Complementary Therapies in Clinical Practice 31 (2018) 278–281

Contents lists available at ScienceDirect

Complementary Therapies in Clinical Practice

journal homepage: www.elsevier.com/locate/ctcp

The short-term effects of TENS plus therapeutic ultrasound combinations in chronic neck pain

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ARTICLE INFO

Article history:
Received 21 June 2017
Received in revised form
13 March 2018
Accepted 14 March 2018

Keywords:
Neck pain
Transcutaneous electrical nerve stimulation
Ultrasound

ABSTRACT

Introduction: To investigate the effects of TENS plus therapeutic ultrasound combinations on symptom relief, physical functionality, perceived stress levels, daytime sleepiness and neck mobility in patients with chronic neck pain (CNP).

Methods: A total of 64 patients were divided into two groups as the TENS plus ultrasound group (n = 39) and the control CNP group (n = 25). The therapy comprised TENS and therapeutic ultrasound applications for 10 sessions. The control subjects were discouraged from using analgesics but were allowed to use paracetamol daily, if necessary. The Neck Disability Index (NDI), Epworth Sleepiness Scale (ESS), Perceived Stress Scale (PSS), visual analog scale (VAS) and tragus-wall/chin-manubrium distances were recorded at the baseline and after therapy.

Results: Significant improvements were detected in the TENS plus ultrasound group compared to the control CNP subjects in respect of VAS, PSS and NDI scores after the TENS plus therapeutic ultrasound therapies (all $p < 0.05$).

Discussion: The combination of therapeutic ultrasound plus TENS can be an effective modality for relieving pain/stress levels and improving functionality in the short-term of CNP.

1. Introduction

Chronic neck pain (CNP) can be related to various reasons such as degenerative processes, discopathies, vertebrae defects and trauma [1]. The risk of prolonged pain can be high in spinal pain conditions [2]. The relationship between CNP, psychosocial and functional situations leads to chronicization of the pain [3]. CNP can also impair personal, social and occupational activities which can lead to a need for multidisciplinary management.

Therapeutic ultrasound can be effective in reducing musculoskeletal pain [4]. Although, some authors do not suggest utilization of transcutaneous electrical stimulation (TENS) in routine management of the chronic spine pain [5], TENS is an analgesic current which is commonly used in the treatment of musculoskeletal pain conditions. The safety and effectivity of TENS applications have been stated in various pain conditions [6–12]. The combination of TENS and therapeutic ultrasound is a widely used treatment for CNP but the effects of this combination have not yet been studied in detail. Thus, the aim of the present study was to investigate the effects of TENS plus therapeutic ultrasound combination on symptom relief, physical functionality, perceived stress levels, daytime sleepiness and neck mobility in patients with mechanical CNP.

2. Methods

The study included 64 patients with non-specific mechanical CNP. Eighty patients were randomly divided into two groups as the TENS plus ultrasound group (n = 40) and the control CNP group (n = 40) but 39 patients in TENS plus ultrasound group and 25 patients in the control CNP group completed the study. Randomisation was applied with a simple-random approach, utilizing a table of random numbers. The clinical and demographic features of the individuals were recorded. Patients older than 18 years and with CNP (pain ongoing for longer than 12 weeks) were included in the study. Exclusion criteria were neck pain of less than 12 weeks duration, surgery of the spine, a history of corticosteriod injections to the spine, skin ulceration of the neck region, tumors, psychiatric disorders, sleep disorders, night sleep shorter than 6 h/day and pregnancy. Informed consent was obtained from all patients. Approval for the study was granted by the Local Ethics Committee.

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https://doi.org/10.1016/j.ctcp.2018.03.010
1744-3881/

Table 1
Demographical and clinical features of the CNP patients.

	TENS plus therapeutic ultrasound group *(n = 39)*	Control CNP group (n = 25)	*p value*
Age (years)	52,41 ± 14.08	48,95 ± 9,3	0,332
Disease duration (mo)	26,14 ± 27,17	32,1 ± 54,98	0,430
Neck pain (%)	39 (100)	25 (100)	
Radicular pain (%)	7 (18)	5 (20)	

mo; month, CNP; chronic neck pain.

A therapy program consisting of 10 sessions of TENS plus therapeutic ultrasound applications was applied for 2 weeks (5 days/week) to the TENS plus ultrasound group. The TENS current was applied using a two-channel portable TENS unit [BTL-4620, Czech Republic] on the lumbar spine for 30 min. This uses two electrodes to deliver a current premixed amplitude-modulated with 100 Hz frequency/pulse 60μs width and intensity adjusted according to the threshold for each participant without emerging pain or contractions. The electrodes were placed crosswise in the cervical paravertebral region. Therapeutic ultrasound (1 MHz frequency at an intensity of 1 W/cm2 for 5 min) [BTL-4000 professional, Czech Republic] was applied to the cervical paravertebral muscles of the patients. Activity and resting visual analog scale (VAS) for neck pain, Perceived Stress Scale-10 (PSS) [13], Neck Disability Index (NDI) [14], Epworth Sleepiness Scale (ESS) [15], tragus-wall distances (TWD) and mouth closed chin-manubrium distances (CMD) were recorded at baseline and after the therapy programs. Final assessments were performed on the first day following the end of the treatment. The control group subjects were evaluated twice, on the first visit and two weeks after the first visit. Throughout the study, the participants were discouraged from using analgesics, but were allowed to use paracetamol daily if necessary.

2.1. Statistical analysis

Statistical assessments were made using SPSS 20.0 (SPSS Inc. Chicago, IL, USA) statistical software. Descriptive data were stated as mean ± standard deviation. Normal distribution was checked with the Kolmogorov-Smirnov and Shapiro-Wilks tests. Baseline characteristics were compared with the Chi-square and Student's t-tests where appropriate. The results before and after treatment were evaluated through paired sample t-tests. A value of $p < 0.05$ was accepted as statistically significant.

3. Results

The demographic and clinical features of the patient and control groups were similar (Table 1). Significant statistical improvements were detected between the baseline and final (after therapy program) intra-group evaluation of the TENS plus ultrasound group and significant statistical improvements were detected in the TENS plus ultrasound group compared to the control group in respect of the $VAS_{resting}$, $VAS_{activity}$, PSS, NDI scores after the therapy programs (Table 2).

Table 2
Comparison of the groups at baseline and after the therapy programs.

	TENS plus therapeutic ultrasound group (n = 39)	Control CNP group (n = 25)	p values
ESS Scores			
Baseline	7,23 ± 1.42	6,80 ± 4.91	
After	7,10 ± 1.51	6,35 ± 4.15	0,167
p values	0,225	0,367	
NDI Scores			
Baseline	58,61 ± 14,57	53,45 ± 5,99	
After	43,64 ± 15,39	57,25 ± 6,70	***0,001***
p values	<***0,001***	0,961	
PSS Scores			
Baseline	23,14 ± 4.34	21,2 ± 2,7	
After	18,23 ± 5,24	21,05 ± 2,85	***0,037***
p values	***0,001***	0,160	
VAS $_{resting}$			
Baseline	6,44 ± 2,17	6,25 ± 1,77	
After	3,91 ± 1,74	6,1 ± 2,07	<***0,001***
p values	<***0,001***	0,860	
VAS $_{activity}$			
Baseline	7,32 ± 2,07	6,6 ± 1,14	
After	4,7 ± 1,76	6,35 ± 1,46	<***0,001***
p values	<***0,001***	0,602	
CMD (cm)			
Baseline	1,91 ± 1,46	1,60 ± 0,88	
After	1,64 ± 1,29	1,60 ± 0,88	0,392
p values	0,444	0,887	
TWD (cm)			
Baseline	11,94 ± 2,53	10,9 ± 1,37	
After	11,64 ± 2,95	11,1 ± 2,18	0,481
p values	0,672	0,757	

ESS; Epworth sleepiness scale, NDI; neck disability index, PSS; perceived stress scale, VAS; visual analog scale, TWD; tragus-wall distance, CMD; chin-manubrium distance, CNP; chronic neck pain. *$p < 0.05$ values show statistically significance.*