8 - TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) BURST MODE EFFECTS ON THE PAIN THRESHOLD INDUCED BY HYPOTHERMIA IN HEALTHY SUBJECTS

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INTRODUCTION

Modalities such as electrotherapy have been used for years to treat pain. Among them, the application of transcutaneous electrical nerve stimulation (TENS) is among the leading options for this type of treatment (MONTENEGRO et al., 2010). The TENS can be defined as a current that produces electrical impulses, often between 0 and 200 Hz, and aims to influence and modulate pain processes neuroconduction (RUSHTON 2002; CHEING e HUI-CHAN, 2003).

It is also found in the literature, the frequency of current used in TENS is related to the specific mechanism of analgesic action ((RAIMUNDO et al., 2009). The high-frequency TENS acts on a sensory level, activating pain behavior, since the low frequency, has action on the motor level, due to the release of endogenous opioids (BARBOSA et al., 2003). These theories described by Melzack & Wall, in 1965, and Woolf et al. In 1977, respectively.

The burst TENS can be considered as a mixture of Acupuncture TENS (high intensity and low frequency), with the conventional (low and high frequency). The burst mode of operation works with individual pulses of high frequency (40 to 150 Hz), distributed in trains of low frequency, repeated 1-5 times per second (LOW; REED, 2002). The pulses range from 1 to 10 Hz with pulse duration ranging from 100 to 200 μs, and are felt as a single stimulus by the patient (SCORZA et al. 2008).

Despite having been popularized as a resource for the induction of analgesia, are the numerous controversies about its real benefits, and little is known about the effect of using burst TENS on pain relief (SCORZA et al., 2008).

The cold stimulation is a simple method with minimal risk of tissue injury and without persistence of pain after the end of stimulation. During this procedure, a sense of unease is generated by thermoceptors skin, which send stimuli can damage tissue by peripheral routes (A-delta fibers and C) and central (spinothalamic and espinoreticular), resulting in an unpleasant sensation induced by cold (MORIMOTO et al., 2009).

For these reasons, the aim of this study was to investigate the influence of the use of TENS burst on the change in pain threshold induced by hypothermia immediately after application, 20 minutes and one hour after application, using for such a analysis of the pain threshold (in seconds) and pain intensity by visual analog scale (VAS).

MATERIALS AND METHODS

This study was characterized as crossover trial, quantitative, randomized, double-blind design model of pre-and post-treatment and was approved by the Ethics Committee on Human Research of the State University of West of Paraná (UNIOESTE) at number 244 / 2011.

Sample Characterization

The sample consisted of 18 volunteers, healthy men and women, mean age 20.85 ± 2.98 years (18 and 23 years). The inclusion criteria were: willingness to participate in assessments and tests in the days and times pre-determined. The not inclusion criteria were: present dominant upper limb injury, diabetes mellitus, skin tumors, abnormal skin sensation, diseases that could compromise cognition and hypersensitivity to cold. Exclusion criteria were: having no sense of discomfort in the cold stimulation period to quantify the VAS to 0 to level of discomfort from the cold.

Evaluation Protocol

After the formal invitation and be clear about the objectives and procedures of the study, volunteers underwent a screening assessment to record data and to identify possible factors not included. After having verified the eligibility for the study, subjects signed an informed consent, and underwent two treatments in random order during successive periods, with a minimum interval of twenty-four hours.

Then all subjects were evaluated to check for cold stimulation discomfort threshold was performed as follows. Initially, the volunteers immersed their dominant hand, and with outstretched fingers extended vertically up to the elbow in warm water (37° C) for 5 min, so that is an adaptation and create a homogeneous sample. The water was heated to 37° C with the aid of water heater unit whirlwind, with temperature control achieved with the aid of a mercury thermometer brand Incoterm® model L225/07. After five minutes, the patient immersed in the same way his hand in a container of cold water, with an average temperature of 2° C during the period of 30 seconds (held the temperature control with the help of thermometer and where necessary, added to ice water to thermal levels remain in the desired range). Since the elapsed time (in seconds) until the appearance of discomfort was recorded as the measure of pain threshold. At the end of that time the person withdrew the hand of the container, and quantified the discomfort by visual analogue scale (VAS).

Treatment Protocol

For treatment we used the TENS device four channels Bioset®, with two electrodes dimensions of 2x4cm that were placed on region of the median nerve in the supracondylar region, and on the ulnar nerve, also in the supracondylar region. The parameters used for the delivery of current were still in burst mode stimulation, lasting 200 μs phase, for 15 minutes, the intensity was increased until the motor threshold was reached, reaching the highest level before it becomes painful. To reduce the resistance to electrical current, the participant's arm was cleaned with alcohol prior to electrode placement, which were attached to the patient lubricated with water soluble gel.

For the placebo stimulation, subjects were led to believe they were being subjected to a treatment of microcurrent electrical stimulation, in which there would be no form of tingling sensation or muscular contraction. It was explained to the group that microcurrent works with very low intensities, with great power of analgesia and is not noticeable (without vibratory sensation). The electrodes were placed, and the device connected, but no electrical current was being transmitted.

Immediately after the application, the participants were reevaluated making new immersion of a new member and

quantifying the discomfort of cold, the same way as mentioned above. After 20 minutes and 1 hour of completion of electrical evaluations were repeated.

Statistical Analisys

The variables of this study were collected values for the cold pain threshold and VAS. To verify the Gaussian distribution of the variables, we applied the test of Kolmogorov-Smirnov normality. In addition to descriptive statistics as means and standard deviations, intragroup comparisons of this work were performed by repeated measures ANOVA and Tukey's test. The intergroup comparisons were analyzed using the paired t test. In all cases the level of significance was p-value <0.05.

RESULTS

In intragroup comparison, related to the evaluation of discomfort threshold to cold, there were not significant differences (p> 0.05) in any of the times for the comparisons of values in GT and in GC (Fig. 1).

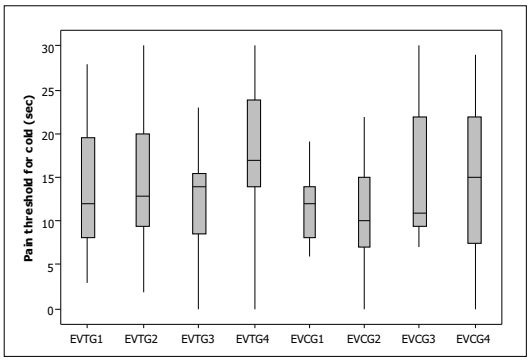

Figure 1. Pain threshold to cold for the treatment group (TG) and control (CG), at different moments of evaluation (EV)

In intragroup comparison of the values obtained of VAS for the GT decreased significantly for comparisons AV1 vs. AV3, AV1 vs. AV4, AV2 vs. AV3, AV2 vs. AV4 to the group submitted to TENS intervention. For comparison of VAS values for the GC were not significant differences between the evaluations performed (Fig. 2).

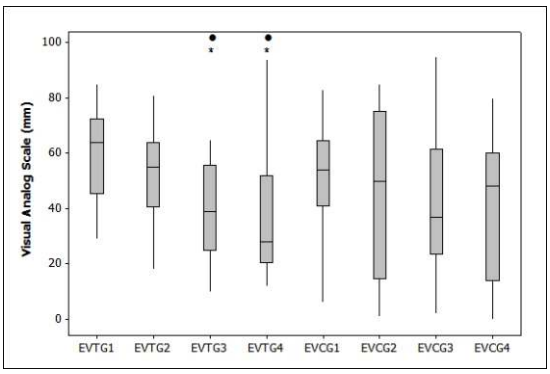

Figure 2. Visual analog scale of pain for cold treatment groups (TG) and control (CG). • a significant difference with GTAV1, * significant difference compared to GTAV2

For intergroup evaluations, no significant differences (p> 0.05) for comparison between the placebo group and treatment group in times of pre-intervention (EV1), immediately post-intervention (EV2), twenty minutes after intervention (EV3) and one hour after the intervention (EV4), both for the evaluation of discomfort threshold to cold and to the values obtained from the VAS.

DISCUSSION

Studies' dating back to the 70's already reported the effects of current TENS on acute and late pain. These studies were initiated in order to explain the influence of such equipment on the various algesic processes (GREGORINI et al., 2010).

Rodrigues-Bigaton et al. (2008) argue that low-frequency electrical stimulation (burst) produces muscle contraction, and thereby promotes the release of endogenous opioids and increases arterial blood flow to the area stimulated, generating greater analgesia. Thus, the motor level stimulation is effective in the modulation of clinical and experimentally induced pain. Sluka and Walsh (2003) observed that the use of TENS as burst causes a transient increase in blood flow in the area of stimulation. In a review of the literature on the effectiveness of TENS on the various algesic types. Pena, Barbosa and Ishikawa (2007), concluded that the experiments interpreted as effective, ineffective outweigh, suggesting that TENS should be considered as an adjuvant analgesic therapy pain control.

This study quantitatively, crossover trial, aimed to evaluate the effect of TENS applied for 15 minutes on the pain-induced threshold and pain intensity to the cold. It was found that transcutaneous electrical nerve stimulation in burst mode, is able to improve the results obtained with the VAS in healthy subjects, but produced no change to the start time of discomfort, such as found in a study performed by Montenegro et al. (2010), who found no significant difference in these values.

We chose to work in the crossover study design, because it eliminates the variation between participants in response to treatment, since this type of study treatments are assigned to all individuals. Furthermore, this design provided a decrease in sample size required to test the treatment methodology adopted in this research.

Johnson (1998) evaluated the effects of different frequencies of TENS on pain cold-induced, found no significant difference with respect to experimental pain by men and women. Based on these results it can be stated that the collection held

with both sexes in this study can not be regarded as a form of bias to the results obtained.

Studies claim that the treatment time for conventional TENS should be less than 30 minutes and that for treatment with acupuncture TENS treatment should have an average of 20 minutes (JOHNSON, 2003). This may have been a factor for the failure to obtain positive results for the cold pain threshold observed in this work, since the burst mode TENS can be considered as a blend of conventional acupuncture and TENS.

Mello, Nobrega and Lemos (2011), in a review of nine studies found no significant difference in the use of electrical stimulation on the relief of labor pain or the need for additional analgesia, however observed statistically significant evidence about the desire of the mother TENS to use in future labors. Suggest then that TENS therapy is effective to increase the subjective pain threshold, as observed in this study when we assessed nociception with VAS, in which there was a reduction of exposure to cold .

To carry out further studies to verify the influence of burst mode TENS on pain threshold induced by cold, it is suggested that treatment protocols are used over time to 20 minutes, aiming to better efficiency in the mechanism of action. Moreover, it is suggested to be used different age groups and individuals with musculoskeletal pain-producing diseases.

CONCLUSION

Observed in this study, the burst mode TENS application did not generate changes in pain threshold induced by cold. However, there were changes in the level induced by nociceptive stimulation of the cold, as pointed out by the results obtained with the VAS, indicating analgesic action of TENS in the medium term.

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TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) BURST MODE EFFECTS ON THE PAIN THRESHOLD INDUCED BY HYPOTHERMIA IN HEALTHY SUBJECTS

ABSTRACT

The aim of this study was to evaluate the cold pain threshold front therapy with transcutaneous electrical nerve stimulation (TENS) in healthy subjects, using a bipolar application technique on the nerve root. The study included 18 volunteers of both sexes, who underwent two treatments, with a current TENS and a placebo, and moments induced hypothermia in order to provoke a painful response. Subjects were evaluated by using VAS and latency of cold pain. As a form of electrical stimulation, TENS used the burst mode, and individuals were evaluated at three time points: immediately after, 20 minutes and one hour after electrostimulation. As to results, the data obtained through the EVA show a significant increase in pain threshold for individuals undergoing therapy with TENS in evaluations after 20 minutes and an hour compared to the pre assessment and intervention immediately after. For evaluation of the pain threshold to cold by the time, there were no significant differences in the comparisons. They found that as the application of burst TENS is effective in increasing the pain threshold stimulation promoted by low temperature.

KEYWORDS: Electric stimulation, Pain, Criotherapy.

STIMULATION NERVEUSE ELECTRIQUE TRANSCUTANEE (TENS) RAFALE EFFETS DE MODE SUR LE SEUIL DOULEUR INDUITE PAR L'HYPOTHERMIE CHEZ LES SUJETS SAINS

RÉSUMÉ

Le but de cette étude était d'évaluer le traitement de la douleur froide seuil de l'avant avec la stimulation du nerf électrique transcutanée (TENS) chez des sujets sains, en utilisant une technique d'application bipolaire sur la racine nerveuse. L'étude a inclus 18 volontaires des deux sexes, qui a subi deux traitements, avec un TENS courant et un placebo, et l'hypothermie induite par moments, afin de provoquer une réaction douloureuse. Les sujets ont été évalués en utilisant l'EVA et la latence de la douleur froide. Comme une forme de stimulation électrique, TENS utilisé le mode rafale, et les individus ont été évalués à trois moments: immédiatement après, 20 minutes et une heure après l'électrostimulation. Quant aux résultats, les données obtenues grâce à l'EVA montrent une augmentation significative du seuil de la douleur pour les personnes subissant un traitement par TENS dans les évaluations après 20 minutes et une heure par rapport à l'évaluation préalable et d'intervention immédiatement après. Pour l'évaluation du seuil de douleur au froid par moment, il n'y avait pas de différences significatives dans les comparaisons. Ils ont constaté que l'application de TENS rafale est efficace pour augmenter la stimulation seuil de la douleur promu par basse température.

MOTS-CLÉS: La stimulation électrique, La douleur, Criotherapy.

EFECTOS DE LA ESTIMULACIÓN NERVIOSA ELÉCTRICA TRANSCUTÁNEA (TENS), MODO RÁFAGA EN EL UMBRAL DEL DOLOR DE LOCAL INDUCIDA POR HIPOTERMIA EN SUJETOS SANOS

RESUMEN

El objetivo de este estudio fue evaluar el umbral de dolor a la terapia frente frío con la estimulación nerviosa eléctrica transcutánea (TENS) en sujetos sanos, utilizando una técnica de aplicación bipolar de la raíz nerviosa. En el estudio participaron 18 voluntarios de ambos sexos, que se sometieron a dos tratamientos, con un TENS actual y un placebo, y los momentos inducidos crioestimulação térmica con el fin de provocar una respuesta dolorosa. Los sujetos fueron evaluados mediante el uso de EVA y el tiempo (latencia) de dolor frío. Como una forma de estimulación eléctrica, TENS utiliza el modo de ráfaga, y los individuos fueron evaluados en tres momentos: inmediatamente después, a 20 minutos y una hora después de la electroestimulación. En cuanto a los resultados, los datos obtenidos a través de la EVA muestran un aumento significativo en el umbral del dolor en personas sometidas a terapia con TENS en las evaluaciones después de 20 minutos y una hora en comparación con la evaluación previa y la intervención inmediatamente después. Para la evaluación del umbral del dolor al frío por el momento, no hubo diferencias significativas en las comparaciones. Encontraron que a medida que la aplicación de la ENET ráfaga es efectiva para aumentar el umbral de estimulación del dolor promovido por la baja temperatura.

PALABRAS CLAVE: Estimulación eléctrica, dolor, crioterapia.EFEITOS DA ESTIMULAÇÃO ELÉTRICA NERVOSA

EFEITOS DA ESTIMULAÇÃO ELÉTRICA NERVOSA TRANSCUTÂNEA (TENS) MODO BURST SOBRE O LIMIAR DE DOR INDUZIDA PELA HIPOTERMIA LOCAL EM INDIVÍDUOS SAUDÁVEIS.

RESUMO

O objetivo deste estudo foi avaliar o limiar da dor ao frio frente à terapia com estimulação elétrica nervosa transcutânea (TENS), em indivíduos saudáveis, utilizando uma técnica de aplicação bipolar sobre a raiz nervosa. Participaram do estudo 18 voluntários de ambos os sexos, os quais foram submetidos a dois tratamentos, um com corrente TENS e um placebo, e a momentos de indução térmica com crioestimulação com o objetivo de provocar uma resposta dolorosa. Os indivíduos foram avaliados com auxílio da EVA e pelo tempo (latência) de dor ao frio. Como forma de eletroestimulação, utilizou-se a TENS modo burst, e os indivíduos foram reavaliados em três momentos: imediatamente após, 20 minutos após e uma hora após a eletroestimulação. Quanto aos resultados, os dados obtidos através da EVA mostram aumento significativo do limiar doloroso para os indivíduos submetidos à terapia com TENS nas avaliações 20 minutos após e uma hora após quando comparadas com os momentos pré intervenção e avaliação imediatamente após. Para as avaliações do limiar de dor ao frio pelo tempo, não foram observadas diferenças significativas nas comparações. Têm-se como conclusão que a aplicação da TENS burst é efetiva no aumento do limiar doloroso promovido pela estimulação de baixa temperatura.

PALAVRAS-CHAVE: Estimulação Elétrica, Dor, Crioterapia.