow-up period to evaluate the response to treatment and change in ENG findings.

The data collected was compiled and analysed using statistical package for social services (SPSS 16.0). The categorical variables were presented as frequency and percentages using Microsoft excel.

RESULTS

In the present study, majority of the patients with vertigo are in the age group of 31-40 years. The oldest patient is

75 years old. There are 24 females and 26 males in the study. The male female ratio is almost equal.

Table 1: Distribution of cases with respect to age and sex.

Age group (years)	No. of patient (%)	Male (%)	Female (%)
11-20	3 (6)	2 (4)	1 (2)
21-30	8 (16)	3 (6)	5 (10)
31-40	14 (28)	6 (12)	8 (16)
41-50	11 (22)	8 (16)	3 (6)
51-60	9 (18)	4 (8)	5 (10)
61-70	4 (8)	2 (40)	2 (40)
>70	1 (2)	1 (2)	0 (0)
Total	50 (100)	26 (52)	24 (48)

Table 2: Findings of audiometry test.

Pure tone audiometry	No. of patient	Percentage (%)
Conductive loss	4	8
Sensorineural loss	22	44
Mixed loss	3	6
Normal	21	42

Table 2 shows finding of audiometry tests in 50 patients with vertigo. Conductive loss was found in 4 (8%), sensorineural loss in 22 (44%), mixed loss in 3 (6%) and normal hearing in 21 (42%) patients respectively.

Table 3: Electronystagmographic finding.

Test	No. of patient	Percentage (%)
Positional test	33	66
Dix-Hallpike test	33	66
Caloric test		
Hypoactive	33	66
Hyperactive	5	10
Normal	12	24

Table 3 shows electronystagmographic findings in 50 cases of vertigo. The pendular tracking test, gaze test and optokinetic test were found normal. Positional and positioning test showed abnormal responses in 33 (66%) cases. Caloric test showed hypoactive responses in 33 (66%) cases and hyperactive responses in 5 (10%) cases irrespective of different ears. 12 (24%) cases showed normal responses.

In the present study, vertigo due to peripheral causes accounted for 32 (64%) cases and central causes accounted for 12% cases. 24% of the cases presented with idiopathic vertigo, as depicted in Figure 1.

Table 4: Findings in cases of peripheral vertigo at 3 months of follow-up after treatment.

Disease	Total no. of cases	Cases followed	Objective improvement			ENG findings								
			Subjective improvement diminution of vertigo.	Improvement of hearing diminution of tinnitus	Positional nystagmus	Dix Hall pike	First examination			Follow up at 3 month				
							Hypo-active	Hyper active	No response	Normal	Hypo active	Hyper active	No response	Normal
Meniere's disease	14	10	10	2	4	2	10	-	-	-	3	-	-	7
BPPV	12	8	6	4	-	4	-	-	-	8	-	-	-	8
Vestibular neuronitis	4	4	4	-	-	-	1	-	-	3	1	-	-	3
Acute labyrinthitis	2	2	2	-	-	-	1	-	1	-	-	-	2	-

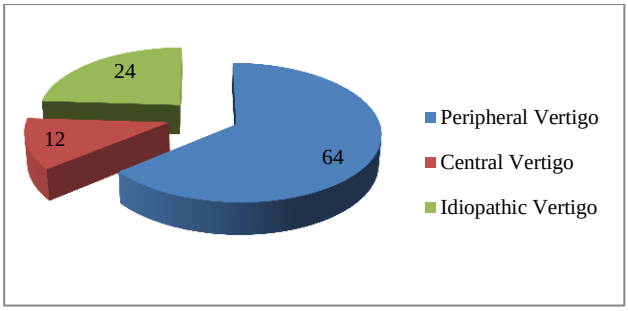

Figure 1: Site of lesion in vertigo cases.

Amongst the peripheral disorders which accounted for 32 (64%) of all the cases, Meniere's disease 14 (28%) formed the most common cause of vertigo followed by benign paroxysmal positional vertigo 12(24%), vestibular neuronitis 4 (8%) and acute labyrinthitis 2(4%). Table 4 shows follow-up cases of vertigo. Out of 50 cases of vertigo studied, only 32 patients could be followed up. Subjective improvement of vertigo and ENG findings was seen in all patients. Positional nystagmus and Dix-Hallpike positive were seen in 2 cases of Meniere's disease and 4 cases of benign paroxysmal positional vertigo.

The positional nystagmus and Dix-Hallpike positive cases showed significant improvement within 4-6 weeks of follow up with use of vertibular adaptation exercises. Hearing loss remained the same in all the cases except in 2 cases of acute labyrinthitis in which hearing improvement was seen following treatment. 18 patients were lost at follow-up.

DISCUSSION

Various diagnostic parameters are available for the diagnosis of the disorders causing vertigo. The present study was carried out in order to evaluate the efficacy of ENG in the diagnosis and management of vertigo of peripheral origin. In the present study, the age of the patients ranged from 11 to 75 years. The maximum cases were in the age group of 31-40 years comprising 28% of the total (Table 1). Similar observations were reported by Bhatia and Deka.[8] The total male to female ratio was almost similar, with males comprising of 52% and females 48% respectively (Table 1). Bhatia and Deka in their series of 330 patients of vertigo observed male:female ratio of 3:2.[8] This disparity in ratio may be due to less number of cases in our series.

Pure tone audiometry test showed normal audiogram in 42%, sensorineural hearing loss in 44%, conductive hearing loss in 8% and mixed hearing loss in 6% patients respectively (Table 2). Gulati et al reported the incidence of normal audiogram ranged from 33.8% to 56%.[9] Mishra SC et al found sensorineural hearing loss in 43.22% patients with vertigo.[10] This is in conformity with the present study. However, Bower and Cotton reported conductive hearing loss in 14.70%[11] of their series which is slightly higher than in this series.

ENG done in all patients showed response in 76%. The pendular tracking test, gaze test and optokinetic tests were found normal, whereas positional and positioning tests were positive in 66% of patients (Table 3). Electronystagmography is found to be the most sensitive diagnostic parameters of vertigo in the study. These findings were not reported in other studies.

In the study, vertigo due to peripheral causes accounted for 64% of patients (Figure 1). Amongst the peripheral disorders in our study, Meniere's disease comprised a single largest group 14 (28%) followed by benign paroxysmal positional vertigo 12 (24%), vestibular neuronitis 4 (8%) and acute labyrinthitis 2 (4%) (Table 4). Cawthrone reported the incidence of Meniere's disease ranged from 2.54% to 63.8%.[12] Bhatia and Deka reported similar observation.[8] Amongst peripheral vertigo BPPV (44.23%), Meniere's disease (19.23%), vestibular neuronitis (13.4%) and labyrinthitis (5.76%) reported by Barman et al.[13]

In our study, follow-up along with treatment was done for a minimum period of 3 months. Out of 50 cases of vertigo studied, only 33 cases reported for follow-up and 17 cases were lost in follow-up, which may be due to relief of symptoms, due to partial or full peripheral or central compensations. ENG findings suggestive of objective improvement after treatment, positional nystagmus and Dix Hallpike positive were seen in 2 cases of Meniere's disease and 4 cases of benign paroxysmal positional vertigo at 3 months follow-up (Table 4). The long duration recurrent vertigo and persistent nystagmus in some cases of benign paroxysmal positional vertigo may be due to the irreversible peripheral pathology like cupulolithiasis. Repeated vestibular exercises induce habituation and patients with peripheral lesions were found to respond well in the study. The central compensation manifests as a decline in the intensity of the spontaneous nystagmus, regression of vertigo and disequilibrium. A dizzy patient always remains a challenge to an ENT surgeon; history is the key role and may be the only positive clue. An overall neurological assessment with special emphasis on nystagmus should be given.[14]

CONCLUSION

ENG, by utilizing the change in corneo-retinal potential consequent upon the movement of the eye is a sensitive and accurate diagnostic procedure for vertigo of peripheral origin. Vertigo of peripheral origin accounted for 64% of patients. Meniere's disease formed the single largest group (28%) amongst the peripheral vertigo. ENG facilitates diagnosis of vertigo when used along with detailed history and otoneurological evaluation although they are not specific in identifying the exact site of lesion.

Subjective improvement of vertigo and ENG was seen in all patients after treatment.

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