VESTIBULAR REHABILITATION OF BENIGN PAROXYSMAL POSITIONAL VERTIGO

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ABSTRACT

Objective: Assessment of the outcome of treatment in BPPV patients objectively using the videonystagmoscope and clinical sensory organization testing and subjectively using two global measures disability rating score and post-therapy symptoms score.

Method: Twenty patients with BPPV were treated with Epley’s maneuver in addition to home exercises (Habitual exercises and balance retraining exercises).

Results: The results of videonystagmoscope and post-therapy symptoms score revealed that 60% of patients were cured and 80% were cured or improved and 20% were improving. The mean post-therapy disability score was significantly lower than pre-therapy score.

The Dynamic posturography equilibrium score worsened significantly in conditions (3-6) and composite in pretreatment group and significantly improved post-treatment, but still significantly lower than the control group. In sensory analysis the vestibular, visual and preference scores were significantly lower in the pre-treatment group but significantly improved after treatment but still lower than the control group except visual preference which became near the normal score.

Conclusion: head repositioning maneuver plus vestibular exercises were beneficial in improving balance function in patients with BPPV.
INTRODUCTION

Benign paroxysmal positional vertigo is the most common peripheral vestibular end-organ disorder (Mizukoshi et al., 1988). Vertigo is evoked by otoconial debris coming from the utricular macula that abnormally excites the posterior canal receptors. Although Barany first described positional vertigo in 1921, it was in 1952 that Dix and Hallpike described the specific characteristics of this disorder. These include critical provocative positioning with the affected ear dependent, rotatory nystagmus, brief latency (1-5 seconds), limited duration (5 to 30 seconds), reversal on assuming an upright position, and fatigability of the response. Postural instability found in BPPV has been documented by vestibulospinal tests (Futaki & Ikeda, 1989; Guidetti, 1985 and Norre et al., 1986), static posturography and dynamic posturography (Vicini et al., 1984).

A number of treatment modalities have been proposed over the years for BPPV, including medication (McClure & Willet, 1980), body repositioning exercises (Brandt, 1991), surgery (Gacek, 1974) or the use of a vibrator and a head maneuver that Epley labeled as "Canalith Repositioning Procedure" CRP (Epley, 1992). Semont and colleagues described a similar head maneuver, dislodging the deposits from the cupula and called the maneuver "liberatory" (Semont et al., 1988 and Herdman et al., 1993).

Most clinical studies on the effectiveness of vestibular rehabilitation have relied on subjective measures focused on assessing changes in symptom severity (Shepard et al., 1993 and Keim Rjand et al., 1992). Functional assessments have generally been limited to the use of subjective survey instruments directed toward assessing the patient's ability to perform activities of daily living (Cohen, 1992) or the perception of overall level of functional disability (Shepard et al., 1993). The results of these studies suggest that vestibular rehabilitation is effective in reducing symptoms of dizziness and reducing functional disability.

Few data objectively describe the functional outcome of vestibular rehabilitation (Shepard et al., 1993 and Horak et al., 1992). Shepard et al. (1993) compared the mean equilibrium composite score obtained from the sensory-organization portion of computerized dynamic posturography in a sample of 152 patients before and after physical therapy. A small but statistically significant improvement in the overall equilibrium score was demonstrated. However, (Shepard et al., 1993) questioned whether this
difference was a clinically meaningful change because both before and after mean composite scores were very near the normal range. Improvement in objective balance scores was not compared with subjective measures of symptom severity or disability. In contrast, Horak et al. (1992) demonstrated a significant reduction in postural sway during the “vestibular” conditions (5 and 6) of computerized dynamic posturography and increased duration of single-leg stance of patients with a peripheral vestibulopathy after receiving vestibular rehabilitation (n=13) compared with those of a control group receiving only vestibular-suppressant medication (n=8). Horak et al. (1992) also demonstrated that although objective balance function improved after vestibular rehabilitation but not after treatment with medications, subjective assessment of dizziness symptoms improved after either vestibular rehabilitation or treatment with medications.

This work aimed at investigating the success of the head repositioning maneuver plus habitual exercises and balance retraining exercises on BPPV patients by using a combination of objective measures of balance and subjective measures of disability and symptoms severity.

**SUBJECTS & METHODS**

Twenty patients with BPPV were enrolled in this study. All patients underwent a complete clinical neuro-otological examination, basic audiological evaluation and electronystagmography. In selected patients, evoked response audiometry and / or computed tomography and / or magnetic resonance imaging were also performed to rule out concomitant disease. Patients with a history of symptoms, physical findings or laboratory tests indicating the presence of CNS, ocular motility were excluded.

Videonystagmoscope was used to diagnose BPPV and criteria for diagnosis of BPPV were the presence of positional vertigo and rotatory, transitory (5-30 sec.) and short latency (1-10 sec.) fatigable nystagmus in the Dix-Hallpike position, which reversed when assuming the upright position.

Dynamic posturography was carried out using the six posturographic conditions of Sensory Organization Test (SOT) (Nashner. 1972) that are:

1) The eyes were open, and the platform surface and visual surroundings fixed.
2) As condition 1, but the subject’s eyes were closed.
3) The platform was fixed while the visual surroundings kept moving around an axis co-linear with the patient’s ankle joint, in direct proportion to the antero-posterior sway of the patient’s center of gravity. In this way, the patient could not perceive changes in the body sway orientation with respect to the visual surrounding (Nashner, 1972).

4) The visual surrounding was fixed, the eyes were open and the platform was kept moving in direct proportion to the patient’s sway so

5) That change in the patient’s orientation with respect to the platform was cancelled. The visual surrounding was fixed, the eyes were closed and the platform was kept moving as in condition 4.

6) The eyes were open, and the platform and visual surrounding were rotated proportionally to the antero-posterior body sway.

The total balance score indicating the range of sway angle with respect to the earth vertical was computed for each condition.

The following formula was used:

\[ ES = 12.5^\circ - (\theta_{\text{Max}} - \theta_{\text{Min}}) \times 100/12.5^\circ, \]

Where \( \theta \) is the angle between a line extending vertically from the center of the foot support and through the center of gravity.

Sensory analysis calculating the relationships among the equilibrium scores in the six conditions identified the sensory dysfunction and individual preference for different inputs: somatosensory (test condition 2/1), visual (4/1), vestibular (5/1) and vision preference (3+6/2+5).

Twenty normal volunteers matching the age, sex and general somatic features of the study group were added to constitute the control group for dynamic posturography.

Treatments have included Canalith repositioning maneuver (Epley et al., 1992) habituation exercise, and balance retraining exercises.

**Canalith Repositioning Maneuver:**

First the patient’s head was brought into the Dix-Hallpike position with the symptomatic side down. With the patient supine and the neck extended, the head was then turned 90\(^\circ\) to the opposite side. Next, the patient was turned onto the contralateral shoulder with the head prone (180\(^\circ\) from the original position). Finally, the patient was returned to a seated
position with the head still turned. Nystagmus was allowed to abate completely between each phase of the cycle. Premedication was not used, nor was a bone vibrator.

**Habitual exercises:**

Habituation exercise was done to decrease nystagmus of motion, provoked dizziness, light-headedness or unsteadiness. The exercises were selected by identifying the motions and position that provoked symptoms. The exercise was done by having the patient move quickly into the position that provokes symptoms. Patients were asked to hold the position for as long as the symptoms last then relax and this was repeated three times.

**Balance retraining exercises:**

Balance retraining exercises were performed for patients with impaired sensory organization. Visually dependent patients were taught to utilize other senses by performing balance exercises and functional task with eyes closed, in darkness and in busy visual environments. Similarly those patients who have become reliant on somatosensory cues, exercise on variable and compliant surfaces to facilitate use of vestibular and visual cues in the maintenance of balance exercises for patients with reduced vestibular function are designed to emphasize facilitation of residual function. These patients were trained in various environmental situations, performing tasks on changing and compliant surfaces while vision is removed or conflicting.

Therapy outcome was assessed objectively using video-nystagmoscope and clinical sensory-organization testing. It was assessed subjectively using two global measures disability rating score (Table 1) and post-therapy symptom score (Table 2), *Shepard et al. 1993* (19).

**Table (1): Disability score.**

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No disability; negligible symptoms.</td>
</tr>
<tr>
<td>1</td>
<td>No disability; bothersome symptoms.</td>
</tr>
<tr>
<td>2</td>
<td>Mild disability; performs usual work duties, but symptoms interfere With outside activities.</td>
</tr>
<tr>
<td>3</td>
<td>Moderate disability; symptoms disrupt performance of both usual Work duties and outside activities.</td>
</tr>
<tr>
<td>4</td>
<td>Recent severe disability; on medical leave or had to change job Because of symptoms.</td>
</tr>
<tr>
<td>5</td>
<td>Long-term severe disability; unable to work for over 1 year Or established permanent disability with compensation payments.</td>
</tr>
</tbody>
</table>
Table (2): Post-therapy symptom scores.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No symptoms remaining at the end of therapy.</td>
<td>Mild improvement in symptoms, mild symptoms remaining.</td>
<td>Mild improvement, definite persistent symptoms remaining.</td>
<td>No change in symptoms relative to pretherapy period.</td>
<td>Symptoms worsened with therapy activities on a persistent basis relative to pretherapy period.</td>
</tr>
</tbody>
</table>

Table (3): Results of post therapy videonystagmoscope and post therapy symptom scores.

<table>
<thead>
<tr>
<th>Videonystagmoscope</th>
<th>Number of patients</th>
<th>Post-therapy symptom scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative nystagmus</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Positive nystagmus</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>7</td>
</tr>
</tbody>
</table>

Table (4): Equilibrium scores in the six different test conditions.

<table>
<thead>
<tr>
<th>Test Conditions</th>
<th>Control</th>
<th>Pre-Treatment</th>
<th>Post-Treatment</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>93.7 ± 2.63</td>
<td>92.2 ± 1.7</td>
<td>92.1 ± 1.4</td>
<td>1.80</td>
</tr>
<tr>
<td>2</td>
<td>91.6 ± 1.94</td>
<td>90.8 ± 2.6</td>
<td>91.1 ± 2.3</td>
<td>0.62</td>
</tr>
<tr>
<td>3</td>
<td>90.6 ± 2.1</td>
<td>86.6 ± 5.8#</td>
<td>87.4 ± 3.4#@</td>
<td>6.04*</td>
</tr>
<tr>
<td>4</td>
<td>82.61 ± 4.9</td>
<td>65 ± 15.8#</td>
<td>73.9 ± 4.6#@</td>
<td>15.78*</td>
</tr>
<tr>
<td>5</td>
<td>68.92 ± 5.1</td>
<td>47.4 ± 15.1#</td>
<td>58.0 ± 5.3#@</td>
<td>24.63*</td>
</tr>
<tr>
<td>6</td>
<td>65.9 ± 7.62</td>
<td>43.7 ± 14.1#</td>
<td>56.5 ± 8.2#@</td>
<td>22.99*</td>
</tr>
<tr>
<td>Total</td>
<td>80.5 ± 2.3</td>
<td>59.5 ± 13.3#</td>
<td>71.7 ± 7.3#@</td>
<td>28.2*</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level, # Significant from control group, @ Significant from pre treatment
Table (5): Sensory organization test scores in different group.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Pre-Treatment</th>
<th>Post-Treatment</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somatosensory</td>
<td>96.1 ± 1.8</td>
<td>95.6 ± 2.8</td>
<td>95.9 ± 1.6</td>
<td>0.28</td>
</tr>
<tr>
<td>Visual</td>
<td>85.1 ± 2.8</td>
<td>65.6 ± 12#</td>
<td>75.4 ± 6.5#@</td>
<td>29.39*</td>
</tr>
<tr>
<td>Vestibular</td>
<td>71.5 ± 1.2</td>
<td>46.3 ± 15.1#</td>
<td>63.2 ± 6.0#@</td>
<td>37.28*</td>
</tr>
<tr>
<td>Preferential</td>
<td>96.8 ± 2.3</td>
<td>87.1 ± 9.5#</td>
<td>95.5 ± 4.1@</td>
<td>14.81*</td>
</tr>
</tbody>
</table>

* Significant at 0.05 level, # Significant from control group, @ Significant from pre treatment

RESULTS

The population studied included 13 females (mean age 37.6 years) and seven males (mean age 39.8 years) affected with BPPV. Twelve subjects were diagnosed as idiopathic BPPV, 5 post viral labyrinthitis and vestibular neuritis, 2 post-traumatic and one post-stapedectomy. Table (3) showed the results of videonystagmoscope and post-therapy symptom score.

Nystagmus was absent in 60% of subjects. Thirty five percent of them were rated as score zero, the remaining 25% were score one. Nystagmus was present in 40% of the subjects, 20% of them with score 1. The other 20% with score two.

Fig. (1): All patients had score between 0-2. This means that all patients had at least some reduction in their symptoms after treatment. No patient with scores three or four was encountered in our study.
Dynamic Posturography:

The pretreatment group patients (Pre) compared with control group showed a normal performance in conditions 1 and 2 while the equilibrium score worsened significantly in conditions (3-6) and in total balance score in the pretherapy group (Table 4 and Figure 3).

![Fig (2): Disability Scores](image)

Fig. (2): Change in distribution of the disability scores from pre-therapy to post-therapy. The mean post-therapy disability score (0.8) was significantly lower than the pre-therapy one (2.2).

In sensory analysis, the vestibular, visual and preference scores of pretreatment group were significantly reduced in comparison with the control group (Table 5 and Figure 4). Equilibrium scores of the post-treatment patients were significantly lower in conditions 3-6 and in total balance score as compared with the control, but significantly higher compared with the pre-therapy group.

In sensory analysis, the visual and vestibular score of post-treatment were significantly higher as compared with those before treatment but still significantly lower than the control. However, in preference score, there was no significant difference between post treatment and the control group.
Fig. (3): Equilibrium Score

Fig. (4): Sensory Organization Test
DISCUSSION

The results of this study showed that the head repositioning maneuver plus exercises was beneficial in improving balance function in patients with benign paroxysmal positional vertigo.

The results of post-videonystagmoscopy symptom score revealed that 60% of patients were cured and 80% were cured or improved and 20% improving. This was in agreement with the results of Parnes and Price-James (1993) who used Epley’s maneuver and reported 66% of their patients cured and 85% cured or improved when they followed up their patients 3-4 weeks using the Dix-Hallpike maneuver to judge their results. Also, Herdman et al. (1993) reported 57% of the BPPV patients cured and 90% cured or improved two weeks after Epley’s maneuver using Dix-Hallpike maneuver or questionnaire in their assessment. Our results of pre-and post-treatment disability scores were in agreement with Cass et al. (1992) who studied the effect of vestibular rehabilitation on patients with a variety of vestibular diagnoses and found a great significant difference between pre-therapy disability mean score (3.4) and post therapy score (2.6).

Shepard et al. (1993) using vestibular and balance rehabilitation therapy found that 85% of his patients had post-therapy symptom score between 0-2 and there was a significant difference between pre-therapy disability score (mean 3.0) and post-therapy score (mean 1.4). He reported that 80% of the patients reduced their disability score by at least 1 point after therapy.

The results of dynamic posturography showed consistent impairment in patients affected with BPPV (pre-treated) in condition (3–6). This was not in close agreement with results obtained by Black et al. (1984) who observed a reduction in postural stability in BPPV patients in conditions 3, 4 and 6. Based on these results, the authors attributed the reduction of postural balance to the inaccuracy of visual input interfering with the stabilization achieved by both vestibular and somatosensory cues. However, our results were in agreement with Girolamo et al. (1998) where we clearly outlined an impairment of the vestibular system that seems to be unable to maintain the postural balance in conditions 5 and 6 since in those two conditions the postural control relies mostly on vestibular cues. This was confirmed by sensory analysis that showed a prominent reduction in vestibular contribution to postural stabilization.
The low visual score obtained by performing SOT analysis indicates the poor utilization of visual cues to achieve postural balance in BPPV patients and thus increased bodies way in response to visual surrounding motion. This result can be explained by a decrease in the vestibular effectiveness in suppressing postural sway during visual stimulation as demonstrated by Peterka & Benolken (1995) in vestibularly impaired patients. After treatment, there was a consistent improvement in the overall postural control. The equilibrium score increased in conditions 3-6 although remaining significantly lower than the corresponding control values. Sensory analysis showed a significant recovery of both vestibular and visual components. These results were in agreement with those obtained by Boniver (1991). He found an improvement in postural balance in BPPV patients after the liberatory maneuver by means of static posturography and Girolamo et al. (1998) by means of dynamic posturography.

REFERENCES


