THERAPEUTIC EFFECTS OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) AND THERAPEUTIC EXERCISES IN PATIENTS WITH CERVICAL SPONDYLOSIS. A PRELIMINARY STUDY

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Abstract

Aim: To evaluate the therapeutic effects of complex rehabilitation, including TENS - Transcutaneous electrical nerve stimulation and therapeutic exercises on pain and mobility in the cervical spine in patients with cervical spondylosis.

Materials and Methods: The preliminary study included 29 patients with cervical spondylosis, of mean age (Mean(SD)) 59.9(11.6) years (20 women 62.0(10.0) and 9 men 55.3(14.2)). The duration of the current pain episode is 5(2-16) weeks, and the average duration (Me(Range)) of the disease is 8(1-19) years. Patients conducted 10 sessions with TENS and therapeutic exercises. The results were scored before therapy and after rehabilitation, by assessing pain (VAS) and range of motion in the cervical spine by goniometry.

Results: We observed a decrease in pain (Mean(SD)) from 4.86(0.95) to 2.14(0.95);$p<0.05$ and an increase in the range of motion in the cervical spine after the rehabilitation program. In the sagittal plane: Extension from 41.03(12.20) to 56.21(10.32);$p<0.05$, Flexion from 39.83(9.68), 53.10(8.70);$p<0.05$. Rotation in left from 41.55(13.30) to 53.28(12.91);$p<0.05$, Rotation in right from 38.97(14.04) to 50.0(14.08);$p<0.05$. Lateroflexion on the left from 27.41(7.28) to 35.0(6.94);$p<0.05$, Lateroflexion on the right from 23.62(6.67) to 33.45(6.96);$p<0.05$.

Conclusion: The results of the conducted preliminary study showed a reduction in pain and an increase in the range of motion in the cervical spine. Therapy with TENS and therapeutic exercise could be an effective non-pharmacological therapeutic option in the treatment of patients with cervical spondylosis. For better objectification of the obtained results it is necessary to continue the research.

Key words: Cervical spondylosis, Pain, Range of motion, TENS (Transcutaneous electrical nerve stimulation), Therapeutic exercises.

Introduction

The Cervical spondylosis is a disease characterized by progressive degenerative changes that affect all components of the cervical spine (intervertebral discs, facet joints, Luschka joints, ligamenta flava and laminae). It is part of the natural aging process and is more common after the fifth decade [1, 2]. The etiological factors are heterogeneous: poor posture, static overstrain in the cervical region, sports activities etc. [3, 4].

Neck pain is often associated with a modern lifestyle, too long sitting while working on a computer or watching TV, strain in the cervical region, which increase muscle stress [5]. According to some studies, a relation has been found between neck and arm pain and body position and posture during work [6,7]. However, the main risk factor is related to the age and degenerative changes in the intervertebral disc and other cervical vertebrae [1].

Cervical pain is widespread and is the second most common complaint after lower back pain [8, 1]. The overall prevalence of cervical spine pain varies from 10.4% to 21.3% [8]. According to the Global Burden of Disease (2015), the fourth leading cause of disability-adjusted life years (DALYs) is low back and neck pain [9].

Spondylosis can remain asymptomatic for a long time, although changes in cervical structures are detected radiologically. According to a number of studies, the disease occurs in 25% of people under the age of 40, in 50% of people over the age of 40, and most often in people over the age of 60, degenerative changes can be found in 85% of them. The more mobile lower parts of the cervical spine are more likely to be affected (C6-C7 and C5-C6) [1].

The Cervical spondylosis is clinically manifested by axial neck pain, which weakens after rest, stiffness and limited movement and sometimes it is accompanied by tingling and radicular symptoms in the upper extremities. Occasionally, the pain may radiate to the back of the ear in latero-flexion side-bending and hyperextension and rarely it appears as atypical symptoms of cervical angina. In the presence of cervical raciculopathy, it spreads like myotomy type depending on the affected nerve, and may be manifested as unilateral or bilateral neck pain, arm pain, scapular pain, spread along the upper limb, such as paresthesia or to be accompanied by muscle weakness [1].

An increase in prevalence and the associated sustained decline in working capacity over the last 25 years is observed and it is more likely that the increase will continue in connection with the aging of the population [9]. This requires good clinical assessment and management of the pain and accompanying symptoms that often become chronic. Currently, although various therapeutic approaches are used to control pain and accompanying symptoms in cervical spondylosis, such as pharmacological therapy with non-steroidal drugs, analgesics, physiotherapy [4], studies on the application of effective and efficient with less side effects therapeutic methods with prolonged reduction in clinical symptoms, based on evidence, are still in process.

Aim: To evaluate the therapeutic effects of complex rehabilitation, including TENS - Transcutaneous electrical nerve stimulation and therapeutic exercises on pain and mobility in the cervical spine in patients with cervical spondylosis.

Materials and Methods: The 29 patients included in the study with symptomatic cervical spondylosis were assessed at two time periods, before and after the rehabilitation program. To assess the results, a Visual analog scale (VAS), and a test range of motion in the cervical spine by goniometry were used.

Criteria for inclusion in the study are clinical and X-ray evidence of cervical spondylosis, the presence of subacute and chronic neck pain and limited mobility in the cervical spine. Patients contraindicated for electrotherapy, decompensated comorbidity, neoplastic diseases, pacemaker were excluded from the study.

The treatment was carried out as a course - 10 days, 10 procedures in an outpatient department (Monday to Friday). The rehabilitation program was carried out in accordance with the instructions of the Declaration of Helsinki (1964) and with the patient written consent.

The rehabilitation program included the following therapeutic interventions:

TENS - transcutaneous electrical nerve stimulation. The electrodes were placed paravertebral. Anode - in the area of the most pronounced pain, cathode in transverse position. Biphasic mode of operation. Pulse duration 40μs. Frequency 100Hz, current intensity 5-15 mA depending on individual sensitivity, duration of procedure - 20 min.

Therapeutic exercises: They are performed immediately after the electro procedure. The complex includes: Breathing exercises. Active isotonic, unforced exercises for the cervical spine and upper limbs. Exercises for the body and general developmental exercises. Exercises with equipment

A visual analog scale (VAS) and a test range of motion in the cervical spine by goniometry was used to evaluate the results in two time periods before and after rehabilitation.

The Visual Analog Scale (VAS), which is widely applied in different age groups was used to assess pain. VAS is a straight line from 0 to 10 cm (0 mm to 100 mm), at the beginning and the end, on which there are two descriptors representing extreme values of pain intensity (0- no pain and 10 extremely severe pain) at each end, 2 - mild pain, 4-moderate pain, 6-severe pain, 8-very severe pain. Patients themselves determine the level of their pain by placing a mark on the line.

Test: Range of motion in the cervical spine for sagittal, frontal and transverse planes, measured by goniometry in angular degrees.

Statistical analyses: Statistical analyses were performed using SPSS version 25.0 (IBM SPSS Statistics, Armonk, NY, IBM Corp.). Continuous variables were reported as means with standard deviations if distribution follows normal and vice versa as median(range). All counts represented as a percentage of the total sample. Normality was assessed by the test of Shapiro-Wilk. Changes in indicator scores after treatment were analyzed using the Two-Related-Samples test. Indicator mean changes in baseline and after treatment were calculated in percentages. A 2-tailed p value of <0.05 was considered significant.

Results

The preliminary study included 29 patients with cervical spondylosis, of mean age (Mean (SD)) 59.9 (11.6) years, 20 women of mean age 62.0 (10.0) and 9 men of mean age 55.3 (14.2)). The duration of the current pain episode is 5(2-16) weeks, and the average duration (Me (Range)) of the disease is 8 (1-19) years. The characteristics of the studied patients are presented in Table 1. Employees of working and non-working age predominate (Table 2).

After the complex rehabilitation program, a reduction of pain, measured by a visual analog scale (Mean (SD)) from 4.86 (0.95) to 2.14 (0.95);$p<0.05$ was observed, accompanied by an increase in the range of motion in the sagittal plane for flexion from 39.83 (9.68) to 53.10 (8.70) and extension from 41.03 (12.20) to 56.21 (10.32); $p <0.05$. We observed a statistical difference and improvement in the range of motion of rotation in the cervical spine to the left from 41.55 (13.30) to 53.28 (12.91);$p<0.05$ and to the right from 38.97 (14.04) to 50.0 (14.08); $p<0.05$, as well as for lateral flexion to the left from 27.41 (7.28) to 35.0 (6.94); $p<0.05$, and to the right from 23.62 (6.67) to 33.45 (6.96); $p<0.05$. The results are presented in Table 3.

Discussion

In our preliminary study, we aimed to evaluate the therapeutic effects of the rehabilitation program, including TENS - transcutaneous electrical nerve stimulation and therapeutic exercises on pain and mobility in the cervical spine in patients with cervical spondylosis.

The results prove that patients in their sixth decade of life predominate - in our study they were from 33 to 73 years old. Although aging is the main cause [3], the location and the degree of degeneration, as well as the degree of symptoms and functional disorders, vary and are individual for each patient.

Preliminary results indicate increase in the level of pain in patients with cervical spondylosis, which is probably an additional reason for limiting functional activity in combination with degenerative changes in the structures of the cervical spine.

A number of authors report that in other degenerative diseases, a link has been established between high levels of pain, limited functional activity and increased permanent disability and reduced participation in social activities. Reducing pain and increasing physical function can lead to a potential increase in patients' functional and social activity [11]. All this requires the search for and application of effective and safe methods of treatment that effectively reduce pain and affect clinical symptoms.

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We observed a reduction in pain in the cervical region of the spine after the application of conventional TENS procedures and therapeutic exercises. Qiang M. et all. (2018) reported a significant reduction in pain and increase in volume of movement in patients with cervical spondylosis who received TENS compared with placebo - TENS procedures [4].

The TENS method has few side effects and can be used without the risk of overdose [12]. The analgesic effect of TENS is realized by several mechanisms: by activating the "Pain gate" pain control [13-15]. Electrical stimulation activates non-pain peripheral receptors, creating a stream of afferent impulses to the vegetative centers and the cerebral cortex through thick A-β

fibers. In addition, through their collaterals in the substratia gelatinosa a process of excitation on the suppressive neurons is caused and they selectively close the door to the afferent impulse coming from the pain receptors. A "descending pain suppression mechanism" is activated, which is mediated by endogenously released opioid substances. According to clinical experience, TENS therapy may be effective in acute and chronic nociceptive pain, neuropathic pain, and musculoskeletal pain [12].

Kasumovic M. et all. (2013), also reported an increase in the range of motion in cervical spine and a reduction in pain after the application of TENS and therapeutic exercises [5].

The application of kinesitherapy, and especially dynamic and isometric exercises, is likely to affect pain, muscle strength, flexibility and range of motion in patients with cervical spondylosis. Azemi A. et al (2018) reported a reduction in pain and improved mobility in the cervical spine after a ten-day course of treatment. In this study, the authors reported that in the group in which dynamic exercises were applied, a more significant increase in the range of motion was achieved. They suggest that a better therapeutic effect would be achieved if massage, isometric and dynamic exercises were combined [16].

In a meta-analysis, Liang L et al. (2019) indicate that there are a large number of studies that show that exercise or exercise in combination with other treatments can be effective in reducing pain, improving functional status and quality of life in patients with cervical radiculopathy[17-20].

The hypothesis that therapeutic exercises can affect pain is shared by a number of authors including lower back pain, myofascial pain [17, 21-24] as well as pain due to osteoarthritis of the knee joint. According to Roos EM. et al. , muscle function is more closely related to joint pain than joint narrowing and is more easily modifiable, making it a potential therapeutic goal [25]. Liang L et al. also reported that therapeutic exercise could affect the NDI (Neck Disability Index), by improving the cervical spine function achieved by restoring muscle balance and improving the strength of weakened muscles and reducing muscle tone in the muscles with increased tone [22].

Despite the accumulated data for reduced pain and improved muscle function, there are currently no convincing data with a high level of confidence about the impact on the quality of life in these patients, which requires studies to continue[17].

Limitations: Despite the observed therapeutic effects, this report has the following limitations: The study covers a small number of clinical cases. The clinical assessment of pain is based on the use of the Visual Analog Scale (VAS), which is largely a subjective scale, although it is used conventionally in physiotherapy practice. There is no possibility to establish a causal relationship between the rehabilitation program, including TENS therapy and the change in functional activity and quality of life in the observed patients.

Conclusion

The results of the conducted preliminary study showed a reduction in pain and an increase in the range of motion in the cervical spine. Therapy with TENS and therapeutic exercise could be an effective non-pharmacological therapeutic option in the treatment of patients with cervical spondylosis. For better objectification of the obtained results it is necessary to continue the research.

Potential conflict of interest: There is no potential conflict of interest.

Table 1Characteristics of the studied patients

Characteristics:	Total	Women	Men
Gender	29	20(69.0)	9(31.0)
Age Mean (SD)	59.9(11.6)	62.0(10.0)	55.3(14.2)
Current paint episode Me (Range)	5(2-16)	5(2-7)	4(3-16)
Total duration of disease Me (Range)	8(1-19)	10.5(3-19)	6(1-12)

Table 2 Distribution of patient according to their age and professional activity.

Profession	Frequency	Percent
Worker	2	6
Employee	13	45
Retired worker	7	24
Retired employee	7	24

Table 3 Dynamics of the observed indicators for the monitored period

Indicators:	Mean(SD)	Median	Range	% Change	Z value with associated p value
VAS P1	4.86(0.95)	5	3-7	-	
VAS P 2	2.14(0.95)	2	0-4	56.0±9.2	Z=-4.800; p<0.001
Flexion P1	39.83(9.68)	45.0	20-50	-	
Flexion P2	53.10(8.70)	55.0	30-70	33.3±6.8	Z=4.570; p<0.001
Extension P1	41.03(12.20)	40.0	10-60	-	
Extension P2	56.21(10.32)	60.0	35-70	37.0±9.0	Z=4.724; p<0.001
Rotation to the left P1	41.55(13.30)	40.0	25-70	-	
Rotation to the left P2	53.28(12.91)	55.0	30-70	28.2±8.4	Z=4.685; p<0.001
Rotation to the right P1	38.97(14.04)	40.0	15-65	-	
Rotation to the right P2	50.0(14.08)	50.0	25-75	28.3±8.4	Z=4.494; p<0.001
Lateroflexion to the left P1	27.41(7.28)	25.0	15-45	-	
Lateroflexion to the left P2	35.0(6.94)	35.0	20-50	27.7±8.3	Z=4.456; p<0.001
Lateroflexion to the right P1	23.62(6.67)	25.0	10-35	-	
Lateroflexion to the right P2	33.45(6.96)	25.0	20-45	41.6±9.2	Z=4.597; p<0.001

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