Abstract

Background and Aim: Vertigo, a type of dizziness, is the illusion of motion, associated symptoms include nausea, and unsteadiness, vertigo should be distinguished from other types of dizziness, such as imbalance and lightheadedness.

We aimed to evaluate the effect of biofeedback training in treatment of vertigo secondary to cervical lesions.

Subjects and Methods: Thirty patients from both sexes, diagnosed as cervical vertigo secondary to cervical lesions were included in this study recruited from neurology outpatient clinic at Kasr El-Aini Hospital, Cairo University. They were assigned into two equal groups a control Group (G1) and study Group (GII). G1 received conventional physical therapy program (hot pack, isometric exercise, stretching exercise and eye head coordination exercises) while GII received the same physical therapy program of G1 in addition to biofeedback training on biodex balance system. The patients were assessed with Over All Stability Index (OASI), active Cervical Range of Motion (CROM), vertigo short scale and Visual Analogue Scale (VAS) for pain intensity measurement pre and post physiotherapy program.

Results: Post physiotherapeutic evaluation revealed significant difference between Group I and Group II regarding (OASI), (CROM), vertigo scale and visual analogue \( p < 0.001 \).

Conclusion: Biofeedback training is an effective in treatment of vertigo secondary to cervical lesions.

Key Words: Vertigo – Biofeedback training biodex balance system – Cervical lesions.

Introduction

CERVICAL vertigo is the term used for dizziness associated with cervical lesions. Position receptors located in the facets of the cervical spine are important in the coordination of head and neck movements and cervical proprioceptive dysfunction is a common cause of dizziness that triggered by neck movement [1].

Dizziness is a very common condition in the community that often leads to physical problems such as unsteadiness and falls, as well as social, emotional and financial issues. There are many causes of dizziness, one being a dysfunction in the cervical spine. In this condition, termed cervicogenic dizziness, that is accompanied by an arrange of symptoms including neck pain, neck stiffness headache, nausea, sweating and tinnitus [2].

Proprioceptive input from the neck participates in the coordination of eye, head and body posture as well as spatial orientation. On this basis, it has argued that syndrome of cervical vertigo might exist. However, cervical vertigo is a controversial clinical entity and patients with suspected disease often have alternative bases for their symptoms [3].

The neck contains mechanisms directly involved in balance control (neck afferents). Cardiovascular control (carotid bodies) and purely vascular structures (carotid and vertebral arteries). Neck movement are variably associated with head movements. Thus experiencing unsteadiness or vertigo associated with neck movement could be due to a disorder in vestibular, visual, vascular, neurovascular, or cervicoproprioceptive mechanisms [4].

The term cervical vertigo is reserved for cases where the suspected mechanism is proprioceptive disorders. The perception of head rotation is mediated by vestibular, visual, or proprioceptive receptors, vertigo is therefore induced by stimulation of any of these systems. So degenerative or traumatic changes of the spine could induce distorted sensation of head motion.
It can be interpreted that relations between neck proprioceptors of upper and lower cervical spine, dorsal roots and vestibular nuclei play a role in eye hand coordination, perception of balance and postural adjustments [8].

**Material and Methods**

The study was carried out on 30 patients complaining of vertigo recruited from neurology outpatient clinic at Kast El-Aini Hospital, from February 2014 till March 2015. Their symptoms assumed to be related to cervical musculoskeletal dysfunction.

Patients were selected after proper history taking, through clinical assessment includes ENT assessment by otologist and comprehensive investigations including full lab work up, neurovascular and neuro-radiology, to rule out the following causes:
- Central vertigo especially vascular causes excluded by vertebral and carotid artery duplex.
- ENT causes like benign positional vertigo, Meniere's diseases, acute peripheral vestibulopathy and otosclerosis.
- Toxic vestibulopathy due to alcoholism.
- General medical disorder like anemia, liver, renal fall out.

**Instrumentation for evaluation:**

**I- Cervical Range of Motion (CROM) evaluation:**

Measurement of cervical range of motion was carried out by Cervical Range of Motion instrument (CROM). Ms55110 according to the manufacturer's instructions.

The physical therapist manually stabilized the patient in sitting position with back support and the movements of the upper thoracic and trunk were controlled. The patient practiced each movement three times before the measurement. Each motion was measured twice in succession and then averaged. The patient moved through this R.O.M. to the point where pain began then the range was recorded.

This test was performed pre and post treatment program.

**II- Vertigo scale to assess severity of vertigo symptoms:**

Vertigo symptoms scale-short form, a questionnaire that assesses the intensity of vertigo. 15 dizziness related symptoms during the post month on a 5-point scale, clinically significant changes on this questionnaire as defined as a change in a score of at least 3 points [6]. The subject was asked to circle the appropriate number of indicate about how many times he/she has experienced each of symptoms. Score <12 points is low severity while 12 is high severity.

**III- Visual Analogue Scale (VAS) for pain intensity measurement:**

Patients were instructed to mark visual analogue scale (VAS CO-100mm) to represent their pain intensity (pre and post treatment program). The mark corresponds. With the patient's level of comfort. A mark on the left of the scale indicated "on pain" whereas as a mark on the far right indicated "unbearable pain" [7].

**IV- Over all stability index test:**

Biodex stability system. (Biodex crop. Shirley, Ny) was used for the assessment of standing postural control of the patient before, and after eight weeks of treatment. Each patient in both groups was evaluated through dynamic balance Overall Stability Index (OASI). The biodex stability system had eight stability levels. These levels indicated the stiffness of the platform surface, whereas stability level one indicates a very unstable surface.

The subject assumed the test positions which are standing on both feet with eye open. All the tests were done with the at stability level eight (most stable level). The duration was 20 seconds [8].

**Treatment protocol:**

After the baseline measurements, the patients were randomly assigned into two equal groups. The first group, control group (G1) received superficial heat in the form of hydro collator hot pack on the neck for ten minutes followed by exercise program, lasted approximately 30 minutes in the form of:

1- Warm up with free arms, shoulders and neck movements.
2- Relaxation training for the neck musculature in the form of hold-relax technique in different directions (forward, backward and laterally) for ten repetitions in each direction [9].
3- Stretching exercise for neck extensor muscles.
4- Neck flexors exercise: The patient adopted supine position with a 5cm thickness cushion placed behind the neck then he or she asked to do head nod-like movement and then lift the head off the plinth as much as possible and hold.
5- Eye fixation exercises [11] Aiming to improve cervico-cephalic kinasthesis via eye head coordination which include:

A- Automatic movement of the neck to maintain gaze on a fixed target while the physical therapist passively moved trunk.

B- The patient was instructed to fix a target for a few seconds and to memorize the head-neck position. Then the patient performed a maximal rotation of the head (with closed eyes), tried to find the initial position and then opened the eyes. The exercise was repeated to relocate as accurately as possible the initial head position.

Group II (study group) received the same program of Group I in addition to biofeedback training on biodex balance system in form of dynamic limits of stability training for ten minutes. Patient started training according to his ability, on the most stable level of platform tilt.

The patient began training with the foot plate centered and the cursor over the blinking central target. The patient was instructed to hold the cursor inside the central flashing box until it stopped blinking. Then instruction was given to the patient to shift his/her body weight to move the cursor over the second randomly appearing flashing box and also to hold it inside that flashing box until it stopped flashing. Then the patient was asked to move the cursor back to the central flashing box [12].

Statistical analysis: The data are described and presented as mean SD. Comparison of means using student t-test. The level of significance was at p<0.05.

Results

Demographic features of the two groups:

There was no statistically significant difference between the two groups regarding mean age, height, weight and duration of illness (p=0.258, p=0.346, p=0.470, p=0.882 respectively) (Table 1 & Fig. 1).

Comparison of the measured clinical parameters between the two groups:

1- Visual analogue scale score:

There was a statistically non-significant difference in the mean value of VAS score between the patients in the two groups are treatment (p=0.726), pt while there was a statistically highly significant difference between the two groups post treatment (p=0.001) (Table 2 & Figs. 2,3).

2- Vertigo scale score:

There was a statistically non-significant differences in the mean value of vertigo scale score between the patients in the two groups pretreatment (p=0.571) while there was a statistically highly significant difference between the two groups post treatment (p=0.001) (Table 3 & Fig. 4).

3- Comparison of the cervical range of motion between the two groups:

There was statistically non-significant difference in the mean value of cervical ROM of flexion, extension, right bending, lateral bending, right rotation and left rotation score between the patients in the two groups pretreatment (p=0.842, p=0.887, p=0.924, p=0.554 and p=0.054 respectively) while there was a highly significant difference between the two groups post treatment (p=0.001 for all variables) (Table 4).

4- Comparison of the overall stability score within each group:

The mean value of overall stability score pretreatment was 5.9 in both GI and GII. The mean value of overall stability score post treatment was 5.4 in GI and 3.7 in GII. A statistically highly significant difference was found in the mean value of score post treatment in both groups (p=0.001) (Table 5 & Fig. 6).

<table>
<thead>
<tr>
<th>Table (1): Demographic features of the two groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
</tr>
<tr>
<td>Age (year)</td>
</tr>
<tr>
<td>Height (cm)</td>
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<tr>
<td>Weight (kg)</td>
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<tr>
<td>Duration of illness (months)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table (2): Comparison of the mean value of the VAS score between the two groups pre and post treatment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS score</td>
</tr>
<tr>
<td>Pre-treatment</td>
</tr>
<tr>
<td>Post-treatment</td>
</tr>
</tbody>
</table>
Table (3): Compare between mean value of the vertigo scale score between the two groups pre and post treatment.

<table>
<thead>
<tr>
<th>Vertigo scale score</th>
<th>GI (Mean±SD)</th>
<th>GII (Mean±SD)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-treatment</td>
<td>9.9±0.6</td>
<td>9.8±0.7</td>
<td>0.57</td>
<td>0.571</td>
</tr>
<tr>
<td>Post-treatment</td>
<td>7.8±0.4</td>
<td>6.1±0.5</td>
<td>9.7</td>
<td>0.001**</td>
</tr>
</tbody>
</table>

Table (4): Mean values of cervical range of motion.

<table>
<thead>
<tr>
<th>Cervical RO mean</th>
<th>GI (Mean±SD)</th>
<th>GII (Mean±SD)</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexion</td>
<td>24.9±1.8</td>
<td>25±1.8</td>
<td>-0.20</td>
<td>0.842</td>
</tr>
<tr>
<td>Extension</td>
<td>19.3±2.5</td>
<td>19.2±2.6</td>
<td>0.14</td>
<td>0.887</td>
</tr>
<tr>
<td>Right bending</td>
<td>20.7±2.8</td>
<td>20.7±1.8</td>
<td>-0.06</td>
<td>0.947</td>
</tr>
<tr>
<td>Left bending</td>
<td>21.9±2</td>
<td>22±1.8</td>
<td>-0.09</td>
<td>0.9244</td>
</tr>
<tr>
<td>Right rotation</td>
<td>18.7±2.3</td>
<td>19.2±2</td>
<td>-0.59</td>
<td>0.554</td>
</tr>
<tr>
<td>Left rotation</td>
<td>21.3±1.2</td>
<td>22.2±1.2</td>
<td>-2</td>
<td>0.054</td>
</tr>
<tr>
<td>Post-treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexion</td>
<td>28.4±2.1</td>
<td>33.2±2.1</td>
<td>-6.1</td>
<td>0.00**</td>
</tr>
<tr>
<td>Extension</td>
<td>22.5±2.6</td>
<td>28.3±2.8</td>
<td>-5.1</td>
<td>0.001**</td>
</tr>
<tr>
<td>Right bending</td>
<td>24.5±2.9</td>
<td>30.5±2.4</td>
<td>-6.2</td>
<td>0.001**</td>
</tr>
<tr>
<td>Left bending</td>
<td>25.5±1.7</td>
<td>31.1±1.7</td>
<td>-8.9</td>
<td>0.001**</td>
</tr>
<tr>
<td>Right rotation</td>
<td>22.3±2.1</td>
<td>28±2.2</td>
<td>-7.2</td>
<td>0.001**</td>
</tr>
<tr>
<td>Left rotation</td>
<td>24.8±0.9</td>
<td>29.7±0.6</td>
<td>-17.2</td>
<td>0.001**</td>
</tr>
</tbody>
</table>

**: Highly significant of 0.001
SD: Standard Deviation.

Table (5): Comparison between pre and post treatment mean value of overall stability within each group.

<table>
<thead>
<tr>
<th>Over all stability</th>
<th>Pre-treatment Mean±SD</th>
<th>Post-treatment Mean±SD</th>
<th>Mean difference</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GI</td>
<td>5.9±0.3</td>
<td>5.4±0.3</td>
<td>0.5</td>
<td>17.0</td>
<td>0.001**</td>
</tr>
<tr>
<td>GII</td>
<td>5.9±0.3</td>
<td>3.7±0.3</td>
<td>2.2</td>
<td>22.2</td>
<td>0.001**</td>
</tr>
</tbody>
</table>

**: Highly significant of p<0.001
SD: Standard Deviation.

**Fig. (1): Demographic features of the two groups.**

**Fig. (2): Comparison of the mean value of the VAS score between the two groups post-treatment.**


**Discussion**

This study was carried out to evaluate the effect of biofeedback proprioceptive training on vertigo secondary to cervical lesion.

- Thirty patients aged from (45:55) years old participated in this study patients were selected from the out-patient clinic of Neurology, Faculty of Medicine at Kasr El-Aini Hospital, they were divided into two equal groups (Group I and II) according to physical intervention. The patients were assessed the vertigo using short form of the Vertigo Symptom Scale (VSS-SF) and for the neck pain using visual analogue scale and for the neck ROM using CROM and for overall stability index using biodex balance system.

- In this study, there were no statistically significant difference in the mean values of age, body weight and height between the patients in both groups. Additionally, there was no statistically significant difference in the mean values of durations of illness between GI and GII, this indicate that the selection of patients in the both groups (GI and GI was homogenous and this facilitated the comparison between them.

- Regarding over all stability index score there were a statistically significant difference in the mean values of overall stability score between GI and GII ($p < 0.001$), with the highest value in GII. The results of this study come in agreement with the findings of Sharma et al., [13], who mentioned that visual biofeedback training improved static postural sway and dynamic measures of balance in patients with cervical spondylosis with symptoms of vertigo. Significant improvement of the overall stability index in GII as compared to GI might be attributed to use of biofeedback training in GII which stimulate different types of proprioceptive
through afferent impulses of widespread origins, including signals from the periphery play important role in eliciting and guiding responses, while efferent pathways carry messages to control balance.

- The results of this study is agreed with the Bryan Lad Kevin [14]; who stated alternation in proprioceptive sensibility in patient with neck pain due to functional alteration of musculo-tendinous proprioceptors disturbances.

- Also this results agrees with those achieved from Heikkila and Wenngern [15] who stated there is a higher joint position mismatch during activities involving head repositioning suffering from chronic neck pain that may be explained by abnormal proprioceptive input to the central nervous system which is responsible for control of movement.

- Moreover regarding visual analogue scale score, there was a statistically significant differences in the mean values of score between GI and GII ($p=0.0001$), with the highest value in GII. The result of this study come in agreement with the findings of Gallego, et al., [16] who investigated effect of specific proprioceptive training (head relocation, eye-follow, gaze stability and eye head coordination) in patients with chronic neck pain and mentioned that proprioceptive training result to significant reduction in neck pain.

References


التدريب بالتدفقية الرجعية في علاج الدوار الناتج عن إصابات الفقرات العنقية

يهدف هذا البحث إلى دراسة تأثير التدريب بالتدفقية الرجعية في علاج الدوار الناتج عن إصابات الفقرات العنقية. شارك في هذا البحث ثلاثون مريضاً (16 من الذكور و14 من الإناث) الذين يعانون من الدوار الناتج عن إصابات الفقرات العنقية حيث تم تقسيمهم إلى مجموعتين متساويتين.

المجموعة الأولى (المجموعة الضابطة) تم علاجها ببرنامج علاج طبيعي مكون من كمادات دافئة يتبعها تمرنات علاجية مختلفة ثلاث مرات أسبوعيا لمدة ثمانية أسابيع.

المجموعة الثانية (مجموعة الدراسة) تم علاجها بنفس برنامج المجموعة الضابطة معضفاً إلى التدريب بالتدفقية الرجعية. حيث تم تقسيم المرضى قبل وبعد العلاج عن طريق جهاز التحليل (البيرةكس) لتقييم درجة ثبات القوام كما تم قياس حدة الدوار باستخدام مقياس الدوار، وتم قياس حركة اليد بالمدرج البصري للآلام، وقياس مدى الحركة الرقبية باستخدام مقياس مدى الحركة (كروم) الرقبة.

وقد أظهرت النتائج تحسن نمو دالة إحصائية في كل من المجموعتين لصالح المجموعة الثانية. وقد تبين لنا أفضلية استخدام التدفقية الرجعية في علاج الدوار الناتج عن إصابات الفقرات العنقية.