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Original Research Article

CORRELATION BETWEEN MODIFIED CLINICAL TEST OF SENSORY INTERACTION IN BALANCE (MCTSIB) AND DIZZINESS HANDICAP INVENTORY (DHI) SCALE IN PATIENTS OF BPPV

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ABSTRACT

Background: Benign Paroxysmal Positional Vertigo (BPPV) is characterized by brief episodes of vertigo, nausea and/or positional nystagmus upon head movements, is produced by the inadequate presence of statocone particles coming from the utriculus macula floating in the endolymph of the semi-circular canal or attached to their cupule. BPPV is one of the most common peripheral vestibular disorders leading to balance difficulties and increased fall risks. Most patients complain of a loss of equilibrium and unstable gait during and between the vertigo attacks.

Materials and Methods: This study was performed to investigate the correlation between subjective residual dizziness and objective postural imbalance in subjects with BPPV by using DHI and modified Clinical Test of Sensory Integration and Balance (mCTSIB). A total of 40 patients with BPPV were included prospectively in the study. All patients were asked to fill out the questionnaire including both DHI and mCTSIB was measured.

Results: There were no significant differences in age; study results showed significantly higher DHI score and abnormal mCTSIB. DHI score and the number of abnormal mCTSIB showed a statistically significant correlation.

Conclusion: Better static and dynamic balance represents better performance in Physical, Functional Tasks. Study concluded that Better functional independence and community integration reduces stress and anxiety in BPPV patients irrespective of their stage of recovery.

Keywords: Benign Paroxysmal Positional Vertigo; Dizziness; Posture Balance; Surveys, Questionnaires.

INTRODUCTION

Benign paroxysmal positional vertigo (BPPV) is common peripheral vestibular disorder.[1] It is caused by dislodged otoconia from the denatured utricular macula displacing into semicircular canals. The most common treatment for BPPV is the canalith repositioning procedure (CRP) specific to each affected canal.[2] Most patients with BPPV make a good recovery and have their vertigo symptoms disappear after successful CRP, but some patients report residual dizziness for a certain period afterward.[3] Most residual dizziness are characterized by non-positional, non-rotatory, or persistent imbalance of variable duration.

The cause of residual dizziness after successful CRP remains controversial. According to previous literatures, it is associated with age, high scores on questionnaire with higher self-rated anxiety scores,[3] orthostatic hypotension,[4] or utricular dysfunction.[5] Thus, residual dizziness after successful CRP seems to be caused by mental state, vestibular insufficiency, or autonomic dysfunction. Alternatively, residual dizziness may be caused by postural instability that remains after vestibular rehabilitation. Several studies revealed that long-term disturbance in BPPV

patients is linked with vestibule-spinal reflexes by performing static/dynamic posturography.[6,7]

The sensory organization test (SOT) of computerized dynamic posturography is useful for evaluating postural instability. It has sub-conditions based on combinations of support surfaces stability, vision availability, and visual surround stationary/moving. However, it is time and cost consuming test for undergoing the process with space requirements.

In this respect, Shumway- Cook and Horak,[8] proposed an easy and efficient balance test based on SOT, the Clinical Test of Sensory Integration and Balance (CTSIB). It is easily administered with timer and medium- density compliant foam. In addition, CTSIB was modified (mCTSIB) because there were no significant differences in scores between conditions with the visual conflict dome and without dome.[9]

Park et al,[10] reported that the mCTSIB can be used instead of the SOT in screening to distinguish normality from abnormality in dizzy patients with unilateral vestibulopathy. Both SOT and mCTSIB is a useful test tool for assessing the ability of balance. As mCTSIB has advantage of time and cost-effectiveness, mCTSIB could be used instead of the SOT in the screening test for dizziness. The mCTSIB is now widely used in practice, but few studies have assessed the residual dizziness after CRP in BPPV patients and the results of mCTSIB. The aim of the present study was to investigate the correlation between subjective residual dizziness and objective postural imbalance after successful CRP in BPPV by using questionnaires and mCTSIB.

To demonstrate its psychometric adequacy, the relation between the DHI and other measures documenting the consequences of vestibular disease has been investigated extensively. Furthermore, the DHI was compared with other specific condition-related health status questionnaires or generic quality of life questionnaires, as well as with self-report measures of mood, anxiety, and self-esteem after vestibular system disease. Studies have shown that balance performance, when measured quantitatively using laboratory testing, does not necessarily correspond to the extent of handicap in patients with dizziness, with correlations ranging from weak to moderate. Lack of synchrony between subjective complaints and clinical findings with respect to balance ability is common in patients with dizziness, but recently, Whitney et al,[6] highlighted the fact that patients with vestibular disorders who report scores of greater than 60 on the DHI are functionally impaired based on the number of reported falls and physical examination findings, such as the Dynamic Gait Index (DGI) and the five times sit to stand test. Present study sought to investigate the nature of the relationship of the DHI with the clinical balance tests currently used in department in a population of patients with vestibular and/or balance problems.[11]

MATERIALS AND METHODS

A cross-sectional study with purposive sampling n=40 subjects diagnosed as BPPV were taken from hospital campus of Rajkot and informed consent form were taken prior to study. The diagnostic procedure consisted of a detailed clinical history, a neurologic bedside examination, with Inclusion criteria of: (1) idiopathic BPPV and (2) confirmed successful CRP (resolution of positional nystagmus and symptoms) on the initial visit day. Excluded patients who had the following conditions: (1) a history of inner ear disease, (2) previous surgery or trauma, (3) psychologic or neurologic disorders, (4) failure of successful CRP for any reason, and (5) current use of any medication that affects the central nervous system.

Outcome measure used in the study is Dizziness Handicap Inventory (DHI), a validated 25-item questionnaire for assessing physical (P) and emotional symptoms (E), and functional impairment (F) for evaluating symptom severity. The Gujarati version of DHI was used. Subjects were instructed to maintain an upright position during the test for up to 30 seconds. The mCTSIB included four conditions: firm EO, standing on a firm surface with the eyes open; firm EC, standing on a firm surface with the eyes closed; foam EO, standing on a compliant surface with the eyes open; and foam EC, standing on a compliant surface with the eyes closed. Patients have repeatedly examined three trials under the above four conditions. Scores were calculated as the average of three trials. The examiner instructed each patient to balance for 30 seconds to assess the centre of gravity (COG). Equilibrium scores and normal or abnormal findings were determined according to the manufacturer's criteria for each subject.[12,13]

Statistical Analysis: Statistical analysis was performed with Kolmogorov Smirnov normality test found data was not normally distributed so nonparametric Spearman rank correlation coefficient using SPSS Statistics for Windows version 24.0.

RESULTS

The mean DHI total score (DHI-t) for the total sample was 35.1± 25 ranging from 0 to 96. The mean scores for the subscales were 12.1± 8.1, 9.6 ± 8.8 and 13.5±10.5 for the physical, emotional, and functional subscales, respectively. There was a moderate, but highly significant, correlation between the DHI whereas age correlated fair with the DHI ($rP = 0.29$; $p< 0.01$).

Correlation coefficients of the balance performance scores with the DHI total score were almost always superior when compared with DHI subscores, Spearman rank correlation coefficients between DHI total score and the static balance tests were fair and ranged between ≥0.42 ($p<0.01$) Only the Romberg test (EC) with Jendrassik maneuver correlated weakly ($rS = 0.25$; $p< 0.01$) with the DHI total score.

The strongest correlation was obtained when the scores of the static balance tests were summed (rP = 0.54; p <0.01).In this subsample, all correlations were between 0.81 and 0.9.

Table 1: Correlation between balance and subscale components

Sr. no	Outcome measure	r value	Interpretation	Statistical significant
1	Balance and Physical Symptoms	- 0.861	Strong Negative Correlation	Significant
2	Balance and Emotional Status	- 0.849	Strong Negative Correlation	Significant
3	Balance and functional impairment	- 0.819	Strong Negative Correlation	Significant

DISCUSSION

The results of this study showed several findings similar to other studies. First, residual dizziness was relatively common (58.1%) in the follow-up period. The overall prevalence of residual dizziness after successful CRP in BPPV patients ranged from 31% to 61% according to other literatures.[14] Second, residual dizziness is often described as a light headedness or floating sensation in absence of vertigo, or short-lasting unsteadiness occurring during head movements, standing, or walking and the light headedness was most common in our study (55.6%). Moreover, residual dizziness seems not to be related with involved canal, gender, and the number of CRP as described.

Although there have been a lot of findings in literatures about residual dizziness after successful CRP in BPPV patients, possible causes are still under debate. The possible explanations include the persistence of debris in the canal insufficient to provoke noticeable positional nystagmus, a utricular dysfunction, a coexisting vestibular disease, or an incomplete central adaptation. However, these hypotheses have not yet been supported by definitive data.[15]

Standing balance is a complex process that depends solely on the integration of the visual, vestibular, somatosensory systems, central coordination, and muscular adjustment.[16] If any of them has an impairment, a patient could feel an imbalance in standing position. Furthermore, there are some evidences that standing imbalance after successful CRP could be produced by a little amount of residual debris that does not generate positional nystagmus, a coexisting vestibular disease, an incomplete central adaptation or persistent postural-perceptual dizziness.[3,17] In the present study, we aimed to evaluate the correlation between subjective residual dizziness and somatosensory system.

Although the mCTSIB does not specify the exact nature of a patient's balance problem, it is useful in differentiating between individuals with and without vestibular disorders. It is also helpful for obtaining data about patients' performance in daily life.[9] It contains four conditions including firm EO, firm EC, foam EO, and foam EC. Investigating the somatosensory system in this way may give more insight into the pathogenesis of residual dizziness in BPPV. Our study investigated the integrated controls of the vestibulospinal reflex needed to maintain the standing position.

In study of Bartual Magro J et al subjects of non-dizziness maintained an upright position during the test up to 30 seconds in each condition significantly better than subjects of the dizziness subjects as other literature. Also, some correlational literature showing many subjects in the Residual Dizziness (RD) group could not maintain position in the condition of foam EC, suggesting a prevalence of visual cues in balance control. Visual dependence implies subjects who preferentially use vision, as opposed to vestibular or proprioceptive input, for spatial orientation and postural control.[18] An increased visual dependence has been demonstrated in patients after an acute vestibular disorder,[19] and posturography in the condition of foam EC is thought to be more specific in evaluating visual dependence. Study assumed that the standing imbalance of the patients in the RD group could be due to some acute sensory conflict between the affected vestibular system and vision. In addition, these results support that standing balance during normal physical activity can be one of the causes of residual dizziness in BPPV patients.

Mendel et al,[20] reported that residual feelings of anxiety and depression persisted in patients suffering from peripheral vestibular disorders. This would be related to a great anxiety level due to the intrinsic unpredictability of the BPPV itself even after successful CRP.[14] Furthermore, BPPV patients who suffer from anxiety disorders show longer-lasting and more disabling dizziness after the resolution of acute vertigo. Anxiety plays an additional role in dizziness and can be considered in some situations as a somatoform disorder caused by stressful events. Thus, through this study we suggest that we should pay attention to emotional component in follow-up period for BPPV.

Previous studies have attempted to determine the correlation between the severity of subjective dizziness and objective measurements of balance performance. In general, quantitative measurements of the patients' performance did not necessarily correlate with self-perceived dizziness handicaps because of the difference in several clinical factors. This study can postulate that a vestibular dysfunction after BPPV including persistence of a little debris in the canal or utricular dysfunction may lead to a proprioceptive- like disturbance, which in turn, temporarily alters vestibulospinal reflexes, finally resulting in standing imbalance. Stambolieva and Angov,[21] suggested that the physical treatment of BPPV is not able to treat vestibular system which has already been damaged by the otoconia. Thus, the postural disturbance might be due to the presence of

otoconia, which modifies the dynamics of the affected semicircular canal and changes the sensibility of the motion-sensing receptors. From the physiological point of view, the persistence of debris in the semicircular canal can alter the tonic discharge from the affected labyrinth. Such functional asymmetry can induce a new adaptation, through a rebalancing of the activity between the vestibular nuclei.[15] This new condition tends to neutralize the imbalance produced in the peripheral vestibular system. Also, post-DHI(E) score was main component of total post-DHI score in the RD group. Possibly, overlapping neural circuits between anxiety and the balance control system may provoke increased anxiety levels in patients after BPPV, and patients developing higher anxiety have an incomplete central adaptation.[22]

There are some limitations of this study. First, the duration of BPPV was not considered in the present study. Because the longer otoconia remain floating in the endolymph before treatment, the longer time for recovery and central adaptation would be needed. So, time period before diagnosis and treatment should be checked for evaluating residual dizziness in BPPV. Secondly this study did not utilize ocular vestibular-evoked myogenic potentials (oVEMPs) for patients with BPPV. There have been several studies that patients with BPPV have abnormal utricular function, and this dysfunction remains even after a successful CRP. Accordingly, abnormal oVEMPs results can be observed in patients with residual dizziness. But oVEMPs could not show high test-retest reliability clinically. Also, there have been controversies that oVEMPs reflect utricular dysfunction perfectly. Therefore, various vestibular function tests including subjective visual vertical or oVEMPs would be needed in the future study.

This study accessed residual dizziness of patients with BPPV after successful CRP using DHI and compared these findings using mCTSIB in subjects with BPPV. Study demonstrated the correlation between DHI score and mCTSIB in patients with residual dizziness. Therefore, mCTSIB would be a useful test to evaluate both residual dizziness and postural imbalance after CRP in BPPV. However, additional pathophysiological evidence is required for postural imbalance in order to confirm our results.

CONCLUSION

Functional balance tests involving locomotion correlate better with DHI scores when compared with static balance measures. The DHI explains a large component of handicap in dizzy and unsteady patients, which advocates its use in these patients. Better static and dynamic balance represents better Physical, Functional Tasks. Better functional independence and community integration reduces stress and anxiety in BPPV survivors irrespective of their stage of recovery.

Clinical implications: Measures to improve functional independence by improving balance and reduce dizziness using various neuro rehabilitation techniques & modifications in ADL at the earliest, enhances community participation by improving functional tasks & reduces stress and anxiety.

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