

# A Clinical Study on Vertigo with Special Reference to Audio-Vestibular Tests

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**Abstract:** A study was conducted in the Department of Otorhinolaryngology Silchar Medical College, Silchar from October 2010 to September 2011. The aim of our study was to know the incidence of vertigo, to study the clinical pattern and presentation of patient with vertigo, to study the role of history taking, clinical neurological tests and laboratory tests in diagnosis of vertigo and to establish the site of lesion and etiology using proper examination and investigation parameter. A total of 80 patients presenting with vertigo were studied. The clinical diagnosis was made after detailed history taking, otoneurological examination, relevant audiovestibular tests and radiological tests where ever needed. In our study vertigo was more common in males. Peripheral vertigo was found in 52 cases and central vertigo in 28 cases. Amongst the peripheral causes BPPV (44.23%), Meniere's disease (19.23%) and vestibular neuritis (13.46%) were three common causes in descending order. The central causes include cervical vertigo (25%), VBI (14.28%) and Migraine (14.28%) were three common causes in descending order. Results of our study were compared with the published data available in the literature.

**Keywords:** Central vertigo, ENG, nystagmus, peripheral vertigo

## 1. Introduction

The term Vertigo, is derived from Latin word "vertere" which means "to turn". It is the sense of rotational movement of the self or the surroundings and is usually due to disturbances in the vestibular system. 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 loss of vestibular sensation causes distinct and often severe symptoms. This study aims to present the spectrum of cases and findings from vestibular tests in our region

## 2. Materials and Methods

The present study was carried out in the Department of Otorhinolaryngology, Silchar Medical College & Hospital, Silchar from October 2010 to September 2011. A total of eighty (80) cases of patient with vertigo were studied. All cases had undergone thorough clinical evaluation with special reference to Cochleo-vestibular symptoms, ear diseases, head trauma and systemic illnesses like diabetes, hypertension. All patients were subjected to general physical examination, local examination of ear, nose and throat, examination of balance system, pure tone audiometry, caloric tests and Electronystagmography test. The electronystagmography test comprised of calibration, Test for spontaneous nystagmus, test for gaze nystagmus, positional test, paroxysmal nystagmus test, pendulum tracking test, optokinetic test and caloric test at warm 44°C

and cold 30°C water irrigation. For evaluating calorically induced nystagmus parameter used were maximum slow phase velocity and culmination frequency. Caloric irrigation with warm and cold water was not done in patients with perforated membrane. BERA test was done in paediatric group of patients and patients with suspected or confirmed having Eight Nerve Lesion. Informed consent was obtained from all the patients before including them in the study. The study had the required Institutional Ethical clearance.

## 3. Results

### 3.1 Age distribution

The highest incidence of vertigo cases in our study was found in age group 41-50 years (30%) followed by 31-40 years (23.75%). Peripheral vertigo was commonly seen in 31 to 50 years age group whereas central vertigo was seen in patients of age group more than 50 years. (Fig I). The commonest type seen in our study is Peripheral vertigo (n=52, 65%) and central type in (n=28,35%) cases.

### 3.2 Sex distribution

In the present series the ratio of male to female regarding the incidence of vertigo is 1.85:1 (1.88:1 for peripheral vertigo and 1.8:1 for central vertigo).

### 3.3 Pattern of Vertigo

Subjective vertigo was seen in 38 cases (47.5% cases), out of which 52.63% cases were in central group and 47.36% cases were in peripheral group. Objective vertigo was seen in 42 (52.5%) cases, out of which 80.95% cases were in peripheral group and 19.04% cases in central group. In objective

vertigo, Z-test for single proportion analysis revealed values for peripheral vertigo to be 1.34 which is  $<1.96$  and for central vertigo is 7.155 which  $>1.96$  respectively at 5% level of significance. Thus central vertigo is significantly associated with objective vertigo but not peripheral vertigo. For subjective vertigo the values of z test for peripheral and central vertigo is 4.919 and 4.472 which are  $>1.96$  respectively at 5% level of significance. Thus both peripheral and central vertigo are significantly associated with subjective vertigo (Fig2).

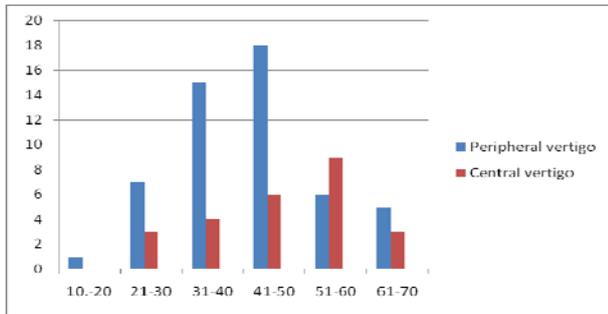


Figure 1: Age wise distribution and types of vertigo

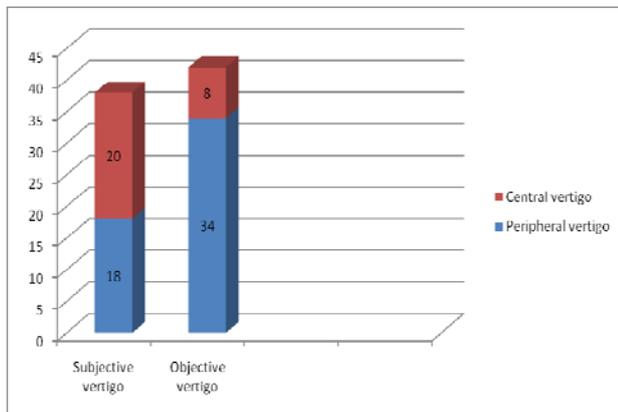


Figure 2: Types of vertigo

### 3.4 Duration of attack

33.75% cases had vertigo lasting for less than 60 secs. (Fig 3)

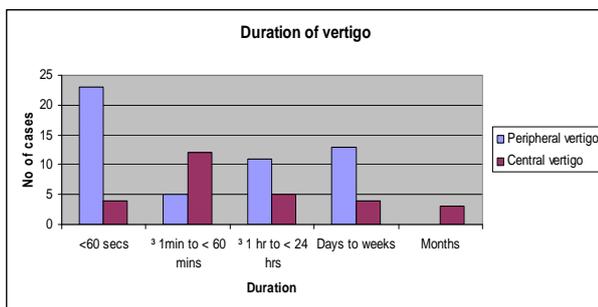


Figure 3: Duration of Attack

### 3.5 Aggravating Factors

Aggravating factors were observed in almost 56 (70%) cases. Certain postures (turning of head, rolling over in bed, sitting to supine, looking upwards, bending of head), was significantly associated with peripheral vertigo 31.25% cases (P-value $<0.05$ ). Neck movement as aggravating factor was seen in 17.5% cases and was significantly associated with central vertigo (Fig 4).

### 3.6 Relieving factors

Rest in a quiet room was the most common relieving factor seen in 33 (41.25%) cases out of which 22 cases had peripheral vertigo. Posture change 28 (35%) cases and vestibular sedatives in 13 (16.25%) cases were relieving factors. Change in posture was seen in 23 patient with the peripheral vertigo, Fisher's exact test is performed and the p-value of the test is 0.063 (p $>0.05$ ).

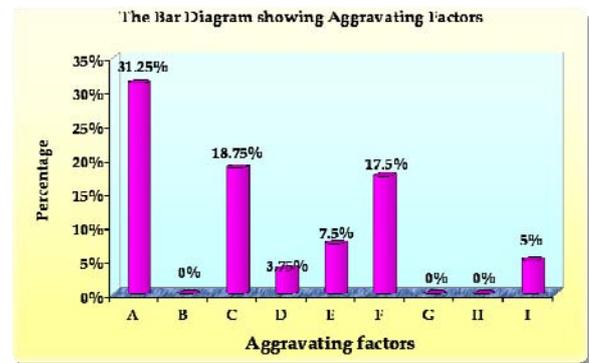


Figure 4: Aggravating factors; A) Turning of head/sitting to supine/bending of head/ looking upward. B) Suddenly standing up from sitting / supine position C) Rapid head movement D) Emotional factors E) While walking F) Neck movement G) Travelling in air/ bus / train H) Coughing/sneezing/by lifting weight /Valsalva maneuver/ sudden ear trauma I) Menstruation, sleep deprivation

### 3.7 Associated Symptoms

Impairment of hearing, aural fullness, tinnitus and fever/URI were more often seen in patients with peripheral vertigo. Nausea and vomiting were present in 44(55%) cases and was more often seen in cases of peripheral vertigo as compared to central vertigo. Blurring of vision and cardiovascular symptoms like palpitation, chest discomfort and breathlessness were more often seen in patient of central vertigo. Z test for single proportion is performed. It is seen that hearing loss is significantly associated with peripheral and central vertigo with the test value 10.77 ( $>1.96$ ) and 2.56 ( $>1.96$ ) at 5% significance level respectively. Nausea and vomiting also significantly associated with peripheral and central vertigo with the test value 14.363 ( $>1.96$ ) and 4.103 ( $>1.96$ ) at 5% significance level respectively. (Fig 5)

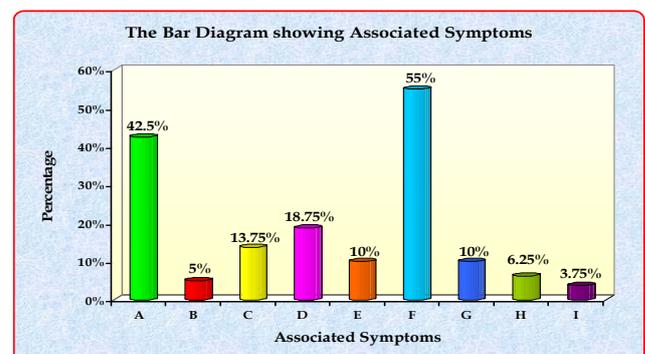


Figure 5: Associated symptoms; A) Hearing loss B) Ear discharge C) Aural fullness D) Tinnitus E) Fever/URI F) Nausea and vomiting G) Blurring of vision H)

Cardiovascular symptoms I) CNS symptoms; motor/sensory loss or headac

### 3.8 Past illness

The commonest past illness was hypertension seen in 13 (16.25%) cases, which was more frequently associated with central vertigo followed by head injury and diabetes mellitus. Ear surgeries include tympanoplasty; myringoplasty and mastoid exploration for CSOM were significantly associated with peripheral vertigo. (Fig 6)

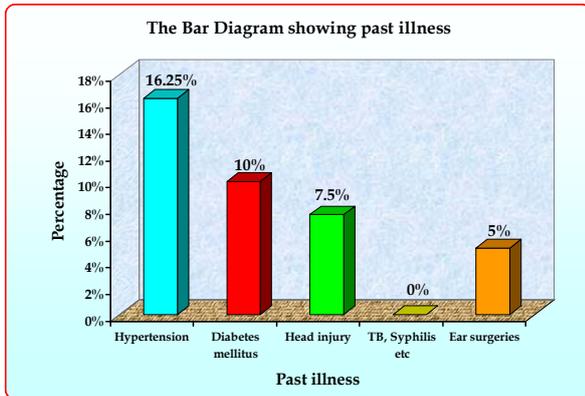


Figure 6: Past Illness

### 3.9 Neurotological Profile

Positional nystagmus on Dix-Hallpike maneuver was significantly associated with peripheral vertigo as compared to those of central vertigo. Spontaneous nystagmus, tandem walking and stepping test were often seen with peripheral vertigo. Z test for single proportion is performed. Spontaneous nystagmus, Romberg’s test, Stepping test, Writing test and Positional/positioning test are statistically associated with peripheral vertigo with their corresponding test value 4.61, 3.07, 9.23, 7.69, 7.18 and 13.85 respectively, as all the values are greater than 1.96 at 5% level of significance. (Fig 7)

### 3.10 Audiometric Profile

Pure tone audiometry revealed normal hearing in 108 ears, (67.50%), sensorineural hearing loss in 42 ears (26.25%), conductive hearing loss was seen in 6 ears (3.75%) and mixed hearing loss was seen in 4 ears (2.5%). All patients of vestibular neuritis had the normal hearing, 82.6% cases of BPPV had normal hearing. (Fig 8)

### 3.11 Electronystagmography tests

Tests for spontaneous nystagmus was present in 18 (22.5%) cases out of which 18 (100%) cases were of peripheral vertigo and (00%) of central vertigo. Tests for gaze nystagmus was present in 12 (15%) cases out of which 07 (58.33%) were of peripheral vertigo and 05 (41.66%) were of central vertigo. Positional nystagmus was present in 23 (28.75%), out of which 20 (86.95%) cases were of peripheral vertigo and 3 (13.04%) cases were of central vertigo. On estimation of nystagmus intensity by slow phase velocity, the Caloric test showed normal response in 51 (70.83%) cases, canal paresis in 18 (25%) cases and

directional preponderance in 03 (4.16%) cases. Fig (9). Estimation of nystagmus intensity was also done by calculating culmination frequency the result showed mostly of butterfly pattern of 0000 in 56 (77.77%) cases, 1000 in 01 (1.38%) case, 0010 in 01 (1.38%) case, 1100 in 06 (8.33%) cases 0011 in 04 (5.55%) cases, 1111 in 01 (1.38%) case, 1021 in 02 (2.77%) cases and pattern 2100 in 01 (1.38%) case. Fig (10)

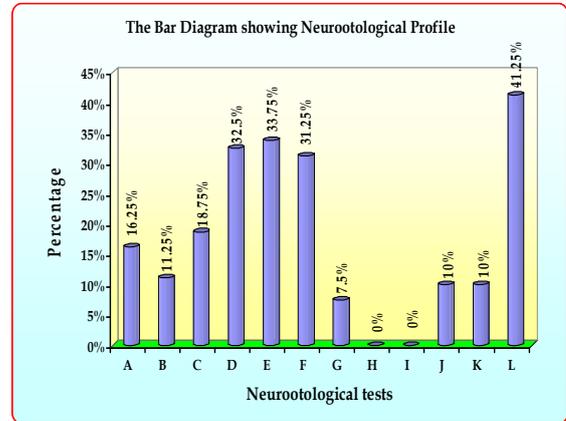


Figure 7: Neurotological tests; A: Spontaneous nystagmus B: Gaze nystagmus C: Romberg’s test D: Walking test E: Stepping test F: Writing test G: Past pointing H: Finger nose test I: Rapidly alternating test J: Head shaking nystagmus test K: Head thrust test L: Positional/positioning test

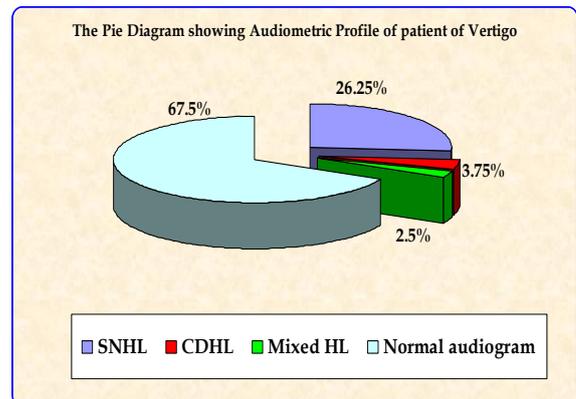


Figure 8: Audiometric profile

### 3.12 BERA

BERA test was done in 23 patients and the result showed abnormal response in 21.74% cases. BERA test was done only in those patient who is having Eight Nerve Lesion.(Fig 11)

### 3.13 Etiology

**3.13.1 Disorders of Central vertigo:** Cervical vertigo constituted the largest group 07 (25%) cases, followed by vertebrobasilar insufficiency, seen in 04 (14.28%) cases Fig 12.

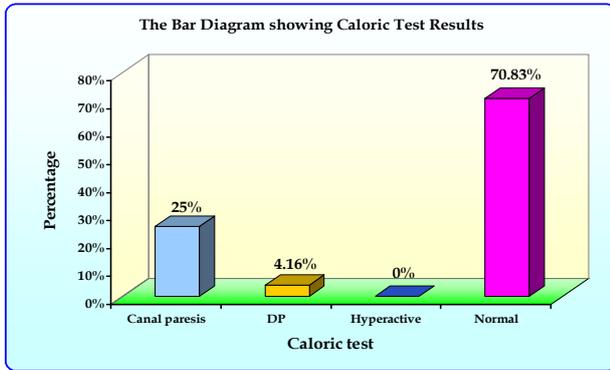
**3.13.2 Disorders of peripheral vertigo:** Spectrum of Peripheral vertigo disorder were divided into three groups viz., middle ear lesion, end organ lesion and eight nerve lesion. The maximum number of cases 37 (71.15%) were

due to end organ lesion whereas middle ear pathology accounts for 4 (7.69%) cases. The rest 11 (21.15%) cases were due to lesions in the vestibulocochlear nerve lesion. Amongst the middle ear lesions CSOM was found in 2 (3.85%) cases and post-operative vertigo was found in 2 (3.85%) cases. Amongst the inner ear pathology, BPPV 23 (44.23%), Meniere's Disease 10 (19.23%) cases formed the major part, while the incidences of labyrinthitis and sudden deafness were (5.76%) and (1.92%) respectively. In the inner ear lesions, acoustic neuroma and vestibular neuronitis were seen in 7.69% and 13.46% cases (Table-I)

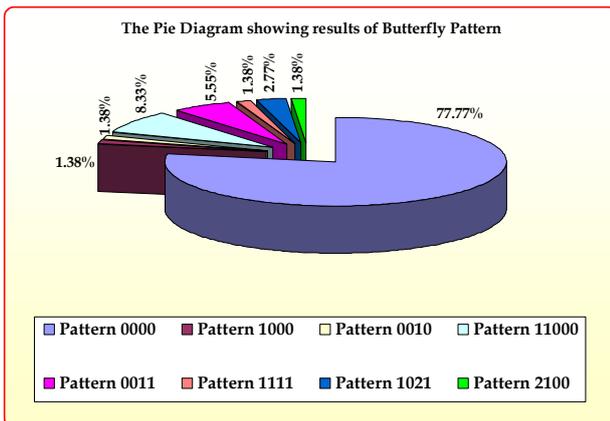
study, peripheral vertigo was more common in 41-50 years age (65%) but Pipal S.K. et al reported in 31-40 years of age. For central vertigo findings of our study was similar to that of Pipal S.K. et al i.e in age group 51-60 years. The morbid conditions and systemic diseases in elderly people seems to be reason for central vertigo in this age group.

**Table 1:** Peripheral causes

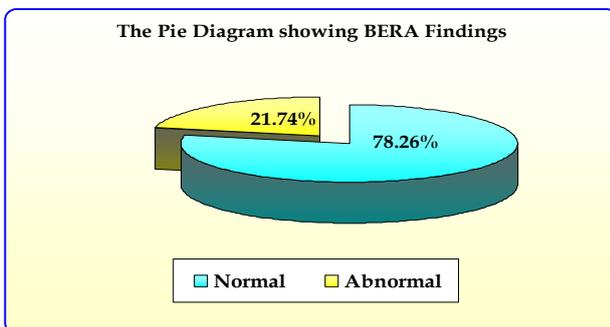
Site	Lesions	Case	%
Middle ear	CSOM (attico-antral)	02	3.85
	Post ear surgery	02	3.85
End organ	BPPV	23	44.23
	Meniere's disease	10	19.23
	Labyrinthitis	03	5.76
	Sudden deafness	01	1.92
Vestibular nerve	Acoustic neuroma	04	7.69
	Vestibular neuritis	07	13.4



**Figure 9:** Caloric test results



**Figure 10:** Butterfly chart pattern

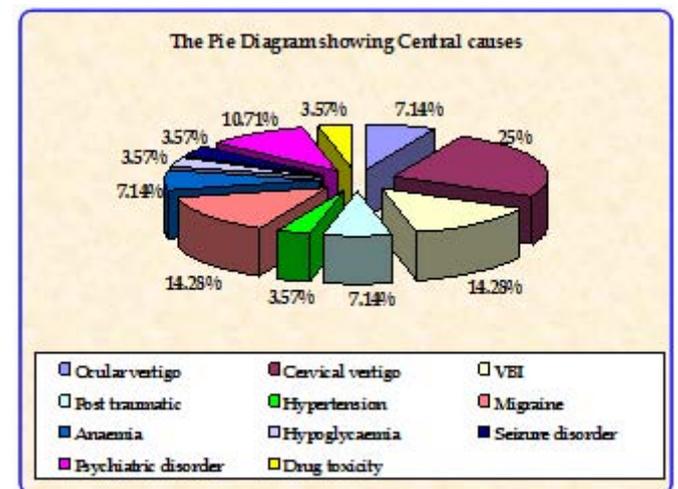


**Figure 11:** BERA findings

## 4. Discussion

### 4.1 Age Incidence

Although the peak age of incidence of vertigo in our study is 5<sup>th</sup> decade, studies by Deka (1985), Gopal (1991), Gulati et al (1992) and Pipal S.K. et al., (2008)[4,6,7,14] reported it in younger age group i.e 3<sup>rd</sup> and 4<sup>th</sup> decade. In the present



**Figure 12:** Causes of Central vertigo

### 4.2 Sex incidence

Our study does not reveal any striking difference in sex distribution of vertigo in comparison to other studies.

### 4.3 Duration of attack

55% cases in our study had vertigo episode lasting between 1 second to 1 hour whereas Pipal S.K. et al (2008) and Kennedy et al, (1997) reported it in 95% and 86.08% cases respectively [8,14]. Dix & Hallpike (1952) concluded that vertigo episodes lasting between 5-90 seconds are typical of BPPV. In our study also, all the 23 patients of BPPV had episode lasting less than 60 seconds.

**Table 2:** Sex incidence in different studies

Total cases	Author	Male : Female
330	Bhatia & Deka (1985)	3:2
50	Gulati et al., (1992)	2:1
118	Mishra et al., (1994)	1.68:1
100	Pipal S.K. et al., (2008)	1.78:1
80	Present study	1.85:1

#### 4.4 Aggravating and relieving factors

Our study showed 73.75% cases with aggravating factors which is marginally less than others studies by Kennedy et al, (1997) and Pipal S.K. et al (66.91%) and (85%) respectively[8,14]. Change of head position and rapid head movement are common aggravating factor which is due to the peripheral nature of the vertigo. Among the relieving factors, resting in a quiet room was found to be most common as it decreases the stimulation of the end-organs and gives relief. 70% cases had relieving factor while Kennedy et al (1997) and Pipal S.K et al reported 97.7% and 82% cases [8,14].

#### 4.5 Associated symptoms

In this present series, the hearing loss was observed in 34 (42.5%) cases, tinnitus in 15 (18.75%) cases and nausea and vomiting in 44 (55%) cases similar to other studies [2,7,8,14]. They reported incidence of hearing loss, tinnitus, nausea and vomiting varying from 16% to 39%, 32% to 48% and 24% to 78% cases respectively. All patients of tinnitus were diagnosed to have menieres disease, acoustic neuroma and one case of sudden hearing loss. Aural fullness was reported in about 18% -20% cases in other studies. [2,8,14]. We found it in 11 (13.75%) cases and were having Menieres disease.

#### 4.6 Past history

Our study reported high numbers of patients with history of diabetes mellitus as compared to other studies. (Table 3)

#### 4.7 Oto-neurological profile

Positional test was positive in 41 cases which is similar to Mishra et al[11] but other studies had much lesser cases. Spontaneous nystagmus and stepping test found similar with other studies [8,14].

#### 4.8 Audiometric profile

In our study majority of cases had normal audiogram (67.5%) followed whereas studies by Mishra and Kennedy found sensory neural loss to be more (43.2% & 50.7%) respectively. Mixed hearing loss was similar to other studies.

#### 4.9 Electronystagmography

Gaze nystagmus was present in 12 (15%) cases out of which 07 (58.33) were of peripheral vertigo and 05 (41.66%) were of central vertigo. In Pendulum tracking test, type III/IV wave was not seen in both central vertigo and peripheral vertigo. Positional nystagmus was present in 23 (28.75%), out of which 20 (86.95%) cases were of peripheral vertigo and 3 (13.04%) cases were of central vertigo. Caloric test showed normal response in 51 (70.83%) cases similar to other findings.[7, 8,11,14]. Canal paresis was observed in 18(25%) cases and directional preponderance in least number cases ,03 (4.16%), as compared to other studies by Pipal S.K.et al and Mishra et al. We found no hyperactive response whereas Behl et al reported %0% cases with hyperactivity.

Estimation of nystagmus intensity was also done by calculating culmination frequency the result showed mostly of butterfly pattern of 0000 in 56 (77.77%) cases; 1000 in 01 (1.38%) case; 0010 in 01 (1.38%) case; 1100 in 06 (8.33%) cases 0011 in 04 (5.55%) cases; 1111 in 01 (1.38%) case; 1021 in 02 (2.77%) cases and 2100 in 01 (1.38%) case.

#### 4.10 BERA test

It was done in 23 patients and abnormal response was obtained in 5 (21.74%) cases. It is very helpful to determine the integrity of the auditory/vestibular nerve (Eight Cranial Nerve)

**Table 3:** Past history in patients of vertigo

	Behl 1982	Kennedy 1997	Pipal S. K 2008	Present 2011
No of cases	50	133	100	80
HT %	2	12.03	20	16.25
DM %	4	7.51	4	10
Head injury %	2	10.5	6	7.5

#### 4.11 Etiology of vertigo

In the present series we have noted 52 (65%) cases of peripheral vertigo and 28 (35%) cases of central vertigo. In our study BPPV is the commonest cause 23 (44.23%) cases, of peripheral vertigo (Montadon , 28%; Deka et al., 17%) [4,13]. Others (Gopal et al.,22.5% cases; Gulati et al, 16%; Mishra et al.,8.4% cases and Majumdar et al., 20% have also reported BPPV to be the predominant cause). Meniere's disease which is supposed to be the commonest peripheral vestibular disorder (Mawson and Ludman [10] is less commonly seen in our set up 10 (19.23%). Others (Gulati et al.,1992-10% and Majumdar et al.,10.5%). Vestibular neuronitis, was observed in 7 (13.46%) cases in our study. Other authors like, Gopal et al., 1991 observed vestibular neuritis in 6.2% and Majumdar et al., [9] observed 6.4% cases of vestibular neuritis. Instantaneous event of sudden deafness was found in 1 (1.92% cases. The etiology remains obscure. McCabe [12] reported 18 cases of sudden deafness with vertigo demonstrating immunological findings and suggesting an autoimmune phenomenon. Central causes include cervical vertigo (25%), VBI (14.28%) and migraine (14.28%) as the commonest cause in descending order

### 5. Conclusion

The clinical profile showed peaks in 41-50 years age group for peripheral vertigo and 51-60 years Age group for central vertigo. There was an overall male preponderance (M:F::1.85:1). Vertigo is mostly due to peripheral etiology. Amongst peripheral causes BPPV, Meniere's disease, vestibular neuritis were the three common causes in descending order. Central causes include cervical vertigo and VBI as the two common causes in descending order. To make diagnostic evaluation of vertigo prime importance is to be given to thorough history taking. The history is key to determining the onset of problem, description of the symptoms and, most importantly, how the symptoms affect the individual's life style. The bedside clinical examination can be used to distinguish peripheral versus central

vestibular problem, the degree of loss and how acute the problem may be. Subsequent detailed clinical examination of the balance system, and investigations for vestibular dysfunction are to be done to confirm diagnosis. The efficacy of different audio-vestibular and radiological tests like ENG, CCG, BERA, CT-scan, MRI etc are hi-tech development in this subject. Finally, the present study has been able to correlate some established facts. Further study may help to establish newer facts to diagnose patient with vertigo. Hence it is concluded that with proper clinical history taking, detailed clinical examination of the balance system, laboratory audio-vestibular test and special radiological tests like CT-Scan and MRI can provide strong foundation for the proper diagnosis of the vertigo cases. Subject itself still remains an enigma. Modification of strategy for the diagnosis of patient with vertigo is under development to minimize the number of steps required to arrive at a diagnosis and to eliminate procedures that may be unnecessary in particular cases without the loss of diagnostic accuracy.

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