

Assessment of application of Video Nystagmography in diagnosis of Vertigo: Application of videonystamography (VNG)

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Abstract-

Background: Diagnosis of Vertigo demands that the complaint of vertigo be analyzed correctly, the nature of the disturbance of function being determined first and then its anatomic localization. Vestibulonystagmography (VNG) has been recommended as a dependable investigation of vertigo.

Objectives: This study aimed to evaluate the role of Video Nystagmography (VNG) in the diagnosis of vertigo & to assess the benefit of VNG in confirmation of canalolith repositioning in patients with BPPV after Epley's maneuver. **Methods:** A Prospective Observational Study was conducted among patients of peripheral Vertigo attending Al Ameen Medical College, Vijayapura, Karnataka, India. A total of 110 patients were included in the study. The patients were followed up on 7th day, 14th day and at 3 Months. Among patients of BPPV, Epley Maneuver was performed at first visit and 7th day follow up & its impact was assessed at 7th day and 14th day respectively. At 3 months both Dix Hallpike & VNG were performed.

Results: Out of the five tests of VNG, four tests (which include Saccadic Test, Gaze Test, Optokinetic Test and Caloric Test) were Normal in all the 110 patients. The Position Test was Positive in 72.73% of patients which indicates that 72.73% patients had either BPPV or Vestibular Neuritis. Dix Hallpike test was positive in 75 cases (68%) & 35 patients (31.8%) had a negative result.

Conclusion: VNG is a simple, reliable and objective diagnostic tool for evaluation of patients presenting with Vertigo & it can differentiate between a central and peripheral vestibular lesion.

Keywords: Vertigo, Diagnosis, Video Nystagmography, Epley Maneuver.

INTRODUCTION

Vertigo is a symptom of vestibular dysfunction with a sensation of motion [1]. It is one of the common presenting complaints in primary care institutions and emergency departments. Vertigo is defined as the hallucination of movement, either of self or the environment. Different words are used by different patients about the type of motion being perceived which include Bouncing, Oscillating, Staggering, Swimming, Twisting Rolling, Spinning, Rocking, Lightheadedness, Imbalance, Floating, Fainting, Falling. Diagnosis of the underlying disease demands that the complaint of vertigo be analyzed correctly, the nature of the disturbance of function being determined first and then its anatomic localization [2]. A careful history and physical examination usually affords the basis for separating true vertigo from the dizziness of the anxious patient and from the other types of pseudo vertigo. In order to reach the exact diagnosis, devise the best management plan & assess the prognosis of treatment a thorough history, clinical examination, various bedside tests like Head thrust test, Dynamic visual acuity, Head shaking test, Dix Hallpike's test, Fukuda's test and Calorie test and investigations like CT / MRI brain, X-Ray neck, Blood sugar, Lipid profile, Carotid vertebral Doppler are being used [3]. Even after an exhaustive diagnostic protocol the validity of the diagnosis is sometimes being questioned & the search for some new and more valid diagnostic test continues. In recent past Vestibulonystagmography (VNG) has been recommended as a dependable investigation of vertigo & has been used at many big health institutions. VNG is a test used to determine whether or not dizziness may be due to inner ear disease [4]. It also assesses the function of the vestibular end organs, central vestibulo-ocular pathway and oculomotor processes. VNG is useful to test balance system and record nystagmus by a camera [5]. There are neural connections that stretch balance mechanisms in inner ear to muscles of eye. Any disorder of balance mechanism produces small eye jerks that can only be detected by computer and Frenzel's goggles. It can be monitored by putting body in different positions by Dix Hallpike's test and Roll Over test [6]. This study has been devised to assess the

utility of VNG in the diagnosis of vertigo. VNG was introduced by Ulmer in 1989, provides an objective assessment of the oculomotor and vestibular system, and is potentially useful to clinicians in otorhinolaryngology, neurology, and ophthalmology. Therefore, this study aimed to evaluate the role of Video Nystagmography (VNG) in the diagnosis of vertigo and to assess the benefit of VNG in confirmation of canalolith repositioning in patients with BPPV after Epley's maneuver.

MATERIAL AND METHODS

The present study was conducted in the Al Ameen Medical College, Vijayapura, Karnataka, India. This prospective observational study was conducted among the study participants attending the medical college. Study participants were composed of all the patients of peripheral vertigo attending Al Ameen Medical College, Vijayapura, Karnataka, India. Inclusion Criteria constituted patients within the range of 21 to 70 years of either gender presenting with peripheral vertigo. Exclusion Criteria constituted with patients of central vertigo, patients of vertigo with severe cervical spinal disease, uncontrolled hypertension and active heart ailments. Only those patients who gave the consent & fulfilled the criteria were taken into the study. Thus a total of 110 patients were taken. Ethical Clearance was obtained from the Institutional Ethical Committee, before the start of study. Patients under the study were subjected to a detailed history & general examination along with clinical evaluation through complete ENT examination, audiological assessment and vestibular tests. The study subjects were also subjected to Video nystagmography (VNG) Tests. Follow up examinations were done at 7th Day, 14th Day & at 3 months. All those patients who were diagnosed as cases of BPPV were subjected to Epley's Maneuver & were assessed on 7th day with Dix Hallpike. Those patients who had a negative result on Dix Hallpike & whose symptoms were resolved were labelled as cured. Those patients who had a positive result on Dix Hallpike were subjected to Epley's Maneuver again & on 14th day (second follow-up) these patients were again assessed with Dix Hallpike for recovery. The third follow up was done at 3 months for all 110 patients under study. Both Dix Hallpike & VNG were performed at this follow-up & canalolith repositioning in patients with BPPV after Epley's maneuver was confirmed. Statistical analysis Data was entered into Microsoft Excel spreadsheet & exported to data editor of Statistical Package for Social Sciences (SPSS Ver. 23) where in statistical analysis was done. Categorical variables were described as frequencies and percentages.

RESULTS

Table 1: Distribution of patients in our study with different study parameters.

VNG Test Findings			
Symptoms	Type	Frequency	Percent
Saccadic Test	Normal	110	100
Gaze Test	Normal	110	100
Optokinetic Test	Normal	110	100
Caloric Test	Normal	110	100
Position Test	Normal	30	27.27
	Positive	80	72.73
Distribution of patients according to Saccadic Test of VNG			
Saccadic Test	Type	Frequency	Percent
Amplitude	Normal in Horizontal & Vertical Saccades	110	100%
Latency	Normal in Horizontal & Vertical Saccades	110	100%
Accuracy	Normal in Horizontal & Vertical Saccades	110	100%
Velocity	Normal in Horizontal & Vertical Saccades	110	100%

Symmetry	Normal in Horizontal & Vertical Saccades	110	100%
Distribution of patients according to Optokinetic Test & Gaze Test of VNG			
VNG Test	Test result	Frequency	Percent
Optokinetic Test	Responses Preserved	110	100%
	Optokinetic Gain Symmetric	110	100%
Gaze Test	No Gaze Evoked Nystagmus	110	100%
Distribution of patients according to Position Test of VNG			
Position Test Result	Frequency	Percentage	Diagnosis
Left Upbeat Torsional Nystagmus	39	35.5	Left BPPV
Right Upbeat Torsional Nystagmus	36	32.7	Right BPPV
No Positional Nystagmus	30	27.3	Meniere's disease
Horizontal Nystagmus Present	5	4.5	Vestibular neuritis
Distribution of patients at First Follow-up Examination (7TH Day). (n=75)			
1st Follow-up Examination (Day7)	Type	Frequency	Percent
Dix hallpike	Negative	53	70.67
	Positive	22	29.33
Distribution of patients at Second Follow-up Examination (14TH Day). (n=22)			
2nd Follow-up Examination (Day14)	Type	Frequency	Percent
Dix hallpike	Negative	22	100
	Positive	0	0
Distribution of patients as per pathology			
Diagnosis	Frequency	Percent	
BPPV	75	68.2	
Meniere's disease	30	27.3	
Vestibular neuritis	5	4.5	
Distribution of patients according to Final Diagnosis			
Final diagnosis	Frequency	Percent	
Left BPPV	39	35.5	
Right BPPV	36	32.7	
Meniere's disease	30	27.3	
Vestibular neuritis	5	4.5	
Distribution of patients at 3 Months Follow-up			
Follow-up Examination at 3 Months	Frequency	Percent	
Dix hallpike	Positive	0	0
	Negative	110	100
VNG	Positive	0	0
	Negative	110	100
Relationship between Diagnosis and Dix Hallpike			

Dix Hallpike	Diagnosis			
	BPPV	Meniere's disease	Vestibular neuritis	Total
Left up beat torsional	38	0	0	38
Rightupbeat torsional	37	0	0	37
Negative	0	30	5	35
Total	75	30	5	100

Relationship between Diagnosis and Position Test				
Position Test	Diagnosis			
	BPPV	Meniere's disease	Vestibular neuritis	Total
Negative	0	30	0	30
Positive	75	0	5	80
Total	75	30	5	110

Distribution of patients in our study with different study parameters is recorded in above **Table 1**. In our study we recorded that out of the five tests of VNG, four tests (which include Saccadic Test, Gaze Test, Optokinetic Test and Caloric Test) were Normal in all the 110 patients. The Position Test was positive in 72.73% of patients which indicates that 72.73% patients had either BPPV or Vestibular Neuritis. All the sub-tests of Saccadic Test had test result of Normal in Horizontal & Vertical Saccades, which excludes any central nervous system abnormality among the patients. Optokinetic Test had Responses Preserved & Gain Symmetric in all the 110 patients, thereby excluding cerebral, cerebellar and brain stem lesions. In Gaze Test, No Gaze Evoked Nystagmus was observed in all the 110 patients, thus excluding any cerebellar pathology or any posterior fossa abnormality.

On Position Test of VNG, we recorded 39 patients (35.5%) with Left Upbeat Torsional Nystagmus, which indicates Left BPPV, 36 patients (32.7%) with Right Upbeat Torsional Nystagmus, which indicates Right BPPV, 5 patients (4.5%) with Horizontal Nystagmus, which indicates Vestibular Neuritis, 30 patients (27.3%) with no nystagmus, which indicates Meniere's Disease, 53 patients with a negative Dix hallpike test at 1st Follow-up Examination (Day 7), while as 22 had a positive Dix hallpike test. These 22 cases were further subjected to Epley Maneuver & followed for another week. All the 22 patients had a negative Dix hallpike test at 2nd Follow-up Examination (Day 14).

Out of 110 patients in this study 75 Patients (68.2%) had BPPV, 30 Patients (27.3%) had Meniere's disease & only 5 Patients (4.5%) had Vestibular neuritis. 39 Patients (35.5%) had Left BPPV, 36 Patients (32.7%) had Right BPPV, 30 Patients (27.3%) had Meniere's disease & only 5 Patients (4.5%) had Vestibular neuritis. Dix Hallpike presented as Left up beat & Right upbeat torsional in all BPPV cases, while as it presented as negative in Meniere's disease and Vestibular neuritis cases. Position Test was positive in all the five cases of Vestibular neuritis and in all the 75 cases of BPPV, while as it was negative in all the 30 cases of Meniere's disease. This association was statistically significant with a p value of < 0.001. All the 110 patients had a Negative result on Dix hallpike & a Normal result on VNG at 3 Months.

DISCUSSION

The present study was conducted in the Al Ameen Medical College, Vijayapura, Karnataka, India. Patients aged 22 to 70 years of either gender presenting with the complaint of vertigo were included in a Prospective Observational Study. A total of 110 patients were included in the study. A detailed history, complete ENT examination, audiological assessment including PTA, clinical vestibular tests and VNG was carried out among all the patients. The patients were followed up on 7th day, 14th day and at 3 Months for further assessment. Among patients who were found to have BPPV, Epley Manuere was performed at first visit and 7th day follow up & its impact was assessed at 7th day and 14th day respectively. At 3 months both Dix Hallpike & VNG were performed. This study was conducted with following inclusion and exclusion criteria: Video nystagmography (VNG) Out of the five tests of VNG, four tests (which include Saccadic Test, Gaze Test, Optokinetic Test and Caloric Test) were Normal in all the 110 patients, which indicates that the cause of vertigo was peripheral. while as Position Test was Positive in 72.73% of patients. All the sub-tests of Saccadic Test had test result of Normal in Horizontal & Vertical Saccades. Optokinetic Test had Responses Preserved & Gain Symmetric in all the 110 patients. In Gaze Test, No Gaze Evoked Nystagmus was observed in all the 110 patients. The Position Test of VNG was positive for all the 75 BPPV patients and 05 Vestibular neuritis patients, while as it was negative among all the 30 Meniere's disease patients. In 36 (32.7%) patients of Vertigo, the Position Test showed a Right Upbeat Torsional Nystagmus indicating Right BPPV, while as

in 39 (35.5%) patients of Vertigo, the Position Test showed a Left Upbeat Torsional Nystagmus indicating Left BPPV. In 30 (27.3%) patients of Vertigo, the Position Test showed No Positional Nystagmus indicating Meniere's disease; while as in 5 (4.5%) patients of Vertigo, it showed Horizontal Nystagmus indicating Vestibular neuritis. When these diagnoses were compared with clinical diagnosis, based on symptoms, signs and other tests, they were found to be exactly the same.

Thus Video nystagmography (VNG) is a simple, reliable and objective diagnostic tool for the evaluation of patients presenting with Vertigo. The VNG also documents the benefits of Epley Maneuver among patients of BPPV. VNG can differentiate between a central and peripheral vestibular lesion, and if peripheral it can decipher between unilateral and bilateral vestibular loss.

VNG addresses the functionality of each ear. Thus VNG helps document unilateral/bilateral loss of vestibular function, confirm benign peripheral positional vertigo (BPPV), and detect central lesions that are missed during a routine physical examination. One study concluded that VNG helps in finding out the cause of vertigo, including whether the cause is unilateral or bilateral. They also described the utility of VNG in detecting the central lesions that are missed during a routine physical examinations [7].

These findings are very much similar to our findings. Distribution of different Diagnoses of Vertigo Out of the 110 patients included in the study, 75 (68.2%) had BPPV, 30 (27.3%) had Meniere's disease and 05 (4.5%) had Vestibular neuritis. Many studies have shown similar distribution of different diagnosis among patients of Vertigo with BPPV being the most frequent diagnosis. Peripheral vertigo, the most common cause is benign paroxysmal positional vertigo [8]. A total of 444 patients between the age of 6 and 89 years were included in the study. The most frequent cause of vertigo/dizziness was benign paroxysmal positional vertigo (59.23%) followed by unilateral/bilateral vestibular hypofunction (20.72%), central pathologies (14.63%), Meniere's disease (3.60%) and vestibular neuritis (1.80%). They concluded that the most common diagnosis was benign paroxysmal positional vertigo [9]. Five most common diagnoses were phobic postural vertigo, benign paroxysmal positional vertigo, vestibular neuritis, psychogenic vertigo and Ménière's disease [10-15]. Thus, the results of all these studies are very much similar to the results of our study with respect to the relative proportion of different diagnoses of Vertigo.

Epley Maneuver & follow up assessment with Dix hallpike Dix Hallpike test was positive in 75 cases (68%). 36 patients (33.6%) had Right upbeat torsional result, 39 patients (34.5%) had Left upbeat torsional result & 35 patients (31.8%) had a negative result on Dix Hallpike. Dix Hallpike presented as Left up beat & Right upbeat torsional in all BPPV cases, while as it presented as negative in Meniere's disease and Vestibular neuritis cases. The 75 BPPV patients were provided with Epley Maneuver & followed up on 7 th & 14th day for response to management. 53 patients had a negative Dix hallpike test at 1st Follow-up Examination (Day 7), while as 22 had a positive Dix hallpike test. These 22 cases were further subjected to Epley Maneuver & followed for another week. On 2nd Follow-up Examination (Day 14), these 22 patients were subjected to assessment through Dix hallpike test & all had a negative result. Thus finally all such patients were symptom-free on 14th Day. On 3rd Follow-up Examination (at 3 Months), all the 110 patients were assessed through Dix hallpike & VNG; and both the tests were normal in all the 110 patients. Thus Epley Maneuver benefits the patients of BPPV, and this can be confirmed with VNG on follow up examination. Patients with benign paroxysmal positional vertigo benefit from nonpharmacologic agents [16].

The primary treatment for BPPV is focused on head rotation maneuvers that displace calcium deposits back to the vestibule through canalith repositioning or the Epley maneuver. The benefit of the Epley maneuver is that the patient at home can perform it. To perform a modified Epley maneuver, patients are instructed to position themselves upright on a bed with their head turned 45 degrees to the left and a pillow behind them. The pillow should be positioned so that when supine, the pillow is directly under their shoulders. Once the patient is in position, they should lie back quickly onto the pillow, so the head is reclined onto the bed. They should hold this position for 30 seconds. Without raising their head, they should then turn their head 90 degrees to the opposite side (right) and hold this position for another 30 seconds. After 30 seconds, they should turn their body and head another 90 degrees to the right and wait for another 30 seconds. Finally, they should sit up on the right side of the bed. This maneuver can be repeated starting on the opposite side and should be performed at least three times a day until the patient has no further episodes of positional vertigo for 24 hours. The Epley maneuver is effective in 50 to 90% of patients. One study studied 35 patients of BPPV presenting at vertigo clinic of ENT Department at Civil Hospital Ahmedabad treated with canalolith repositioning procedure (CRP) and improved in nystagmus and confirmed by VNG. They included 35 patients suffering from BPPV with positive history of positional vertigo, confirmed with Dix hallpike's test and nystagmus was recorded with VNG. VNG showed improvement in nystagmus immediately in 31 patients after 1st CRP, 3 patients showed improvement on VNG with 2nd CRP and 1 with 3rd CRP. They concluded that Video Nystagmography is a very useful tool for ensuring the otolith repositioning by the canalith repositioning maneuver. It is a confirmatory adjunct to visual analysis [17].

One study concluded that complete evaluation of a dizzy patient must be done to arrive at a causal diagnosis. Injudicious use of vestibular sedatives should be discouraged. They suggested that a proper training and education to

the primary care physician should be imparted so that they can adopt a practical approach for evaluation and management of a dizzy person [18].

Another study proved that VNG helps document unilateral/bilateral loss of vestibular function, confirm benign peripheral positional vertigo (BPPV), and detect central lesions that are missed during a routine physical examination. They also mentioned that VNG helps to decide whether additional tests (e.g. MRI) are needed and helps in preoperative evaluation of such patients [19]. These results from these studies are consistent with the results from our study. Video nystagmography (VNG) has the benefit of not requiring skin preparation or electrode application and wiring. Moreover, adjustments are seldom required as VNG does not depend on changes in corneo-retinal potential over time in contrast to ENG. However, VNG is unable to record eye movements when the eyes are closed. Video nystagmography (VNG) can differentiate between a central and peripheral vestibular lesion, and if peripheral it can decipher between unilateral and bilateral vestibular loss. VNG addresses the functionality of each ear [20].

CONCLUSION

Vertigo is a symptom of vestibular dysfunction with a sensation of motion, whose underlying cause needs to be elucidated so that proper management is planned. The diagnosis protocol of Vertigo is an exhaustive one including detailed history, thorough examination and a long set of bedside tests; & even after that there is sometimes a diagnostic dilemma. In our study BPPV was the most common diagnosis followed by Meniere's disease. The Position Test of VNG differentiated very efficiently between different diagnoses along with the side involved & Epley Maneuver was found very useful as a non-pharmacological management tool for BPPV. This benefit of Epley Maneuver in patients of BPPV can be confirmed with VNG on follow-up examination. It was concluded that Video nystagmography (VNG) is a simple, reliable and objective diagnostic tool for the evaluation of patients presenting with Vertigo & it can differentiate between a central and peripheral vestibular lesion, and if peripheral it can decipher between unilateral and bilateral vestibular loss.

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