Cervical Dystonia: Abnormal Head Posture and its Relation to Hand Function

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ABSTRACT

To evaluate the effectiveness of physical therapy on abnormal head posture and hand function in cervical dystonia, forty patient of cervical dystonia were randomly assigned to either control group (n=20; 8 females and 12 males) and study group (n=20; 7 females and 13 males). Both groups were injected with Botulinum toxin type A (BOTX) at least one month before the study. The study group received additional physical therapy regime in the form of stretching exercise for sternocleidomastoid muscle, facilitation of voluntary movement and TENS, while control group received placebo TENS. Both groups were treated every other day for 6 weeks. The study group showed significant improvements in rotation head posture (p=0.001), and hand function (p=0.001), as indicated by Cervical Rang of Motion (CROM) and Purdue Peg Board Test (PPBT) respectively compared with the control group. It can be concluded that the physical therapy regime was effective in correcting the head posture and improving hand function of cervical dystonia patient injected with Botulinum toxin type A (BOTX). (Egypt J. Neurol. Psychiat. Neurosurg., 2009, 46(1): 203-208)

INTRODUCTION

Idiopathic cervical dystonia (ICD) is the most frequent form of adult onset focal dystonia. Its main clinical feature is torsion of the neck, which is the consequences of involuntary tonic spasm of the cervical muscles. Fundamentally sternocleidomastoid muscle, however, both splenius capitis and cervicis, scalenes and trapezius share to a variable degrees in producing this type of focal dystonia¹.

Although the pathophysiology of ICD still remains unclear, review by Beradelli et al.² and Anastasopoulos et al.³ suggested that dystonia may result from functional disturbance of the basal ganglia, possibly involving striatal control of the globus pallidus and consequently, thalamic control of cortical motor planning and execution.

The increasing dystonic contraction of cervical muscles leads to the abnormal head posture which influence both locomotor as well as fine activities, in addition, it can induce pain, myofascial contractures, and dysphagia. Moreover, persistence of abnormal neck postures is often associated with variable degrees of disability, ranging from subjective discomfort in social situations to alterations qualitative and quantitative of the subject's occupational place⁴.

It was widely accepted that the integrity of the upper extremity function is essential for the fine motor skills which is important to achieve activities such as feeding, dressing, and grooming⁵.

Kinematic studies have shown that when an object, to be grasped, appears in the peripheral visual field, the onset of eye movement starts after a brief latency even before the head movement. The eyes reach the target first because they move very quickly, so they focus on the target before the head stops moving⁶. In addition, some tasks require eye movement alone, while the others require a combination of eye-head movement, and still other tasks require a combination of eye-head and trunk movements, that dictates an interaction of several neural mechanisms. As an example, it has been shown that people trained to focus with great accuracy make combined eye-head movements that go most of the distance to the target⁷.
Standard pharmacological treatments for ICD are ineffective in most cases. In the last decade, the introduction of chemical denervation through injection of Botulinum toxin has allowed selective reduction of the spasm of dystonic muscles and led to clinical improvement in most ICD patients.

Aim of the study:
The aim of this study was to evaluate the effect of physical therapy intervention on realignment of head posture and its effect on hand function in cervical dystonia patient injected with Botulinum toxin type A.

MATERIALS AND METHODS

Subjects:
Forty patients (25 males and 15 females) with idiopathic cervical dystonia were selected from Neurology Out patient clinic and In patient departments in Kasr El-Aini Hospitals, Cairo University. They were assigned randomly into two equal groups after obtaining their consent.

Study group:
Twenty patients (13 males, 7 females), their age ranged from 25-40 years with mean of 32.50±4.64 years treated by Botulinum toxin type A (BOTX) in addition to specific physiotherapeutic program that consisted of prolonged stretch for sternocleidomastoid muscle, facilitation of voluntary movement and transcutaneous electrical nerve stimulation (TENS).

Control group:
Twenty patient (12 males and 8 females) of 32.45±3.63 years treated by Botulinum toxin type A BOTX and placebo TENS.

Inclusion criteria
1- Illness duration of at least one year.
2- Free from any pharmacological oral anticholenergics or muscle relaxant.
3- Botulinum toxin therapy had been injected at least 1 month before the study.

Exclusion criteria:
- Peripheral nerve lesion of the muscles of the neck and upper limb.
- Cervical disc diseases and/or spondylitis.
- Eye squint and/or visual problems.
- History of previous orthopedic disorders affecting the upper limb, and/or cervical spines.

Instrumentation for assessment:
1- Cervical range of motion instrument (CROM): Performance attainment associates Roseville, MN 55110 (USA). It consists of rotation arm, forward head arm and magnetic yoke. Three dial angle meters area included, sagittal plane meter measuring head flexion and extension, frontal plan meter measuring head side bending and these are gravity meters. The horizontal plane measuring head rotation and is magnetic meter responding to the shoulder-mounted magnetic yoke.

2- Measurement of the rotation head posture: The patient was instructed to sit erect in a straight-back chair with the sacrum close to the back of the chair. The CROM instrument was then aligned on the Nose Bridge and ears was fastened to the head by Velcro strap with putting the magnetic yoke around the neck, readings of the rotation of the neck was recorded. The reduction in rotation position of the head was precisely measured by CROM, since rotation of the head is primarily induced by sternocleidomastoid SCM muscle.

3- Measurement of hand function using Purdue peg board test (PPBT). The board was placed on a table in front of the patient while he/she was adopting a sitting position. The shoulders were at the same level with the hips and knee joints were flexed 90° and the feet were supported on the ground. The patient was asked to place three pegs in each hole and a stop watch was used to count the number of successful assembly per minute.

4- Disability rating scale: It ranks the severity of dystonic spasm in four grades:
0- No spasm.
1- Mild, barely noticeable.
2- Mild, noticeable spasm without functional impairment.
3- Moderate spasm with moderate functional impairment.
4- Severe incapacitating spasm.

**Treatment instrumentation:**

* Four channels phyaction 787, Netherlands production, it has pulse amplitude: 30 mA, (Frequency 50-160 Hz and 230 volts).
* TENS Application: Electrode placement: Two rubber stimulating electrodes (2 x 2 cm) were placed over the most tender points of spasmodic sterncleidomastoid muscles, the treatment provided from supine lying position. TENS was applied for 20 min per session. It consisted of continuous high frequency (120 Hz) with pulse duration of 150 sec. the intensity of stimulation was gradually increased to a level when the subject reported a tingling sensation.
* **Prolonged stretch** of sterncleidomastoid muscles, was applied with patient adopting the supine position for three times, 10 minutes for each.

*The hand placement:* The hands are placed on the side suffering SCM spasm, one hand is firmly applied on front of the shoulder to fix it. The other hand is placed on the jaw(of the same side)forcing the head toward the other side simultaneously extending the neck and head. So the spasmodic SCM muscle is fully stretched (Fig. 1).
* **Facilitation of voluntary movement for 10 minutes:** by gentle scratch on the jaw of the opposite side facilitates the head turning towards this side(stimulated side), the subject was asked to turn it as much as possible.

**Fig. (1):** Application of sternocleidomastoid stretch.

**Statistical analysis:**

Data were statistically described in terms of mean ± standard deviation (± SD). Comparison of quantitative variables between the study and control groups were done using Mann Whitney test for independent samples. Comparison of quantitative variables between Pre and post treatment values within each group was done using Wilcoxon signed rank test for paired variables. A probability value (p value) less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs Microsoft Excel version 7 (Microsoft Corporation, NY, USA) and SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

**RESULTS**

Before intervention both groups were matched as regard to age, disability score, rotation head posture and hand function respectively, p>0.05 (Table 1).

**Rotation head posture**

Before intervention, there was no significant difference between study and control groups regarding mean values of CROM p=>0.05, after intervention, a highly significant reduction was found in the study group compare to that of the control group (p=0.0001), also the results revealed a highly significant decrease in rotation head posture.
degrees mean values after intervention in the study group as well as the control group compared to that before intervention (p<0.0001 and p<0.05 respectively) (Table 2).

Disability score

Before intervention, there was no significant difference between study and control groups regarding mean values of disability score (P>0.05), after intervention, a highly significant reduction was found in the study group compared to that of the control group (p<0.0001), also the results revealed a highly significant decrease in disability score mean values after intervention in the study group as well as the control group compared to that before intervention (p<0.0001 and p<0.05 respectively) (Table 3).

Hand function

Before intervention, there was no significant difference between study and control groups regarding mean values of Purdue peg board test (P>0.05), after intervention, a highly significant improvement was found in the study group compare to that of the control group (p<0.0001), also the results revealed a highly significant increase in Purdue peg board test score mean values after intervention in the study group as well as the control group compared to that before intervention (p<0.0001 and p<0.05 respectively) (Table 4).

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**Table 1.** Characteristics of the patients in both groups including age, disability score, rotation head posture and hand function score.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Mean ± SD</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>G1 study</td>
<td>32.50±4.64</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>G2 control</td>
<td>32.45±3.63</td>
<td></td>
</tr>
<tr>
<td>Disability score</td>
<td>G1 study</td>
<td>1.95±0.60</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>G2 control</td>
<td>1.90±0.64</td>
<td></td>
</tr>
<tr>
<td>Rotation</td>
<td>G1 study</td>
<td>38.75±1.74</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>G2 control</td>
<td>38.95±1.82</td>
<td></td>
</tr>
<tr>
<td>Hand function</td>
<td>G1 study</td>
<td>0.65±0.48</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>G2 control</td>
<td>0.70±0.47</td>
<td></td>
</tr>
</tbody>
</table>

NS=non-significant

**Table 2.** Comparison between study and control groups before and after treatment, regarding rotation posture of the head.

<table>
<thead>
<tr>
<th>Rotation position</th>
<th>Study group</th>
<th>Control group</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean±SD</td>
<td>Mean±SD</td>
<td>P value</td>
</tr>
<tr>
<td>Before treatment</td>
<td>38.75±1.74</td>
<td>38.95±1.82</td>
<td>NS</td>
</tr>
<tr>
<td>After treatment</td>
<td>21.80±2.41</td>
<td>31.40±1.84</td>
<td>p&lt;0.0001**</td>
</tr>
<tr>
<td>Comparison before and after</td>
<td>p&lt;0.001**</td>
<td>P&lt;0.05*</td>
<td></td>
</tr>
</tbody>
</table>

Level of significant p<0.05 NS=non-significant **=highly significant

**Table 3.** Comparison between study and control groups before and after treatment regarding the disability scale.

<table>
<thead>
<tr>
<th>Disability scale</th>
<th>Study group</th>
<th>Control group</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean±SD</td>
<td>Mean±SD</td>
<td>P value</td>
</tr>
<tr>
<td>Before treatment</td>
<td>1.95±0.60</td>
<td>1.90±0.64</td>
<td>NS</td>
</tr>
<tr>
<td>After treatment</td>
<td>0.95±0.22</td>
<td>1.40±0.59</td>
<td>P&lt;0.0001**</td>
</tr>
<tr>
<td>Comparison before and after</td>
<td>p&lt;0.001**</td>
<td>P&lt;0.05*</td>
<td></td>
</tr>
</tbody>
</table>

Level of significant P < 0.05 NS=non significant **=highly significant
Table 4. Comparison between study and control groups before and after treatment regarding hand function using Purdue peg board tests score.

<table>
<thead>
<tr>
<th>Purdue peg board test score</th>
<th>Study group Mean±SD</th>
<th>Control group Mean±SD</th>
<th>Comparison P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before treatment</td>
<td>0.65±0.48</td>
<td>0.70±0.47</td>
<td>NS</td>
</tr>
<tr>
<td>After treatment</td>
<td>2.05±0.68</td>
<td>1.10±0.64</td>
<td>P&lt;0.0001**</td>
</tr>
<tr>
<td>Comparison before and after</td>
<td>p&lt;0.001</td>
<td>p&lt;0.05*</td>
<td></td>
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</table>

DISCUSSION

The majority of tasks performed in our daily routine require active range of motion (AROM) of the cervical spine to accomplish the task, reading, eating, writing, talking on the telephone are all examples of functions that require motion of the cervical spine in normal situations.

As the aim of this study is to obtain stability of the head through realignment of its position, this realignment was indicated by decreased head rotation to zero as much as possible (Table 2).

The physiotherapeutic protocol applied in this study could improve the hand function, which demonstrated by significant improvement of PPBT score (Table 4).

Regarding prolonged stretch, one of the possible mechanisms that could explain its effect on spasm is Ib autogenic inhibition.

Additionally the effect of facilitation of voluntary movement of the head provides an increase of proprioceptive input to the sensory cortical areas that increase the awareness of the brain to the newly head posture.

Furthermore, regarding the TENS mechanism, there is evidence to support that improvement seen in the patient's finding can be attributed to pain relief that is mediated by TENS.

The abnormal head posture in spasmodic torticollis patients is associated with asymmetries of neck proprioceptive input, of vestibular input and/or of the central representation of these afferents, one might expect spasmodic torticollis patients to misjudge the positions of their own bodies. This in turn could lead to further problems with spatial perception. This could explain the improvement of hand function when the patient head become realigned, and demonstrated the important neck afferents in perceiving not only head posture but also the motion and localization of visual objects which consequently influence the functional outcome.

The findings of this study was agreed with Maurer and Co-workers, who studied the effect of abnormal head posture in torticollis patients on saccadic gaze shifts and associated head movements. They found that the share of the head in the total gaze shift amounted to 30% (normal is about 70%) that necessitating larger orbital eye displacement. Moreover, patient's head and eye movements together were asymmetric and there were normal eye saccades except for the increase in latency. The authors suggested that the observed changes don't reflect a direct effect of the disease upon the gaze shift mechanism, but can be interpreted as adaptive changes that compensate for altered head posture.

This study was also in accordance with Munchau and associates, who investigated the vestibulo-collic reflexes in the sternocleidomastoid muscles in patients with spasmodic torticollis. The reflex was of normal latency and duration in the passive drop. In contrast, in head active drop, voluntary responses were delayed, they concluded that this finding indicated abnormal use of vestibular signals at higher motor levels and had a functionally significant consequences of the head stability.

Conclusion

It can be concluded that the suggested physical therapy regime used in this study was effective in realignment of head posture and consequently improving hand function in cervical dystonia patients injected with Botulinum toxin type A (BOTX).

REFERENCES


الملخص العربى

الوضع الخاطئ للرأس وعلاقته بوظائف اليد في مرضى الصعار العنقى

الهدف من الدراسة: كان الهدف من هذه الدراسة هو تقديم برنامج علاج طبيعي خاص لعضلات الرقبة وعلاقته بوظائف اليد في مرضى الصعار العنقى.

بوجازان التحقيق: أجريت الدراسة على أربعون مريضا بالغا من الجنسين يعانون من مرض الصعار العنقى، وهو عبارة عن عضلات الرقبة وأقسام الأعصاب بالقصر العنقى. وقد تم تقسيم المرضى إلى مجموعتين متساويتين. مجموعة ضابطة: تتكون من عشرون مريضاً من الجنسين تم علاجهم بالحقن الموضعى بعقار البوتولينوم السام (دوع أ) في عضلات الرقبة والتعبئة العصبية الحسية الكاذب. مجموعة دراسية: تتكون من عشرون مريضاً من الجنسين تم علاجهم بالحقن الم وضعى بعقار البوتولينوم السام (دوع أ) في عضلات الرقبة والتعبئة العصبية الحسية الكاذب.
عضلات الرقبة بالإضافة إلى برنامج علاج طبيعي مكون من شد للعضلة القصبة الترقوية الحلمية، تدعم إيجابي لحركة الرقبة، وتبنيه عصبي حسي على أماكن الألم وذلك بواقع ثلاث جلسات أسبوعياً (يوم بعد يوم) لمدة سته أسابيع.

وقد أشرت النتائج عن تحسن ملحوظ في المجموعة الدراسية عنها في المجموعة الضابطة بالنسبة إلى الوضع الخاطئ للرأس، مقياس الإعاقة ومقياس بردي لوظائف اليد، وكان ذلك التحسن ذو دلالة إحصائية واضحة.

ومن ثم نستنتج من هذه الدراسة أهمية العلاج الطبيعي في تصحيح الوضع الخاطئ للرأس وأهميته في تحسين وظائف اليد التي تمتل جزأ أساسياً لأداء الوظائف الهمة في الحياة اليومية لمرضى الصغر العنقي.