

Effectiveness of Vestibular Rehabilitation Therapy in Patients Suffering from B.P.P.V

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Abstract: Majority of patients who suffered from Vertigo due to Benign Paroxysmal Positional Vertigo (B.P.P.V) have a residual feeling of imbalance and light headedness. This is compounded by phobia and psychological dread of getting an attack of Vertigo. Most of patients of B.P.P.V need some form of Vestibular Rehabilitation. This study was aimed to examine the benefits of our 21 day customized Vestibular rehabilitation program (Radsan Program). Vestibular Rehabilitation is an effective method of functional restoration of the patient who has been affected with Vertigo.

Keywords: Benign Paroxysmal Positional Vertigo, Vestibular rehabilitation therapy, Vertigo, Exercise therapy, Posterior Semicircular Canal

1. Introduction

Benign paroxysmal positional Vertigo is by far the most common form of Vertigo encountered in Clinical practice [1]. Most of the patients who suffered from B.P.P.V have constant sense of imbalance and light headedness. This may be due to asymmetric dynamic gain of vestibular reflexes. This study looks at the effectiveness of our Vestibular and Balance rehabilitation strategies used in B.P.P.V patients after the acute phase.

2. Materials and Methods

2.1 Type of study

The degree of suffering from Vertigo and response to Vestibular Rehabilitation is not quantifiable on a percentage or numerical scale; hence this is a type of Non- parametric, before- after response type of clinical study.

2.2 Method of study

Patient selection criterion

A total of 15 B.P.P.V patients were selected. Only those had moved out of acute phase, with Epley and Semont maneuvers or with drugs were chosen [2]. These were the set of patients who needed Vestibular rehabilitation. The entire study was carried out on an out-patient basis, for 3 weeks, in a private practice setup at our Sai Sanjeevan Clinic, Mulund West, Mumbai -80. The study was designed by the principle author and implemented in an integrated manner by his spouse Mrs. Radha in her day today Physical therapy and Rehabilitation practice from Sep 2012 to Jan 2013.

2.3 Diagnostic Inclusion criterion. [1]- [4]

1. Sudden onset of Vertigo associated with movement of head, lasting few seconds to a minute. Frequently the patients report that they get Vertigo immediately after getting up from bed in the morning. Vertigo may be severe (paroxysmal) in nature and may be associated with nausea

and vomiting. Patient may feel light headed, weak, tired for many hours following the attack. Vertigo tends to occur in clusters with many months of remission in between attack. Majority of B.P.P.V is due to **Canalithiasis** of the **Posterior Semicircular Canal**, where an up-beating and torsion nystagmus is observed and the torsional component beating towards the earth: **Geotropic nystagmus**. This is depicted in Figure 1 [2].

In most of the patients there is no identifiable cause. The most common age of presentation is sixth decade, with females affected twice than males [15].

2. A clinically positive Dix-Hallpike maneuver or Nylen-Barany maneuver in the acute phase. This test is done in the following manner, the patient is made to sit on near the edge of examination couch and the head extended to one side, then the head is rapidly brought to below horizontal level of the table in the turned manner. The test is positive if the

- Objective component – examiner can spot a Nystagmus and
- Subjective component – patient feels Vertigo and nausea. Same test is then repeated with head turned to opposite side [1].

3. Acute phase is arbitrarily defined as one in which the patient experiences acute Vertigo, on and off many times. B.P.P.V progresses from the acute phase which is treated with Vestibular sedatives and calcium channel blockers like Flunarizine and Cinnarizine. Particle repositioning maneuvers like Semont's and Epley's maneuvers were also used in an attempt to reposition the particles and quench the acute phase [3].

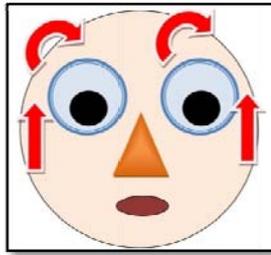


Figure 1: Vertical-torsional Nystagmus in Right Benign paroxysmal positional Vertigo. Fast phase of Vertigo is Upward and Torsional, and the torsional nystagmus beats towards the earth, known as **Geotropic nystagmus**. Right side is most frequently affected, perhaps because we usually sleep lying sideward, on right side. This causes gradual settling and building up Otoconia to in the low lying Posterior semicircular canal ampulla, over many decades and eventually causing a B.P.P.V [4]

2.4 Exclusion Criterion from Study

Physical therapy is contraindicated, in patients with progressive vestibular pathology. Patients with active vertiginous complaints were excluded. Also patients who had neck instability and frail patients were also excluded from vigorous physical therapeutic demands of Vestibular Rehabilitation [1], [4]. Patients who had any Brainstem or Cerebellar signs or Meningeal signs, unresolving positional Vertigo and atypical nystagmus were also excluded from the study.

2.5 Our Vestibular Rehabilitation program – The Radsan Vhr Program for B.P.P.V [5]

Vestibular rehabilitation was started once the acute phase was over. The patients were given Vestibular Rehabilitation Physical therapy over a period of 21 days. The aims of our Vestibular rehabilitation program are as follows

1. To provide relief to persistent and troublesome symptoms of the B.P.P.V.
- 2 To restore the confidence level of the patient
- 3 To allow resumption of his/ her day today activities, and not to be debilitated by the fear of Vertigo.
4. To improve the central vestibular compensation [1].

Medical treatment with vestibular sedatives was reserved only for the control of acute phase symptoms. Patients were kept on minimum medications. Patients were asked to repeat these exercises two to three times a day. Vestibular rehabilitation strategy used in this study included the following components

2.5.1. Desensitization technique and Habituation Exercises [6]

Patients were counseled that the residual imbalance is due to weakness of the vestibular system, overlaid by the fear of the patient. The “Shadow” analogy was used to explain that feeling Imbalance and unsteadiness is like a shadow behind you and that the Vertigo will vanish if one tries to face at it. Patients were also motivated to try these exercises at home. Patients were desensitized to their Vertigo provoking positions and situations like standing with feet close to ground, or walking on a line or standing with on heel and

toes. Foam standing, practice where patients were made to stand on foam with eyes closed for 15 – 20 minutes. Early habituation prevents development of motion sickness in long term. [1]. Patients were asked to sleep *only* on the healthy side for 8 hours to allow the otolithic debris to gravitate to the vestibule. This was our modified form of Vannuchi's, 'Forced prolonged position', the original being of 12 hours long duration.

2.5.2 Head-Eye exercises [6],[8]

Adaptation exercises aimed to improve the Vestibulo-Ocular Reflex. Head and eye coordinated movements like following a pen or torch were taught. Patients were asked in their leisure, to follow movement of objects with eye in their home and surrounding. Focusing exercises in which patients try to focus on objects like pen placed between the two eyes. Gaze Stabilization Exercises, in which patient were asked to focus gaze on a moving target like an ant or fly.

2.5.3 Substitution Exercises [8]

Patients were taught to use alternative strategies and sensory information to compensate for the defective Vestibular inputs. Patients were taught to take up a variety of clues from the surrounding and reinforce them into conscious signals for making up the lack of balance. In order to enhance somato-sensory inputs patients were encouraged to move about in bare feet where ever possible. Romberg's position in which the patients practice maintaining standing position with eyes open and then closed, standing on “*terra firma*” and “*terra mollis*”.

2.5.4 Postural, Brandt Daroff and Gait exercise [7]

Patients were asked to practice correct weight-bearing, limiting the range of movement around the center of gravity. Activities included Tandem walking, standing on foam, standing on one leg, and standing with arms outstretched. Brandt Daroff positional exercises were also demonstrated to the patients and patients were motivated to perform them, 15 minutes three times a day. The patient consciously moves the upper and lower half of his body in the same direction, and this is called Ankle Postural strategy. Step strategy in which patient resorts to slow stepping movement used when he senses that he is not stable. Swaying back and forth exercise in which body is alternatively swayed forward and backward.

2.5.5 Maintenance Activities [6]

Most of the patient had a history of sedentary life styles. Patients were asked to engage in a variety of physical activities like running, jogging, using treadmill, bicycling, ball catching, karate, and yoga. This was done as per the patient choice and tolerance levels.

A detailed questionnaire [in English, Marathi and Hindi] was given to the patient asking in Colored gradient Visual analogue scale on the various problems related to the Vertigo [9]. Vestibular rehabilitation strategies were used for 3 weeks. Best results of Vestibular rehabilitation are usually seen after 14 days of therapy [9]. At the end of a Twenty-one day course of therapy, a same second set of questionnaire was given and response to therapy marked. 9 questions were asked and result graded from 0 to 5 on a colored visual cue scale [10]. This questionnaire is given in the table below.

Table 1: Questionnaire with VAS for Vertigo patient
Please choose in the best possible number that describes your suffering at this moment.

S. No	Question	Please tick mark your response on a scale from 0 to 5 0 = No problem 1 = Mild problem 2 = Moderate 3 = Moderately severe 4 = Severe problem 5 = Totally incapacitated/ over whelmed with problem
1.	How is your Vertigo?	[0]/[1] / [2]/[3] / [4] / [5]
2.	How is your balance?	[0]/[1] / [2]/[3] / [4] / [5]
3.	How is your dizziness?	[0]/[1] / [2]/[3] / [4] / [5]
4.	How is the feeling of Light headedness?	[0]/[1] / [2]/[3] / [4] / [5]
5.	How are you able to manage day to day activities like office, home work?	[0]/[1] / [2]/[3] / [4] / [5]
6.	Have is the tendency for fall?	[0]/[1] / [2]/[3] / [4] / [5]
7.	How is the nausea?	[0]/[1] / [2]/[3] / [4] / [5]
8.	How is the feeling of blurring of vision with movement (Gaze instability)?	[0]/[1] / [2]/[3] / [4] / [5]
9.	How much you afraid of Vertigo?	[0]/[1] / [2]/[3] / [4] / [5]
	Total score	Minimum score = 0 Maximum score = 45



Figure 2: Colored visual cue scale for Visual analogue scale pertaining to the symptom severity. Green depicts totally symptom free, and at the other end of spectrum is red: the incapacitating or over whelming symptom. [9]

3. Observations

After the completion of Vestibular rehabilitation program, we asked the participants to answer the same questionnaire and the response was tabulated as follows. The outcomes of the study, after 21 days, in relation to each complaint were tabulated. Statistical data analysis of the survey response was done using Computer software GNU-PSPP and PAST (Paleontological Statistics Software for education and data analysis) [11], [12]. GNU PSPP and PAST are free and open source high quality professional statistical tools which allow for a variety of data analysis.

3.1 Statistical Analysis of the Survey [13], [14]

Non parametric statistical tests were employed to calculate the P value and to ascertain the significance of the outcomes of the study. Signed (Binomial) test one tailed (upper) and Mann-Whitney-Wilcoxon Tests were done on computer and significant values computed. The assumed level of significance for all the analysis was 5% (P = 0.05, Z=+1.96). The modified formulae for the questionnaire evaluation are as follows:

3.2 Signed Test [13], [14]

This test uses the following analogy: Probability of getting 15 positive responses from 15 patients for each compliant is computed, it is assumed that there is an equal chance of an improvement and no improvement. This test is not very powerful and can easily give erroneous results.

$$P(\text{Improvement}) = P(\text{No Improvement}) = \frac{1}{2} = 50\%$$

Formula 1: Signed [Binomial] non parametric test

$$P(k \text{ success in } 15 \text{ trials}) = \sum_k^{n=15} \binom{n}{k} \left(\frac{1}{2}\right)^n$$

3.3 Mann-Whitney Tests [13], [14]

Mann Whitney’s test is a gold standard non parametric test. The test results are quite accurate in their prediction. The following formula was derived from the standard Mann Whitney’s formula for analysis.

Formula 2: Mann-Whitney non parametric Test

$$U = 345 - R_2$$

R₂ stands for Sum of ranks of items after Vestibular Rehabilitation. The Critical value of U in 15 X 15 situations is 64. To be statistically significant, our obtained U for each problem had to be equal to **or LESS** than this critical value.

Table 2: The statistical inferences drawn out from the survey is given in the table below.

No	Problems of patient	Signed (Binomial) test-one tail P(15) Critical value +1.96	Mann-Whitney Tests at 95% Critical Value 64
1.	Vertigo	Yes	Yes
2.	Balance	Yes	Yes
3.	Dizziness	No	No
4.	Light headedness	No	No
5.	Day to day activities	Yes	No
6.	Tendency for fall	Yes	Yes
7.	Nausea	Yes	No
8.	Blurring of vision	No	No
9.	Vertigo fear	Yes	Yes

4. Discussion

Vertigo is defined as the sensation or illusion of movement without any actual movement taking place.[2] Vertigo word is derived from Latin language “Verto” meaning turn or spin. Vertigo arises when there is imbalance in input from

one of the three organs that maintain posture and balance i.e. Muscle spindles, Vestibular system and the Vision-Oculomotor. Cerebellum acts like an on-board computer which integrates these inputs and forwards them to Cerebral Cortex. [4]

Vertigo can have devastating impact on the quality of life of patients. Benign paroxysmal positional Vertigo can quickly leave the patient debilitated and unable to return to normal life. The Vertigo is “Paroxysmal” which means that it can be quite severe enough, leading to vomiting and weakness at its peak. Patients can become afraid to move fearing an attack of Vertigo. This reinforces the psychological distress of positional Vertigo. Most common age of presentation is around 60 years [15]. Majority of patients at this advanced age suffer from some form of Arthritis and have movement and postural problems.

4.1 Canalithiasis vs Cupulolithiasis [17]

Most form of B.P.P.V is due to free debris (Otoconia) floating in the semicircular canals. This phenomenon is called **Canalithiasis** and seems to account for around 95 percent of B.P.P.V. (Figure 2)

Free floating debris in the Cupula/ Crista ampullaris is called **Cupulolithiasis**. This is a rare form of B.P.P.V. (Figure 3) When the Cupula is horizontal position, patient does not have Vertigo and nystagmus. When the Cupula is not in horizontal position (most of the time), there is a constant stimulation from the inner ear and Vertigo. Thus this is a more problematic entity.

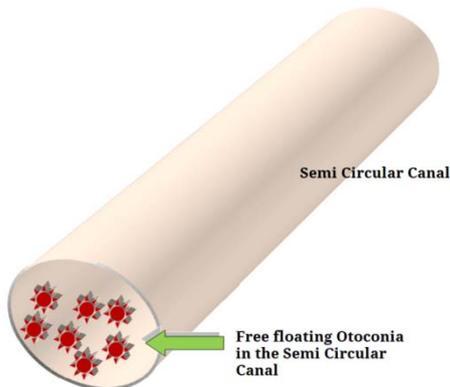


Figure 3: Loose debris (Otoconia) floating in the Posterior Semicircular Canal causes B.P.P.V – Canalithiasis type

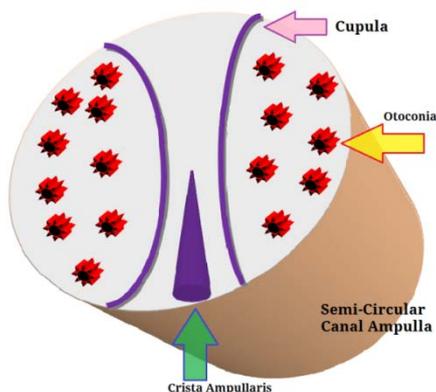


Figure 4: Loose debris (Otoconia) floating in the Cupula of the Semicircular Canal causes B.P.P.V – Cupulolithiasis type

In chronic phase patients of B.P.P.V show deficiency of movement-induced vestibular reflexes and abnormal gain in symmetry and phase of the Vestibulo-ocular reflex (VOR). At molecular level, this seems to be related to a reduction in efficacy of Gamma-Amino Butyric Acid (GABA)-A and GABA-B receptors in neurons. Eventually there is an unconscious increase smooth pursuit reflex or generation of saccades or blinks during any head movement to the affected side. This effectively eliminates the visual blur that occurs due to a deficient VOR gain [16].

Table 3: Canalithiasis vs. Cupulolithiasis

<i>Canalithiasis</i>	<i>Cupulolithiasis</i>
Latency period present	No Latency period
Paroxysmal attacks of Vertigo	Permanent dizziness
Strong Nystagmus	Weak Nystagmus
Nystagmus undergoes decay	No decay in intensity of Nystagmus
Mostly Geotrophic	Mostly Ageotropic

4.1 Vestibular compensation [16]

Vestibular compensation is a complex end-result of neural plasticity of the Central Nervous system neurons that compensate for the one sided lack of vestibular input. The different sub systems of the balance, recover from injury at different rates and to different levels. Understanding this difference is a key component of any Vestibular Rehabilitation program. For instance Static ocular/vision reflexes begin to recover within few hours of the injury. Dynamic vestibular – postural reflexes take a much longer time to recover.

In 1940 Terence Cawthorne and Harold Cooksey developed exercises to rehabilitate patients of Vertigo. Their aim was 'to encourage the patient to move his eyes and head freely in all directions'. This concept is applicable even today to Vestibular Rehabilitation.

In Benign paroxysmal positional Vertigo, patients need a gentle introduction to physical therapy. Because most patients have movement fear, early Physiotherapy can help in alleviating the fear-factor and help restore the balance. It is important patients understand the limitations of Vestibular Rehabilitation. **This study aims to highlight where Vestibular rehabilitation can help the patient and where it cannot help.**

From the given table, it is apparent that majority of patients benefit well with Vestibular Rehabilitation. Vertigo is improved very much, the value of Mann Whitney’s test was found to be 50. Balance problems are also reduced, with a Mann Whitney’s test score of 57. Vestibular Rehabilitation does little to improve the dizziness, light headedness, nausea and gaze instability. Ease of day- today activities is modestly better. Fear of Vertigo also showed a good improvement, the score in Mann Whitney’s test was found to be 55.

5. Conclusion

Vestibular rehabilitation is a powerful method for functional restoration of the patient who has been affected with Vertigo, especially Benign Positional Paroxysmal Vertigo. The program of Vestibular Rehabilitation [Radsan protocol] developed by us, seems very effective in alleviating the symptoms of Vertigo and improves the balance. It promotes an early resumption of day today activities and reduces Vertigo-phobia. Late development of Motion sickness is also prevented

References

- [1] Thomas Brandt, Marianne Dieterich, Michael Strupp in "Vertigo and Dizziness Common Complaints", Springer-Verlag London Limited 2005
- [2] Bisdorff AR, Debatisse D Localizing signs in positional Vertigo due to lateral canal cupulolithiasis. *Neurology* 57:1085–1088, 2001
- [3] Semont A, Freyss G, Vitte E Curing the BPPV with a liberatory manoeuvre. *Advances in Otorhinolaryngology* 42:290–293, 1988
- [4] Baloh RW, Halmagyi GM "Disorders of the vestibular system." Oxford University Press, New York, Oxford 1996
- [5] Brandt T, Daroff RB: Physical therapy for benign paroxysmal positional Vertigo. *Archives of Otorhinolaryngology* 1980; 106:484.
- [6] Neil T. Shepard Steven A. Telian in "Cummings: Otolaryngology: Head & Neck Surgery", 4th Ed Mosby 2005
- [7] Horak FB, Nashner LM: Central programming of postural movements: adaptation to altered support surface configurations. *Journal of Neurophysiology* 1986; 55:1369
- [8] Igarashi M, Ishikawa M, Yamane H: Physical exercise and balance compensation after total ablation of vestibular organs. *Progress in Brain Research* 1988; 76:395.
- [9] Yardley L, Putnam J. Quantitative analysis of factors contributing to handicap and distress in vertiginous patients: a questionnaire study. *Clinical Otolaryngology*. 1992; 17: 231-6.
- [10] Jacobson GP, Newman WC. The development of the Dizziness Handicap Inventory. *Archives of Otolaryngology - Head and Neck Surgery*. 1990; 116: 424-8.
- [11] Hammer O Harper D.A.T and Ryan, P.D PAST: Paleontological Statistical software package for education and data analysis. *Paleontological Electronica* 4(1):9 pp, 2001
- [12] Kyle Bemis in "GNU PSPP- A program for the statistical analysis of Sampled data" 27 July 2010. [Online]. Available: <http://www.gnu.org/software/pspp/manual/> [Accessed: May . 24, 2013].
- [13] Ian Scott and Debbie Mazhindu in "Statistics for Health Care Professionals An introduction" SAGE Publications Ltd 2005
- [14] David Bowers in "Medical Statistics from Scratch an Introduction for Health Professionals"
- [15] 2nd Edition John Wiley & Sons Ltd, 2008

- [16] Katsarkas A. Paroxysmal positional Vertigo: an overview and the deposits repositioning maneuver. *Am J Otol* 1995; 16: 725–30
- [17] Vertigo: clinical management and rehabilitation Doris-Eva Bamiou and Linda M Luxon pages 3791 - 3817 *Scott-Brown's Otorhinolaryngology, Head and Neck Surgery* 7th edition 7th Ed vol3 2008 Edward Arnold
- [18] Squires TM, Weidman MS, Hain TC, Stone HA. A mathematical model for top-shelf Vertigo: the role of sedimenting otoconia in BPPV. *J Biomech*, 2004. 37(8): p. 1137-46.

Authors' Profile



Rajamani Santhosh Kumar received M.B.B.S and M.S. (E.N.T) degrees from TN Dr MGR Medical University in 2005 and 2010 respectively with gold medals and awards. During 2010 -2011 he worked at the Tagore Medical College Hospital, Chennai as Assistant Professor of ENT. In 2012 he worked in Hinduja Hospital, Mumbai where he obtained world class training in ENT Surgery. In 2012, he received the Diplomate of National board certification D.N.B in E.N.T. He is now working in Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry as Assistant Professor of ENT. He is very actively involved in the academic pursuits of teaching, practicing and research in ENT, Head and Neck Surgery.



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